



INTERNATIONAL ENERGY AGENCY

# Energy Policies of IEA Countries



# AUSTRALIA

2005 Review

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of IEA Countries**

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## **INTERNATIONAL ENERGY AGENCY**

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The International Energy Agency (IEA) is an autonomous body which was established in November 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme.

It carries out a comprehensive programme of energy co-operation among twenty-six of the OECD's thirty member countries. The basic aims of the IEA are:

- to maintain and improve systems for coping with oil supply disruptions;
- to promote rational energy policies in a global context through co-operative relations with non-member countries, industry and international organisations;
- to operate a permanent information system on the international oil market;
- to improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use;
- to assist in the integration of environmental and energy policies.

The IEA member countries are: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, the Republic of Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States. The European Commission takes part in the work of the IEA.

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The OECD is a unique forum where the governments of thirty democracies work together to address the economic, social and environmental challenges of globalisation. The OECD is also at the forefront of efforts to understand and to help governments respond to new developments and concerns, such as corporate governance, the information economy and the challenges of an ageing population. The Organisation provides a setting where governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies.

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## REVIEW TEAM

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The 2005 IEA in-depth review of the energy policies of Australia was undertaken by a team of energy specialists drawn from IEA member countries and the IEA Secretariat. The team was in Australia from 21 February through 2 March 2005 and visited the cities of Canberra, Sydney, Newcastle and Melbourne. Meetings were held with government officials, energy suppliers, energy consumers and public interest groups. This report was drafted on the basis of those meetings and the government's official response to the IEA's policy questionnaire. The team greatly appreciates the openness and co-operation shown by everyone it met.

The members of the team were:

**Bo Diczfalusy (team leader)**

Ministry of Sustainable Development  
Sweden

**Sylvie Cornot**

Energy Diversification Division  
IEA

**Vidar Christensen**

Ministry of Petroleum and Energy  
Norway

**Mitsuhide Hoshino**

Division of Energy Technology Policy  
IEA

**Philippe Geiger**

Ministry of Economy,  
Finance and Industry  
France

**Noé van Hulst**

Director, Office of Long Term  
Co-operation and Policy Analysis  
IEA

**Masahide Kokubun**

Ministry of Economy,  
Trade and Industry  
Japan

**Jonathan Coony**

(Desk Officer)  
Country Studies Division  
IEA

**Rick Bradley**

Head, Energy Efficiency  
and Environment Division  
IEA

Jonathan Coony managed the review and drafted the report with the exception of the environment chapter drafted by Rick Bradley, the natural gas chapter drafted by Sylvie Cornot and the energy research and development



chapter drafted by Mitsuhide Hoshino. Monica Petit and Bertrand Sadin prepared the figures, and Sandra Martin provided editorial assistance.

## **ORGANISATIONS VISITED**

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The team held discussions with the following groups:

- Department of Industry, Tourism and Resources (DITR)
- Australian Bureau of Agricultural and Resource Economics (ABARE)
- Department of Transport and Regional Services (DOTARS)
- Australian Greenhouse Office (AGO)
- Office of the Renewable Energy Regulator (ORER)
- The New South Wales (NSW) Treasury
- Department of Energy, Utilities and Sustainability (New South Wales)
- Public Interest Advocacy Centre (PIAC)
- Energy Retailers Association of Australia (ERAA)
- National Electricity Market Management Company (NEMMCO)
- AusIndustry
- World Wildlife Fund (WWF)
- Port Waratah Coal Services Limited
- The Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- Australian Business Council for Sustainable Energy (BCSE)
- Australian Conservation Foundation (ACF)
- BHP Billiton
- Rio Tinto
- Origin Energy
- Geodynamics Limited
- Energy Users Association of Australia (EUAA)
- Sustainable Energy Authority of Victoria (SEAV)

- Australian Institute of Petroleum (AIP)
- British Petroleum
- Caltex
- Mobil
- National Offshore Petroleum Safety Authority (NOPSA)
- Department of Infrastructure (Victoria)
- Australian Aluminium Council
- Cement Industry Federation
- Electricity Supply Association of Australia (ESAA)
- Australian Petroleum Production and Exploration Association (APPEA)
- Energy Networks Association
- Australian Coal Association
- Australian Competition and Consumer Commission (ACCC)
- Productivity Commission

## **REVIEW CRITERIA**

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The IEA *Shared Goals*, which were adopted by the IEA Ministers at their 4 June 1993 meeting in Paris, provide the evaluation criteria for the in-depth reviews conducted by the IEA. The *Shared Goals* are set out in Annex B.



# SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

The Australian energy sector and energy policy are heavily influenced by the country's natural circumstances and general market approach to economic issues. Australia is the world's sixth-largest country, roughly 80% larger in land mass than the EU-25 countries together. With a population of 20 million people, it has the lowest population density in the OECD. The country is rich in mineral resources, including coal, oil and natural gas. As an island nation, it has no land boundaries and is a substantial distance from most of its major trading partners. From 1993 through 2003, Australian gross domestic product grew at an average annual rate of 3.9%, while unemployment fell to a 27-year low in November 2004 with a rate of 5.2%. The generally light-handed government approach to the economy is reflected in the energy sector. Energy policy is also influenced by Australia's federal structure with six states and two territories<sup>1</sup>.

Like all IEA countries, Australia strives to achieve the three E's of energy policy: Economic efficiency, Energy security and Environmental sustainability. The federal government's June 2004 energy White Paper explains the strategy to meet these objectives and is a commendable document developed in a transparent manner that gives predictability to all stakeholders. Regarding economic efficiency, Australia fares well. It has some of the lowest prices in the IEA for electricity, coal and gas. For example, industrial electricity prices are 38% below the IEA average and household prices are 31% below the average. There is a great deal of choice at the retail level, allowing many customers to select their preferred supplier. In addition, Australia successfully exploits its domestic fuel resources in the international market. The coal, oil and gas industries employ 120 000 people and provide more than AUD 24 billion<sup>2</sup> annually in export revenue, equal to about one-fifth of the country's total export revenue.

Australian energy security is sound. Security is enhanced substantially by the endowment of domestic fuels (albeit with declining oil production), extensive energy delivery infrastructure and good access to world markets. In 2003, net oil import dependence reached 14% and government forecasts project this figure will rise to 37% in 2010 and 46% by 2020. However, the fluid market

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1. Throughout this report, the terms "government", "federal government" or "Commonwealth government" will refer to the national government based in Canberra. Governments at the state or territory level will be explicitly denoted.
  2. On average in 2004, one Australian dollar (AUD) = USD 0.734. As of 6 June 2005, AUD 1 = USD 0.765.

in crudes and products means this should not pose an undue threat. The government's energy White Paper rates energy security as "high". Nevertheless, recognising the importance of this issue, the government has called for a biennial review of Australia's energy security outlook. Significant indigenous coal and natural gas resources also play an important part in enhancing Australia's energy security.

It is with the third E of energy policy, environmental sustainability, that Australia faces its greatest challenge. Regarding the issue of climate change, Australia's emission intensity is very high. Australian emissions of CO<sub>2</sub> from fuel combustion per unit of GDP are the second-highest in the IEA, behind the Czech Republic, and 43% above the IEA average. This is due to the widespread use of coal and the country's generally high energy intensity which results in part from the presence of numerous energy-intensive industries. Under the Kyoto Protocol, Australia's target was to limit greenhouse gas (GHG) emissions to 108% of 1990 levels by 2008 to 2012. While a signatory to the Protocol, the government has decided not to submit it for ratification. The government recognises the importance of reducing GHG emissions but does not believe Kyoto is an effective international instrument, specifically because many large emitters will not be obliged to reduce their emissions. However, the government has committed to continued engagement and participation in international post-Kyoto efforts to curb global emissions.

Despite not ratifying the Protocol, the government has stated its intention to meet its Kyoto target. According to government projections released in December 2004, the country is on schedule to do so. Australia will be able to meet its target largely as a result of reductions realised in the land use and forestry sectors where emissions are projected to be cut by 85%. By contrast, emissions from other sectors have grown by 30% from 1990 to 2002. From 1990 to 2008-2012, emissions from the energy sector are expected to grow by 43%. Further emissions reduction from land use changes will not be possible and energy emissions will come to increasingly dominate the mix. As a result, the country will have to substantially change future energy supply and/or demand behaviour if it wants to keep overall emissions at moderate levels that are likely to be consistent with a future global climate change mitigation programme.

Australia is taking a technological approach to curbing climate change and is seeking to develop new technologies to provide economic energy with reduced emissions. The government has recently announced a number of new substantial energy research and development (R&D) and technology commercialisation programmes which focus on developing partnerships with industry and the research community. It has also decided not to develop an emissions trading programme at this time. This decision was driven largely by the fact that the country is already on track to meet its Kyoto target and the concern that Australia's international competitiveness would be adversely affected, given that most of its competitors in the Asia-Pacific region have no

obligations to limit their emissions. At the same time, a number of States are considerably more enthusiastic about trading and developing plans of their own.

Australia's focus on technological solutions to climate change has certain advantages. Although it carries the risk that technological solutions will not be forthcoming, it also recognises the long-term nature of this issue and the need for massive changes in energy patterns that new technologies can achieve. However, even if such technologies are found – and in the Australian context, this would likely be carbon capture and storage as well as other clean coal and hydrogen-based technologies – a carbon price signal will probably still be needed to facilitate their implementation. A trading system is an effective means of introducing a price signal and fits in well with the country's overall market approach. The state and territory governments have established a working group to develop the parameters of a multi-jurisdictional emissions trading scheme to be considered. The government is encouraged to periodically appraise the costs and benefits of a national emissions trading scheme in light of international developments of further global and domestic climate change frameworks.

Improved energy efficiency offers an important, immediately available tool for cutting GHG emissions. Australian energy intensity is quite high with primary energy per unit of gross domestic product (GDP) 35% above the IEA average. This is largely due to the country's vast spaces, large reserves of low-cost black and brown coal, predominance of energy-intensive industries and low energy prices. Traditionally, energy policy has focused on the supply side but greater attention is now being paid to the benefits of demand restraint. The June 2004 energy White Paper states that energy efficiency can increase both GDP and employment. The National Framework for Energy Efficiency (NFEE) has been established and the Productivity Commission (PC) will complete a year-long inquiry into the benefits of energy efficiency in August 2005. The Australian energy sector stands to benefit from greater government efforts to improve energy efficiency throughout the economy.

The transport sector could particularly benefit from efficiency efforts. Transport energy use accounts for 40% of final consumption and is projected to grow by 2.0% annually over the period 2001/02 to 2019/20. Despite this, transport appears to be receiving less attention than other sectors. The current fuel efficiency standards are at the lower end of IEA countries and are voluntary without any penalties. Vehicle taxation does not favour more efficient vehicles. The White Paper reform of the excise tax for fuels will substantially lower the overall tax burden, decreasing government revenue in this area by up to AUD 1.5 billion over ten years and could lead to an increase in transport consumption. If the Australian government wants to deal with the overall energy efficiency of the economy, it should address transport energy use more forcefully.

Although the use of renewable energy in Australia is relatively modest, the country has a successful renewable support scheme and some of the lowest prices for renewables in the IEA. Renewable energy development is influenced by the predominance of accessible, well-located, inexpensive fossil fuels and an approach to climate change that is based on securing least-cost abatement opportunities. Nevertheless, government activity supporting renewable energy has risen in recent years. The Mandatory Renewable Energy Target (MRET) system mandates that electricity retailers and wholesale buyers acquire renewables certificates equal to a certain percentage of their electricity sales, likely to be around 3.5% in 2010. MRET has resulted in substantial new capacity in a wide range of different technologies, particularly wind, solar and hydro. Costs for the certificates are below what other IEA countries are paying as part of a renewables "premium" over conventional fuels. While the government has chosen not to expand the MRET target at this time, additional policies could be considered to support the further development of the country's world class renewable energy resources and technologies. In addition, the benefits of renewables use in areas that may be profitable in an Australian context, such as off-grid power and summer electricity peaks, should be further explored. The Solar Cities initiative is likely to advance this possibility.

Electricity plays a pivotal role in Australia and is important for international competitiveness, industrial employment and economic development. It also has a great consequence on the environment as 50% of Australian energy-based GHGs come from power generation. Australia was one of the pioneers in energy sector microeconomic reform and should be commended for its vision and implementation of a liberalised market. The country now has one of the most transparent and competitive electricity markets in the world and could serve as a model for other countries. Electricity prices are low by international standards on both retail and wholesale levels with some of the lowest electricity prices in the IEA and the world. Although electricity security is sound, it will continue to be monitored as in all IEA countries.

Current reforms are moving the electricity sector towards more of a national rather than state-level governance. These reforms include the creation of the Australian Energy Market Commission (AEMC, the national rule-making body) and the Australian Energy Regulator (AER, the national rule-enforcing body) as well as the improvement of the decision-making for investments in inter-state transmission infrastructure. These moves are welcomed and encouraged. Greater inter-state trade enhances security and diminishes market power. Growing constraints on interconnections and greater divergence of prices between regions indicate that the existing infrastructure is becoming constrained. The proposed new rules on the methodology for assessing the cost-effectiveness of inter-state transmission upgrades are welcomed but will need to be further fleshed out. Other areas for improvement include encouraging greater demand-side response and elimination of all appearances of conflict of interest where there is state ownership of electricity assets.

Coal plays a major role in providing Australia with low energy prices and sound energy security. In 2003, it accounted for 43% of TPES and 77% of all electricity generation. The most pressing short-term concern for the industry is a constrained export infrastructure in these times of high prices and demand; however, several major expansions are planned. While infrastructure expansion is largely the responsibility of industry, the federal government can nevertheless work with the states to help in a number of important ways, including the review of Environmental Impact Statements (EIS) in a timely manner, providing leasing for rail tracks, making any state-owned land available for appropriate development and facilitating a dialogue with the governments of purchasing countries to co-ordinate their offtake with the domestic supply chain.

In large part because of coal's high carbon content, Australia's GHG emissions intensity is one of the highest in the world. Electricity from coal-fired plants has more than twice the CO<sub>2</sub> emissions per unit than electricity from gas-fired combined-cycle plants. A number of collaborative efforts between private and government stakeholders have formed to develop technologies that can curb coal emissions, primarily carbon capture and storage. These initiatives, such as COAL21 and the AUD 500 million Low Emissions Technology Demonstration Fund (LETDF), are commendable and will provide the best opportunities for coal's future. However, any co-operative efforts will need to be reinforced with additional funds from the interested parties to expedite the technology development. It is notable that a number of these programmes, such as the LETDF, leverage significant industry funding (at least an additional AUD 1 billion), are based on co-operative industry-government-researcher partnerships. Without the development of a suitable technology to curb high emissions from coal combustion, Australia will only be able to embrace serious climate change mitigation plans with substantial economic costs.

The Australian natural gas sector has experienced major reforms and structural change since the mid-1990s with the separation of formerly integrated companies and the introduction of third party access (TPA) to transmission and distribution pipelines. There has been significant investment for expansion and integration of the gas transmission network, which has enhanced competition and security of supply. In 2003, natural gas accounted for 20% of primary supply although its production and use are expected to expand dramatically with a 184% growth in production between 2003 and 2020 and a 97% growth in domestic use. Most of the gas reserves are located in the north-west of the country, far from demand centres and are most likely to be exploited as liquefied natural gas (LNG) projects. Although competition in the global LNG market is fierce, Australia offers several advantages compared with other LNG suppliers, mainly political and economic stability and proximity to Asian demand centres. Upstream competition has started to emerge, mainly in the south-eastern part of the country.



Despite a progressive move towards more competition, the market is still immature and highly concentrated. A limited number of producers and customers dominate the market. The government has started a major reform to improve consistency of regulation and efficiency of the rules, and to create a national gas market. The most pressing regulatory and policy issues in the gas sector are to proceed with the review of the gas access regime, to facilitate upstream competition and to promote the development of gas hubs. The impact of differing federal and state taxes, charges and royalties may affect the competitive position of gas versus coal and could warrant further study.

Oil accounts for about one-third of Australian primary energy supply. The country has substantial domestic production, which has stayed at a relatively constant level since 1990. The government, through the Australian Bureau of Agricultural and Resource Economics, projects that domestic oil production will remain flat in the coming years and that increasing oil demand will cause import reliance to rise, reaching 37% in 2010 and 46% in 2020. More conservative forecasts from Geoscience Australia predict a steady downturn in Australian oil production over the next two decades as existing fields mature and new discoveries are limited. Given the liquidity of global and regional crude and products markets, this does not necessarily pose a security of supply problem. The government is interested in keeping Australia an attractive investment destination for oil exploration and production. It considers the country's oil resources to be under-explored and would like to see greater activity to exploit domestic oil. The efforts being made to encourage more activity such as a tax uplift and government geoscience pre-competitive surveys appear to be sound, particularly given that these actions are targeted on the so-called "frontier areas", which remain largely unexplored. The success of these measures in attracting investment will only be seen in some years and thus, against the background of high oil prices, it seems prudent for the government to take a step-wise approach towards any further tax or other concessions.

While Australia does not generate electricity from nuclear power, it does have substantial uranium reserves and is a major global uranium exporter. In 2002, total Australian economically demonstrated uranium resources were estimated at 702 000 tonnes, with the majority of the resources located in South Australia, the Northern Territory and Western Australia. Continuing stable uranium exports from Australia contribute to global security of supply.

Australian energy policy has placed a great deal of emphasis on the promises of further energy technology developments, particularly in their treatment of climate change mitigation. As such, energy R&D will be particularly important for the country. The White Paper takes a commendable approach to R&D by looking at the overall innovation process, including not only R&D but also concept identification, commercialisation/demonstration and uptake. There is also effective collaboration among the many stakeholders, including public-private partnerships such as Cooperative Research Centres (CRCs). In general,

the R&D targets and objectives are consistent with overall energy policy. In the past there have been difficulties gathering adequate information on government energy R&D spending. Recent efforts to develop statistics or data in the energy sector, including profiles of various technologies, will help Australia to develop a clearer picture of energy R&D innovation, to realise trends of energy R&D funding since the mid-1990s by sector and to compare Australia's funding with other IEA countries. These efforts are encouraging and should be strengthened. Assessing the performance by a set of indicators or benchmarks is important to maximise the cost-effectiveness of energy R&D programmes. In particular, care should be taken that the energy R&D programme and its product technology are designed specifically to meet the country's overall energy policy goals.

## RECOMMENDATIONS

*The government of Australia should:*

### **General Energy Policy**

- ▶ *Maintain the momentum of the collective government effort demonstrated in producing the White Paper in order to ensure a timely implementation on all levels of the measures and initiatives announced in the White Paper.*
- ▶ *Strengthen the efforts towards creating a National Energy Market, particularly in the gas sector, with the establishment of a national energy regulator (AER). This becomes more important if a carbon price signal is created that will enhance the demand for gas.*
- ▶ *Implement the plan to undertake biennial energy security reviews and continue the work of the Energy Group to maintain energy security; ensure that this work is widely discussed by all the relevant players of government and industry, particularly in light of guaranteeing security in the reformed market sectors.*
- ▶ *Consider stepping up demand-side energy policies to curb growth in energy demand by outlining an ambitious national energy efficiency strategy in order to approach best practices in other IEA countries.*
- ▶ *Look for new opportunities in climate change mitigation policy responding to evolving international and domestic circumstances through further development of the national climate change strategy engaging key stakeholders, in particular industry and state/territorial governments.*

## **Energy and the Environment**

- ▶ *Reappraise as required the costs and benefits of a national emissions trading scheme, particularly in light of developments regarding further international and domestic climate change frameworks and technology advancements. Ensure that all stakeholders are kept abreast of these developments in order to keep supply and consumer decision-makers fully informed.*
- ▶ *Ensure consideration of the environmental consequences in future decisions on energy tax reform.*

## **Energy Efficiency**

- ▶ *Develop a co-ordinated energy efficiency strategy that aims to realise all the benefits of improved efficiency such as emissions mitigation, increased productivity and hence competitiveness, the advantages of delaying infrastructure investments to gain technology advancements, and enhanced energy security.*
- ▶ *Consider targets for improved energy efficiency on a national or sector-specific basis and the appropriate means of achieving them.*
- ▶ *Address means of curbing peak electricity demand, for example through more cost-reflective pricing in meeting summer peaks and/or more stringent efficiency standards for peak energy consumers such as air-conditioning.*
- ▶ *Develop stronger means of improving energy efficiency in the transport sector, in particular through vehicle taxation and fuel efficiency standards.*
- ▶ *Consolidate the different levels of energy efficiency programmes to simplify them for users and/or improve their effectiveness.*

## **Renewable Energy**

- ▶ *Maintain an efficient market-oriented approach to renewables development such as the Mandatory Renewable Energy Target (MRET), while also supporting the most promising renewable energies that still need additional assistance.*
- ▶ *Exploit those renewable energies where Australia enjoys a relative cost advantage over other countries.*
- ▶ *Continue to give a long-term perspective to the renewable industry, by assessing the effect of government support programmes (and their expiration schedules) and responding if renewables development is not consistent with the goal of making renewable energy an important part of the long-term strategy.*

- ▶ *Maintain focus on cost reduction of renewables technologies and on energy needs where renewables may be more cost-effective, such as remote area power generation and summer electricity peaks.*

## **Electricity**

- ▶ *Continue taking measures of transparency, openness and competition as tools for creating a low-priced reliable electricity sector.*
- ▶ *Encourage the process of integrating the markets, with the view to strengthening a fully competitive market with full contestability for all consumers.*
- ▶ *Implement plans for improved decision-making on new interregional transmission investment to enhance reliability, check market power and improve system-wide economic efficiency.*
- ▶ *Accelerate the process of further streamlining and simplifying the regulatory framework with the aim of a more nationally focused regulatory regime.*
- ▶ *Monitor closely the market response to growing generation needs and be prepared to take appropriate action to achieve security of supply; further incorporate the Annual National Transmission Statement (ANTS) into the Statement of Opportunities (SOO) with more concrete suggestions in recognition of transmission's ability to address regional needs.*
- ▶ *Consider the effects of mixed ownership in the generation sector between state and private actors; ensure there is a level playing field between all participants.*
- ▶ *Address the issue of how the market could more efficiently and reliably meet peak demand. Encourage market actors to increase demand-side participation, in order to make electricity demand more responsive to price signals.*

## **Coal**

- ▶ *Work in close co-operation with states and industry to alleviate the bottlenecks in the coal supply value chain, particularly those associated with transportation needs in the immediate and longer term.*
- ▶ *Support the development of the necessary technologies for the next generation of coal use as part of a larger effort to consider how the expanding future use of coal in domestic and international environments can accommodate future carbon constraints.*
- ▶ *Co-ordinate activities between coal producers, electricity companies, government and researchers to address the challenges facing coal's future*

*given its high carbon content, particularly in garnering sufficient funds to develop emission-cutting technology.*

- ▶ *Anticipate the effects of higher energy prices owing to coal's high carbon content.*

## **Natural Gas**

- ▶ *Strengthen the development of a national energy/gas market with better interconnectivity of the grid and more consistency of rules across jurisdictions; complete the gas market development plan jointly developed with the industry; actively promote the development of hubs/spot markets; and increase transparency in the market (e.g. market share information and prices).*
- ▶ *Complete the Gas Emergency Response Protocol as soon as possible, making clear the roles and responsibilities of governments, market participants and customers.*
- ▶ *Establish a clear, transparent and stable framework for a gas access regime that enables cost-effective access at the transmission level, gives enough incentives for new greenfield pipelines and ensures uniformity of approach nationally; quickly respond to the Productivity Commission Review on the Gas Access Regime.*
- ▶ *Promote further upstream competition, for example by reviewing the upstream fiscal regime for onshore and offshore fields in order to incentivise exploration and production offshore and create internationally, as well as across jurisdictions, competitive conditions; by reviewing joint marketing policy and facilitating separate marketing where feasible; and by reviewing/monitoring conditions for access to upstream facilities.*
- ▶ *Continue to encourage the development of LNG exports in the face of global competition, with particular attention to resolving boundaries and royalty issues with East Timor.*
- ▶ *Review the effects of differing taxes, regulations and changes on the competitive position of gas versus coal in energy markets.*

## **Oil**

- ▶ *Continue to review and adapt the upstream regulatory regime in close co-operation with the oil industry.*
- ▶ *Assess whether the announced fiscal measures and the upstream taxation provisions have the intended impact of increasing exploration and production activities and, if necessary, propose new measures.*

- ▶ *Continue to work with industry and other stakeholders to reform legislation governing retail activity in light of the substantial changes that have taken place in the motor fuels market.*
- ▶ *Monitor closely its emergency stockholding position to ensure it continues to comply with IEA obligations, especially in light of the changing domestic refinery industry and the expected growth of oil imports.*

## **Energy Research and Development Innovation**

- ▶ *Maintain and refine the approach taken in the White Paper to look at the innovation process overall.*
- ▶ *Maintain and further develop effective collaboration among stakeholders, including public-private partnerships.*
- ▶ *Ensure regular reviews of the technology assessments and consistency between government support for energy R&D innovation, the technology assessments and the goals of general energy policy.*
- ▶ *Develop improved mechanisms for data collection of overall energy R&D funding, the allocation of that funding and communication of this information to international partners.*
- ▶ *Continue to provide energy R&D innovation support which is both substantial and responsive at different stages of the projects, and which is consistent with the goals of the White Paper in particular and other national research priorities.*
- ▶ *Develop improved mechanisms for assessing the performance of R&D projects conducted by the government and public-private partnership.*
- ▶ *Ensure actions or measures under international technology agreements to help Australia achieve its aspirations as a leader and "fast follower" in technology development.*



## COUNTRY BACKGROUND

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Australia is a large, sparsely populated country, rich in mineral resources. It is the world's sixth-largest country with a land mass of approximately 7.6 million km<sup>2</sup>, or roughly the same size as the contiguous 48 states of the United States and almost 80% larger than the combined EU-25 countries. Australia has a population of just over 20 million people with a population density of 2.6 persons per km<sup>2</sup>, the lowest in the OECD and one of the lowest in the world. Population is concentrated along the eastern and south-eastern coast with a smaller amount in the west and very few people in the country's arid centre. It has no land boundaries with other countries.

Much of Australia is desert or semi-arid with 40% of the land mass covered by sand dunes. Only the south-east and south-west corners have a temperate climate and moderately fertile soil. The northern part of the country has a tropical climate and comprises tropical rainforests, grasslands, and desert. The Great Barrier Reef, the world's largest coral reef, lies a short distance off the north-east coast and extends for over 1 200 kilometres. Rainfall is highly variable, with frequent droughts lasting several seasons. Occasionally a dust storm will blanket a region or even several states and there are reports of the occasional large tornado. Australia is rich in mineral resources, including hard and brown coal, natural gas, petroleum, uranium, bauxite, iron ore, copper, gold, nickel and tin.

Australia is a federal country with a commonwealth government, six states<sup>3</sup> and two territories<sup>4</sup>. A bicameral Federal Parliament consists of the Senate and the House of Representatives. The Australian Constitution allocates power between the Commonwealth and the individual states. The Commonwealth is responsible for income and company taxation, interstate and foreign trade, foreign investment, and negotiation, ratification and compliance with international treaties. The states have primary responsibility for energy production, transport, land-use, mineral rights and environmental assessments. All resources naturally found in the states are considered to be property of the states rather than the Commonwealth. All powers not explicitly given to the Commonwealth revert back to the states.

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3. New South Wales, Victoria, Queensland, South Australia, Western Australia and Tasmania.

4. The Australian Capital Territory and the Northern Territory.



Australia has enjoyed considerable economic success in the last ten or so years. From 1993 through 2003, Australian gross domestic product (GDP) grew at an average annual rate of 3.9%, compared to 1.2% annual growth for Japan, 3.2% for the United States and 1.8% for the then 15 countries of the European Union. Australian GDP growth is estimated to have been 3.5% in 2004 with forecasts showing a slight cooling of the economy to 3.2% in 2005 and 3.1% in 2006. The unemployment rate fell to a 27-year low in November 2004 with a rate of 5.2%.

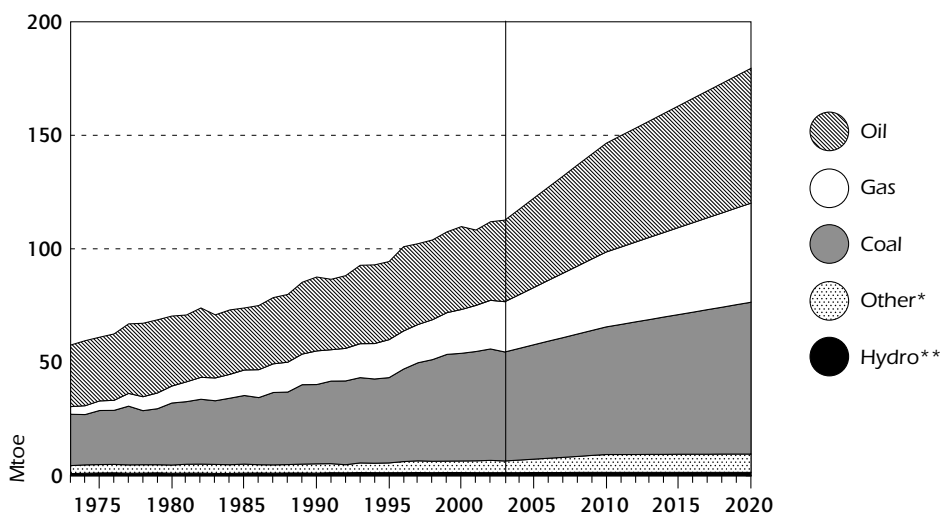
## SUPPLY: DEMAND OVERVIEW

### ENERGY SUPPLY

In 2003, Australian total primary energy supply (TPES) was 112.6 million tonnes of oil equivalent (Mtoe). This represents an increase in TPES of 0.7% from 2002. From 1999 to 2003, TPES growth averaged 1.6%. From 1989 to 2003, TPES increased by 2.3% annually while over the longer term, 1970 to 2003, growth averaged 2.4% annually. By way of comparison, the average annual TPES growth for all current OECD countries from 1971 to 2002 was 1.5%.

Figure 1

Total Primary Energy Supply, 1973 to 2020



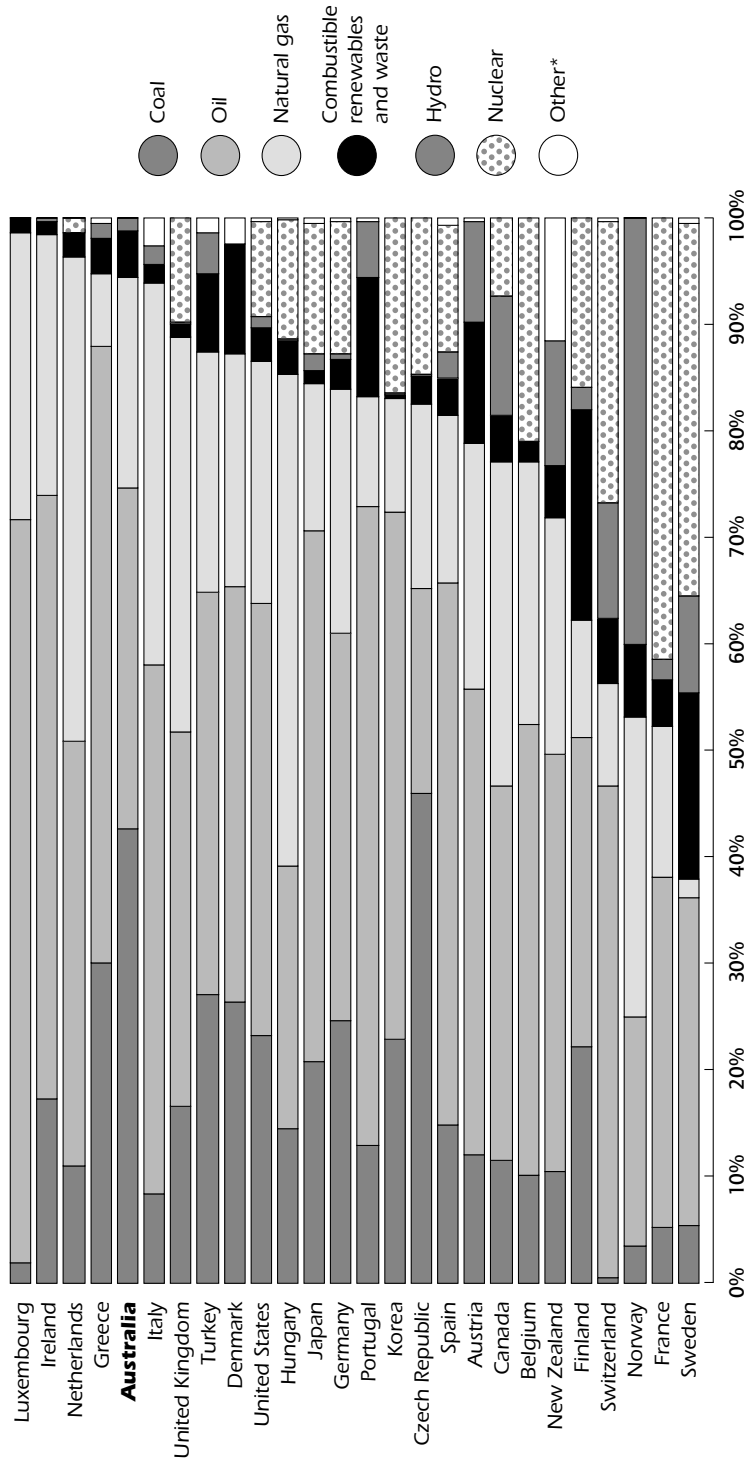
\* includes geothermal, solar, wind, combustible renewables and waste.

\*\* negligible.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005; and country submission.

Figure 2

Total Primary Energy Supply in IEA Countries, 2003



\* includes solar, wind and ambient heat production.  
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005.

Coal has been and continues to be the country's dominant primary fuel. In 2003, coal accounted for 42.6% of Australian TPES, the second-highest in the IEA after the Czech Republic. Coal was followed in usage by oil (31.9% of TPES), natural gas (19.7%), biomass (4.4%), hydropower (1.2%) and combined solar and wind (0.13%). By way of comparison, oil was by far the largest TPES contributor for the IEA countries as a whole in 2002<sup>5</sup> with 40% of the total, followed by gas (22%), coal (20%), nuclear (12%), biomass (3%), hydropower (2%), geothermal (0.4%), and solar, wind and other sources (0.15% combined).

Since 1990, the distribution of TPES among the various fuels has been quite stable. Coal's share of TPES has fluctuated between 39.8% and 44.5% and natural gas has fluctuated between 16.0% and 19.7%. Oil has seen a modest decrease from 37.2% of TPES in 1990 to 31.9% in 2003, but such trends are rather mild by IEA standards. The Australian government does not foresee a radical shift in fuel supply patterns in the mid-term (*i.e.* through 2020). The most recent projections show that coal will be at 37.2% of TPES, followed by oil (33.1%), natural gas (24.3%), biomass (4.3%), hydropower (0.9%) and other renewables (0.3%).

Coal mining dominates domestic energy production. In 2003, Australian mines produced 185.0 Mtoe of coal. Seventy-three per cent (135.5 Mtoe) of this amount was exported. Gas production was equal to 31.3 Mtoe, of which 29% was exported. Oil production in 2003 was 30.7 Mtoe, while imports of crude oil and products were 28.0 Mtoe and exports 22.1 Mtoe. Overall, Australian net fuel exports were 24% greater than the national TPES. When looking specifically at the only fuel Australia does import (oil), net oil imports are equal to 14.3% of oil supply in 2003. The government expects the net import share for oil to grow, reaching 44.9% in 2020.

## ENERGY DEMAND

In 2003, Australian total final consumption (TFC) of energy was 72.3 Mtoe. From 1999 to 2003, TFC grew by an average annual rate of 0.9% and from 1989 to 2002, by an annual rate of 2.0%. By way of comparison, TFC for the IEA as a whole rose by 1.2% annually from 1988 to 2002.

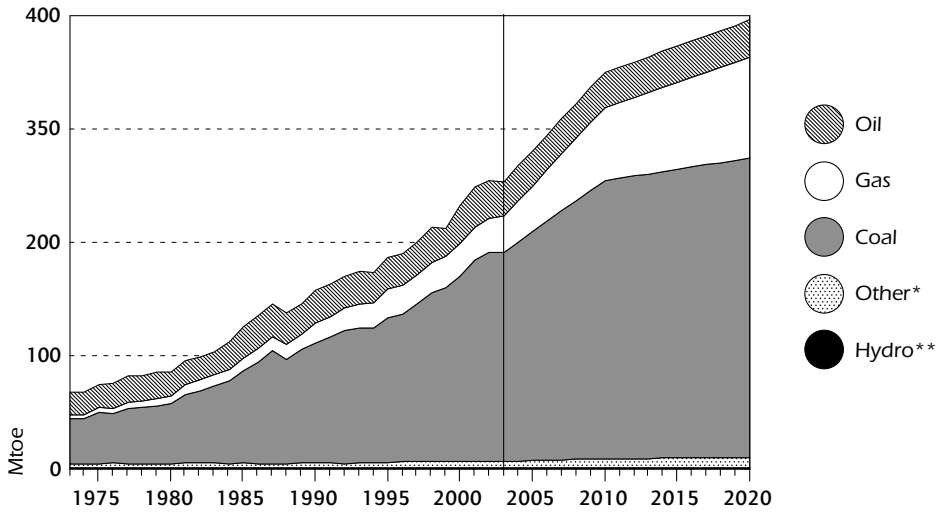
In 2003, oil was by far the most important energy source for final consumption, accounting for 51.7% of TFC. This was followed by electricity (22.6%), natural gas (15.9%), biomass (5.9%), coal (3.8%) and solar and wind combined (0.1%). This fuel consumption profile is comparable to the IEA as a whole, where in 2002, oil accounted for 52.8% of TFC, followed by gas (20.1%), electricity (19.9%), biomass (3.0%), coal (3.0%), and others (3.3%).

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5. Complete IEA figures for 2003 not yet available.

Figure 3

### Energy Production by Source, 1973 to 2020



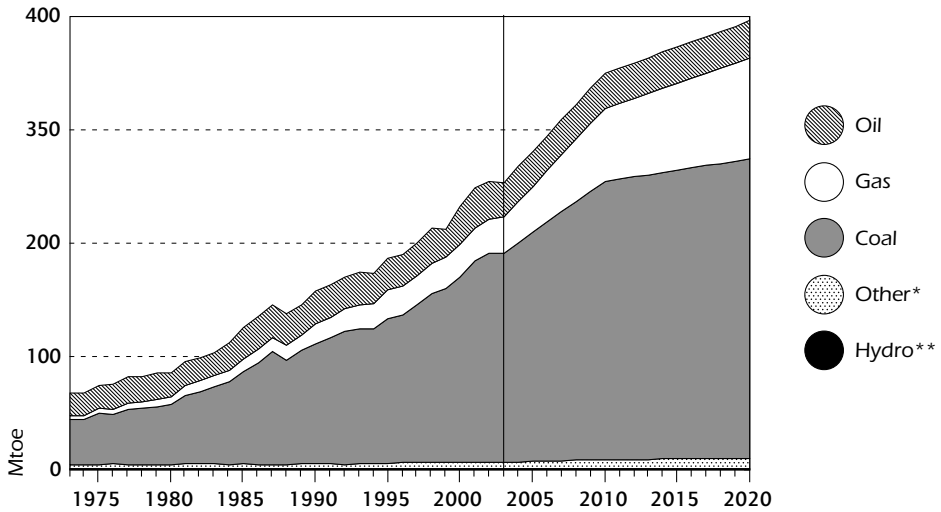
\* includes solar, wind, combustible renewables and waste.

\*\* negligible.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005; and country submission.

Figure 4

### Total Final Consumption by Source, 1973 to 2020



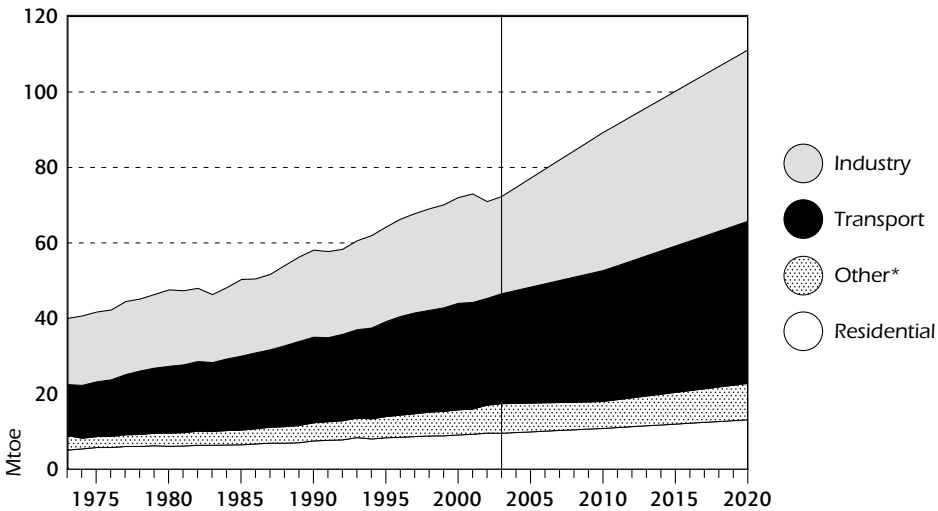
\* includes solar, wind, combustible renewables and waste.

\*\* negligible.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005; and country submission.

The transport sector is the largest final energy user in Australia, representing 40.4% of TFC in 2003, with road transport accounting for 32.5%. The industrial sector was the next largest user of energy with 32.4% of the total, followed by residences (13.2%), other sectors (mostly commercial, 10.8%) and non-energy use (3.3%). Over the long term, the share of the industrial sector has fallen, while the share of the road transport sector has risen. However, since 1990, the percentage shares of TFC by sector have been quite stable.

Figure 5  
**Total Final Consumption by Sector, 1973 to 2020**



\* includes commercial, public service and agricultural sectors.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005; and country submission.

## GENERAL ENERGY POLICY

### ENERGY POLICY OBJECTIVES

The Council of Australian Governments (COAG, described below) has established three primary objectives for national energy policy in Australia:

- Encourage efficient provision of reliable, competitively-priced energy services.
- Encourage responsible development of Australia's energy resources, technology and expertise, their efficient use by industries and households and their exploitation in export markets.

- Mitigate local and global environmental impacts of the energy sector, notably the impacts of increased greenhouse gas (GHG) concentration in the atmosphere.

All Australian governments have agreed that their energy policies will:

- Recognise the importance of competitive and sustainable energy markets in achieving the three main objectives.
- Continuously improve Australia's national energy markets, in particular the balance between and among jurisdictions, between energy sources, and between supply-side and demand-side opportunities.
- Enhance the security and reliability of energy supply, encompassing resource availability, conversion, transportation and distribution.
- Stimulate sustained energy efficiency improvements to technologies, systems and management proficiency across production, conversion, transmission, distribution and use.
- Encourage the efficient economic development and increased application of less carbon-intensive energy sources and technologies (including renewables).
- Recognise that Australia's energy markets operate in the context of world energy markets and seek to enhance the country's international competitiveness in these markets.
- Provide the degree of transparency and clarity in government decision-making required to achieve confidence in current and future investment decisions.
- Carefully consider the social and economic impacts on regional and remote areas, with particular regard to businesses, industries and communities.
- Facilitate constructive, effective inter-jurisdictional co-operation and productive international collaboration on energy matters.

On 15 June 2004, these objectives were confirmed with the release of the Australian Government's White Paper on energy entitled, "Securing Australia's Energy Future". The White Paper begins by explaining the context in which Australian energy policy operates, including the following points:

**Australia is well endowed with energy.** Australia has vast reserves of coal that are relatively easy to mine and located close to energy load centres. The country's natural gas and uranium resources are substantial, although much of the natural gas is located far from large domestic markets and uranium is not used to produce energy in Australia. The nation's oil resources are significant, but reserves are declining in the absence of new discoveries.

**Australia's energy is competitively priced.** Access to low-cost reliable energy is a competitive advantage for Australia. This low cost is driven by ready access to relatively inexpensive sources of energy, especially coal. Energy market reform and other related policies over the last decade have created downward pressure on energy prices.

**Australia is a major exporter of energy-intensive products.** Australia earned AUD 24.2 billion from the export of energy resources in 2002/03, of which AUD 11.9 billion from coal. Australia is the world's largest exporter of coal. The value of coal exports is expected to increase to around AUD 17 billion in 2004/05 and jump to AUD 25 billion in 2005/06 on the back of strong increases in prices, which have already been negotiated for this period. Exports of energy-intensive refined metals and alumina earned Australia a further AUD 18.9 billion.

**Energy resources make a significant contribution to the revenues of the federal, state and territory governments.** The federal government collects around AUD 9 billion net per year from fuel excise, which is around 5% of total revenue. Secondary taxation raised another AUD 2.1 billion for the federal government in 2003/04 and a further AUD 1.5 billion for state and territory governments.

**Australia's energy use is emissions-intensive.** Coal provides around 40% of Australian TPES and generates nearly 80% of the country's electricity. In transport, the passenger vehicle fleet relies on large vehicles and is energy-intensive. Australian per capita emissions of GHGs are among the highest of all industrialised countries.

**Australia is a small global player.** Australia is generally a technology taker. Its oil refineries and automotive manufactures are small by world standards, and its consumer market is generally of insufficient size to significantly affect consumer product specifications.

The White Paper establishes its strategy for a successful energy future given this specific context by outlining the following objectives:

- Attract investment in the efficient discovery and development of Australia's energy resources.
- Deliver a prosperous economy while protecting the environment and playing an active role in global efforts to reduce GHG emissions.
- Encourage development of cleaner, more efficient technologies to underpin Australia's energy future.
- Develop effective and efficient energy markets that deliver competitively priced energy, where and when it is needed in the future.

- Minimise response time to disruptions in energy supplies.
- Establish an efficient energy tax base, restricting fuel excise to end-use and applying resource rent taxes to offshore projects.
- Ensure Australia uses its energy wisely.

Specific initiatives that were announced in the White Paper to achieve these objectives include:

- Fuel excise tax reform to reduce AUD 1.5 billion in excise liability from businesses and households in the period to 2012/13.
- Establishment of a AUD 500 million fund with the intention of leveraging more than AUD 1 billion in private investment to develop low-emission technologies.
- Strong emphasis on the urgency and importance of continued energy market reform.
- The provision of AUD 75 million for Solar Cities trials in urban areas to bring together the benefits of solar energy, energy efficiency and vibrant energy markets.
- The provision of AUD 134 million to remove impediments to the commercial development of renewable energy technologies.
- Incentives for petroleum exploration in frontier offshore areas.
- New requirements for business to manage their emissions wisely, including a requirement that larger energy users undertake, and report publicly on, regular assessments to identify energy efficiency opportunities.

The other major energy policy initiative seen in recent years concerns energy market reform. On 11 December 2003, the Ministerial Council on Energy (MCE, described below) released a communiqué and an accompanying document entitled "Reform of Energy Markets". The overall thrust of this initiative will be to create electricity and natural gas markets that have true national scopes rather than being state-based.

The primary institutional change in this reform is the creation of two new bodies at the federal level; the Australian Energy Market Commission (AEMC), responsible for rule-making and market development, and the Australian Energy Regulator (AER), responsible for energy regulation. The motivation behind the creation of these two entities is to separate the rule-making function from the implementation of the rules. (They are described in more detail below under the Energy Policy Institutions section.) Both the AEMC and the AER were to have been established and operational by July 2004 but owing to administrative difficulties and ongoing negotiations on the final



structure and membership of these organisations, their creation has been delayed. They were then scheduled to start work in July 2005.

Another major proposal of the energy market reform concerns electricity transmission. A new planning process will be established to improve consistency, transparency and economic efficiency, particularly for connections between states. An Annual National Transmission Statement (ANTS) is now developed by the National Electricity Market Management Company (NEMMCO, described below). This assessment details the major transmission flow paths, forecasts inter-connector constraints and identifies options to relieve constraints. A new regulatory test for transmission additions will be developed to recognise the full economic benefits of additional lines, including mitigation of market power and enhanced competition.

## **ENERGY POLICY INSTITUTIONS**

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### **The Council of Australian Governments (COAG)**

The COAG comprises the Prime Minister of Australia, the State Premiers and the Territory Chief Ministers. It meets at least once a year to consider issues that affect all jurisdictions, including those related to energy.

### **Ministerial Council on Energy (MCE)**

Established by COAG in 2001, the MCE oversees the continued development of Australia's energy policy. The council comprises ministers with responsibility for energy from the federal government and all states and territories. The Australian Government Minister for Industry, Tourism and Resources chairs the council and the Department of Industry, Tourism and Resources provides secretariat support.

### **Ministerial Council on Mineral and Petroleum Resources (MCMPR)**

The MCMPR has responsibility for matters affecting the minerals (including energy resources) and upstream petroleum industries. The council consists of the federal government Minister for Industry, Tourism and Resources and state and territory ministers responsible for minerals and petroleum.

### **Department of Industry, Tourism and Resources (DITR)**

The DITR helps promote internationally competitive and sustainable business. It is the principal Commonwealth energy policy-making body. The divisions and agencies with a role in energy are listed below:

- The *Energy and Environment Division* is responsible for domestic and international energy policy, including climate change, renewable energy, energy efficiency and energy security. It gives advice on sustainable development policies for industry and the economy. It also works on energy market reform.

- The *Resources Division* provides legislative advice and administrative support to the government on the resources sector of the economy, including upstream and downstream petroleum sectors and the minerals and coal industries. Its jurisdiction includes the release of offshore petroleum exploration areas, refining and fuels, resources taxation, offshore petroleum safety regulation, and liquefied natural gas (LNG).
- *Invest Australia* is responsible for promoting inward investment in Australia's energy sectors through attracting productive foreign direct investment to support sustainable industry growth and development.
- *AusIndustry* is the Department's programme delivery arm. It provides programmes that support energy research and innovation.
- *Geoscience Australia* is the national agency for geoscience research and geospatial information.

### **Department of Environment and Heritage (DEH)**

The DEH develops and implements national policy, programmes and legislation to protect and conserve Australia's natural environment and cultural heritage responsibilities. The department is responsible for administering the Environment Protection and Biodiversity Conservation Act 1999.

### **Australian Greenhouse Office (AGO)**

As part of the Department of Environment and Heritage, the AGO is responsible for delivering the majority of programmes under the Australian government's climate change strategy.

### **Department of Transport and Regional Services**

The Department of Transport and Regional Services has policy responsibility for transport issues at the national level.

### **Australian Competition and Consumer Commission (ACCC)**

The ACCC is an independent Commonwealth statutory authority. It was formed in 1995 to administer the Trade Practices Act 1974 and the Prices Surveillance Act 1983. The ACCC promotes competition and fair trade in the market place to benefit consumers, businesses and the community. It also regulates national infrastructure services. Its primary responsibility is to ensure that individuals and businesses comply with the national competition, fair trading and consumer protection laws.

### **Australian Energy Market Commission (AEMC)<sup>6</sup>**

The AEMC is a separate legal entity, accountable to and subject to the power of policy direction from the Ministerial Council on Energy. The AEMC comprises

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6. Both the AEMC and the AER were scheduled to begin operations in July 2005, after this book went to press.

three members, two of whom (including the Chair) are to be appointed by the states and territories. The core functions of the AEMC include rule-making (code changes) and undertaking reviews. It assumes all code change and market development functions previously performed by the National Electricity Code Administrator (NECA), the National Gas Pipelines Advisory Committee and the Code Registrar.

### **Australian Energy Regulator (AER)**

The AER is a constituent part of the Australian Competition and Consumer Commission (ACCC, described above) but operates as a separate legal entity. The AER largely replaces the functions of thirteen different but overlapping regulators. It has initial responsibility for economic regulation of electricity wholesale and transmission networks (other than in Western Australia and the Northern Territory) and key rule enforcement functions. The AER implements the rules that have been defined by the AEMC. The responsibilities of the AER are to be extended to gas transmission by mid 2005 or later given the delay in establishing the AER. The AER will assume further responsibility for distribution and retailing in mid-2006. States will be able to appoint two AER members with the third coming from the ACCC. Chairmanship must be agreed by both the Commonwealth and five out of the seven states and territories (Western Australia to be excluded). Appointments are for five years and while the members will be given leeway to act independently, they can be dismissed in exceptional circumstances.

### **National Electricity Market Management Co (NEMMCO)**

NEMMCO was established in May 1996 as the corporate body responsible for the operation and administration of the electricity network and the wholesale spot market for electricity.

### **Productivity Commission (PC)**

The Productivity Commission was established in April 1998. It is an independent national agency and the Australian government's principal review and advisory body on microeconomic policy and regulation. The commission's work covers all sectors of the economy, under both national and state responsibility. The commission provides advice and holds independent public inquiries on matters relating to industry and productivity. It is currently undertaking a study of the potential of improved energy efficiency in Australia with its final report to be released in August 2005.

### **The Office of the Renewable Energy Regulator (ORER)**

ORER was established on 12 February 2001 as the statutory authority to oversee the implementation of the federal government's Mandatory Renewable Energy Target (MRET). Its main responsibilities include accrediting renewable energy generators and the creation of certificates, assessing annual compliance statements and imposing penalties for non-compliance.

### **Department of Education, Science and Training (DEST)**

The DEST has lead responsibility within the Commonwealth for policies and programmes supporting scientific research.

### **Commonwealth Scientific and Industrial Research Organisation (CSIRO)**

CSIRO is the Australian government's most important scientific research agency. It has a staff of 6 500 working in 21 research divisions in 57 sites across Australia and overseas. CSIRO is active in seven different sectors, one of which is Energy and Transport.

### **Australian Bureau of Agricultural and Resource Economics (ABARE)**

ABARE is an Australian government economic research agency that provides independent research and analysis on energy and resource issues, including statistics, projections and economic modelling.

## **SECURITY OF ENERGY SUPPLY**

Australian energy supply is enhanced by its extensive reliable domestic fuel supplies. Brown and black coal resources are plentiful and located near the major population centres of the south-east. Gas supplies are also plentiful but not as well located. Although there are currently ample gas reserves in the Bass Strait to serve demand in the south-east, the majority of large fields are located in the north-west of the country, far from demand centres. The extent of economic oil reserves is higher in Australia than most IEA countries. As recently as 2001, Australia was a net exporter of crude oil and/or petroleum products. However, in 2003 net oil import dependence reached 14% and government forecast scenarios project that Australia's petroleum import dependence will continue to rise, reaching 37% by 2010 and 46% by 2020.

Despite the security benefits derived from its range of domestic fossil fuels, the lack of land borders with other countries and the particular distribution of the population raise some energy security challenges. While opportunities for gas or oil pipeline interconnections, or any electricity transmission links are comparatively limited, the country has in place a reliable system for the import and export of petroleum products. Even where population concentrations are similar to other IEA countries, the major cities and towns are largely spread out along the coast and such a "stringy" load profile also raises challenges.

The White Paper makes energy security an important component of overall strategy, stating that the government should ensure that consumers have reliable energy sources. It goes on to rate the current level of energy security as "high" by noting the country's endowment of domestic fuels, extensive energy delivery infrastructure and a good access to world markets. It also notes that one of the major lessons from other markets is that policies which

seek to pre-empt or override market forces rarely work in the longer term. The White Paper separates energy security challenges into short-term and long-term threats. The major long-term security challenge will be to attract timely large-scale investment in energy supply systems. The major short-term threat to energy security involves disruptions to energy production and distribution.

While noting the currently satisfactory level of the country's energy security, the Australian government has developed a two-pronged approach to address mid- to long-term security challenges. The first is a biennial review of Australia's energy security outlook. The review will analyse energy security from the perspective of the domestic energy sectors, providing information on short- and long-term issues. The review will: *i)* assess the current energy needs and how those needs are being met, *ii)* examine projected energy needs for the coming ten to 20 years, and *iii)* examine the investment requirements needed to meet the expected demand. The International Energy Branch of the DITR will be responsible for conducting the review.

The other energy security mechanism, the Energy Infrastructure Assurance Advisory Group (the Energy Group), will focus on ways to prevent disruptions to production or supply in the country's energy infrastructure. The Energy Group is mandated to assess the medium- to long-term vulnerabilities in protecting the energy infrastructure. The Energy Group comprises representatives from the private sector and the state and territory governments. Its key activities are as follows:

- Mapping the supply chain for the electricity, gas and liquid fuels sectors and identifying vulnerabilities.
- Prioritising these vulnerabilities.
- Collating and assessing industry good practice examples of Critical Infrastructure Protection (CIP) in the energy sector.
- Undertaking a gap analysis of contingency plans within the energy sector.
- Testing the effectiveness of contingency plan coverage for the energy sector.

The International Energy Branch of the DITR is responsible for co-ordinating activities of the Energy Group and for providing strategic support.

While Australia at present comfortably meets its IEA stockholding obligation with 107 days of net oil imports as of 1 January 2005, net import stock coverage has dropped from 419 days as of 1 January 2003. This is a result of a rising import percentage and a decrease in domestic refinery operations. Australia should closely monitor its emergency stock position to ensure it continues to meet its IEA stockholding obligation and we understand the Australian government is investigating options to do so.

## ELECTRICITY

Australia was one of the first countries to engage in electricity market reform and now has one of the most liberalised electricity sectors in the world. From 2000 to 2004, peak demand rose by 4 500 MW (or about 18%), while 4 300 MW was added. In 2004, generating capacity increased only by 365 MW (all from plant upgrades) while demand rose by 1 200 MW. However, this relative lack of new generating capacity can be partly explained by the forthcoming completion of Basslink, which will connect Victoria to the hydropower resources in Tasmania and could make generation investors hesitant in the face of Tasmania's low-priced hydropower resources.

In an effort to enhance the system's long-term energy security, NEMMCO releases the Statement of Opportunities (SOO) for publication on 31 July each year. The SOO is divided into two parts. The first is the Supply-Demand Balance and, new in 2004, the second part is the Annual National Transmission Statement. The Supply-Demand Balance presents NEMMCO's assessment of the adequacy of electricity supply to meet projected demand for the next ten years.

The majority of the recent capacity additions have been either new peak or intermediate cycle plants responding to price signals, or capacity expansions from existing plants. This has thus far been sufficient to meet growing demand. However, the continued high demand growth suggests a new baseload plant will be needed in the coming years. The market appears to be aware of this need and there are several plants tentatively scheduled even though market prices have not yet risen to levels that would cover a new plant's long-run marginal cost. The state drawing the greatest concern in this respect is New South Wales where the existing utilities are state-owned and there have been some complications introducing private-sector generation investment into such an environment.

The short-term electricity security of the Australian system was tested in August 2004. Because of a transformer fault in New South Wales, a portion of the state's capacity was lost. The reaction to this event and the steps taken to minimise disruption are described in the accompanying text box.

## COAL

Australia has some of the most extensive coal reserves in the world. These include both black and brown coal and are located mainly in the east and south-east corner of the country near to the major population centres. Coal substantially enhances Australian energy security and, as the world's largest coal exporter, Australia contributes to international energy security, particularly in the Asia-Pacific region.

On the evening of Friday 13 August 2004 at 21:41 hours, a current transformer at the Bayswater power station in New South Wales developed an internal fault causing it to later explode. This failure triggered a major power system incident, which involved the loss of six generating units in New South Wales (NSW) in less than a minute. This sudden loss of generation caused the power system frequency to fall to 48.9 Hz which resulted in approximately 1 500 MW of under-frequency load shedding (UFLS) in not just New South Wales but also the states of Queensland, Victoria and South Australia. This automatic load disconnection together with the combined response from the remaining generating units successfully controlled the power system frequency and prevented a major system collapse.

The first generating units to trip were Bayswater 1, 2 and 3, followed by Eraring Units, Vales Point Unit 6 and the Redbank Unit. These trips caused the power system frequency to fall from its standard of 50 Hz to just below 49 Hz for a period of about 15 seconds before recovering. Interconnections with other states adjusted accordingly: the combined net flows of all interconnections went from about 200 MW of imports to NSW pre-crisis to 1 235 MW of imports ten minutes after the initial fault. Load shedding was spread out amongst all connected states and was felt more keenly in Victoria and Queensland than in New South Wales, as shown in the following table.

<b>Load Shedding Among States</b>			
<i>State</i>	<i>Demand (MW)</i>	<i>Load shed (MW)</i>	<i>As % of demand</i>
New South Wales	9 208	462	5.0
Queensland	5 726	542	9.5
Snowy River	28	0	0.0
South Australia	1 669	18	1.1
Victoria	5 998	488	8.1
<b>NEM overall<sup>(1)</sup></b>	<b>22 629</b>	<b>1 510</b>	<b>6.7</b>

<sup>(1)</sup>The National Electricity Market (NEM) is the market connecting the states of Queensland, New South Wales, Victoria and South Australia. It also includes the Snowy River hydropower stations.

In January 2005, NEMMCO published an analysis of this incident, "Power System Incident Report – Friday 13 August 2004". While the report generally notes that the initial transformer fault was handled correctly within the designed protection mechanisms, a number of questions about system safety are also raised. For example, the cause of the initial transformer failure at the Bayswater plant has not yet been conclusively

determined. The tripping of the three Bayswater generating units resulted from the reaction of differential protection relays which are intended to detect a fault within the generating unit itself. The transformer that failed, however, was well outside the protection zone for the differential protection relay and the Bayswater owners have yet to determine a rationale for their operation. The tripping of the second unit, Eraring Unit 2, was the result of a time delay function that did not operate correctly on the protection system. The NEMMCO report concludes with a number of suggestions for improving the system's response to any such failures in the future.

## OIL AND OIL PRODUCTS

Australia has substantial domestic oil reserves and a history of high production levels. In the 15 years from 1988 to 2003, Australia's oil import reliance has averaged about 16%. However, the government projects that domestic production will stay at current levels while demand will steadily increase and, as a result, Australian import reliance is expected to reach 37% in 2010 and 46% in 2020. One of Australia's eight major refineries was mothballed in mid-2003 mostly as a result of competition from large refineries in Asia. Barring the reversal of this decision or the construction of new refining capacity, fuel imports will continue to grow. However, as product supplies are readily available in the region, security of supply of liquid fuels is not threatened. New fuel standards to be introduced in the near future and the adjustments made by refiners are not likely to change this picture.

While Australia at present comfortably meets its IEA stockholding obligation with 107 days of net imports as at 1 January 2005, net import stock coverage has dropped from 419 days as at 1 January 2003. Moreover, it should be noted that all stocks are industry stocks held for operational purposes in view of the highly extensive supply network of Australia and would, therefore, be available only to a very limited extent for use in an emergency. If new refinery investments are not undertaken, the deficit will continue to grow. Therefore, Australia needs to closely monitor its emergency stock position to ensure it continues to meet its IEA stockholding obligation and we understand the Australian government is investigating options to do so.

## NATURAL GAS

Australia has abundant gas reserves. Geoscience Australia, the Australian government's geoscience agency, estimates Australian identified gas resources as 3 921 billion cubic metres (bcm) at 1 January 2004. These resources



represent 120 years of current production; 20% of these reserves are considered commercially proven (783 bcm). While gas resources are abundant, most of them are located in the western and north-western areas of Australia, far from the major consuming centres. Gas transport is the major consideration when assessing Australian gas security. Currently, no formal cross-jurisdictional mechanism exists for managing major unplanned gas supply disruptions and there are no specific national laws covering gas supply security. However, disruptions at Longford (1998) and Moomba (2004) highlighted the vulnerability of the gas market to supply disruptions.

In April 2004, the MCE agreed to develop a National Emergency Response Protocol for the natural gas sector to be applied in the event of major disruptions. In developing a gas emergency response protocol, the Gas Emergency Protocol Working Group is considering existing commercial and regulatory arrangements. The prospective emergency response protocols will articulate the responsibilities and roles of government, market participants and end-users. In addition, to ensure that future supply interruptions are managed in a nationally consistent manner, the gas emergency response protocol will cover both cross-border and intra-jurisdictional arrangements. As the first stage in developing a protocol, MCE ministers signed a Memorandum of Understanding in December 2004 under which a jurisdiction proposing to exercise an emergency power must consult other affected jurisdictions before exercising the emergency power. A protocol proposing the establishment of a cross-jurisdictional mechanism, including industry involvement, in managing major unplanned gas supply disruptions is to be considered by the MCE shortly.

## **ENERGY FORECASTS**

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### **METHODOLOGY AND ASSUMPTIONS**

In August 2004, the Australian Bureau of Agricultural and Resource Economics (ABARE) published "Australian Energy National and State Projections to 2019-2020". This report was prepared for the Department of Industry, Tourism and Resources and includes forecasts of supply and demand for all major energy sources. Statistics from this work were used as the basis for analysis in the energy White Paper.

ABARE uses the E4 cast modelling framework to develop its forecasts. E4 cast is a dynamic partial equilibrium model of the Australian energy sector that approximates the principal interdependencies between energy production, conversion and consumption. The model covers the six states and Northern Territory (with the Australian Capital Territory included in NSW), the demand for 17 end-use fuels across 20 end-use and seven conversion sectors. All major industries are covered with energy-intensive industries modelled explicitly,

including lump capacity additions. The transport division is presented in a detailed manner with analysis of all major transport modes.

ABARE's model assumes that Australia will experience an average economic growth of 3.3% in the period from 2001/02 to 2019/20<sup>7</sup>. Demand growth rates for energy-intensive products have separate assumptions: reduced iron (11.0% annual production growth), other iron and steel (2.8%), primary aluminium (2.2%) and alumina (1.7%). All policies that are currently in place are assumed to continue but no assumptions are made on new policies that will likely be put in place.

## RESULTS

The key findings of ABARE's forecast are as follows:

- Primary energy consumption in Australia will grow on average by 2.2% per year through 2019/20. Growth from 2001/02 to 2008/09 will be stronger at 2.5% annually.
- Economic output is the most critical determinant of longer-term energy consumption trends.
- Coal and oil will continue to meet the bulk of Australian energy needs, accounting for more than 70% of TPES in 2019/20.
- Gross electricity generation will increase by more than 50% to 2019/20.
- Liquefied natural gas (LNG) exports are projected to increase fourfold to 35 Mt in 2019/20, accounting for more than 50% of Australian gas production.
- Coal exports will increase from less than 200 million tonnes to 291 Mt.
- While Australia will continue to be a net energy exporter, reliance on imported oil and petroleum products will increase from 17% in 2001/02 to 46% by 2019/20.
- New investment required in the energy sector to 2019/20 is estimated to be AUD 30 to 35 billion, of which around AUD 11 billion will go to the electricity sector.
- Emissions of CO<sub>2</sub> are expected to grow by nearly 40% from 2001/02 to 2019/20<sup>8</sup>.

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7. Australia denotes years according to the fiscal year that runs from 1 July to 30 June. So, the nomenclature 2018/19 refers to the 12-month period from 1 July 2018 to 30 June 2019.

8. While no comparable data on CO<sub>2</sub> emissions are available for 1990 using the same methodology (as thus showing the implications for the Kyoto target), IEA statistics indicate that CO<sub>2</sub> emissions from fuel combustion grew by 32% from 1990 to 2002. Australia is still on target to meet its Kyoto objectives through reduction in the emission of other greenhouse gases (GHG). This issue is explored more fully in Chapter 4.

Table 1

## Primary Energy Supply by Fuel

	Supply, PJ			Growth rates, %	
	2001/02	2009/10	2019/20	2001/02 to 2008/09	2001/02 to 2019/20
Black coal	1 472	1 641	2 027	1.6	1.8
Brown coal	665	695	771	0.6	0.8
Oil	1 757	1 990	2 515	1.8	2.0
Natural gas	951	1 320	1 828	4.8	3.7
Renewables	238	387	403	7.2	3.0
Hydro	57	62	64	1.3	0.6
Biomass	170	281	292	7.5	3.1
Biogas	7	31	28	22.8	7.6
Wind	1	9	15	35.3	15.9
Solar	3	3	4	2.6	2.6
<b>Total</b>	<b>5 084</b>	<b>6 032</b>	<b>7 544</b>	<b>2.5</b>	<b>2.2</b>

Source: "Australian Energy National and State Projections to 2019-2020".

Table 2

## Final Energy Consumption by Sector

	Supply, PJ			Growth rates, %	
	2001/02	2009/09	2019/20	2001/02 to 2008/09	2001/02 to 2019/20
Agriculture	85	93	110	1.3	1.4
Mining	161	226	396	5.0	5.1
Manufacturing and construction	919	1 126	1 350	2.9	2.2
Transport	1 272	1 454	1 833	1.9	2.0
Commercial	238	290	403	2.9	3.0
Residential	393	443	548	1.7	1.9
Other	64	67	74	0.7	0.8
<b>Total</b>	<b>3 132</b>	<b>3 699</b>	<b>4 714</b>	<b>2.4</b>	<b>2.3</b>

Source: "Australian Energy National and State Projections to 2019-2020".

Table 3

CO<sub>2</sub> Emissions by Sector, Mt

	Electricity generation	Transport	Manufacturing	Other	Total	% increase from 2001/02
2001/02	190.3	84.9	53.9	28.6	357.7	
2004/05	193.6	89.6	57.2	31.5	371.9	4.0
2007/08	202.3	95.0	63.5	36.2	397.0	11.0
2010/11	209.8	101.2	68.7	41.4	421.1	17.7
2013/14	219.1	107.7	72.2	46.1	445.1	24.4
2016/17	229.7	114.7	75.4	51.0	470.8	31.6
2019/20	241.7	122.3	78.4	55.7	498.1	39.3

Source: "Australian Energy National and State Projections to 2019-2020".

# ENERGY TAXATION

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Australian energy taxation is divided into taxes on production and taxes on conversion and consumption. In general, the former taxes are referred to as upstream while the latter are referred to as downstream.

## UPSTREAM TAXATION

Federal taxation arrangements on petroleum production include:

- Petroleum resource rent tax (PRRT) on all offshore petroleum production with the exception of the North West Shelf project.
- Production excise on stabilised crude oil from the North West Shelf and onshore areas.
- Royalty on the production of petroleum from the North West Shelf.

The states and territories also impose royalties on petroleum production from areas within their jurisdictions.

### Jurisdictional Provisions

The legal framework within which petroleum taxation applies in Australia results from the division of responsibilities between the Commonwealth and states/territories under the Constitution and the 1979 Offshore Constitutional Settlement (OCS). Responsibility for Australia's offshore areas beyond three nautical miles from the territorial sea baseline rests with the Commonwealth, whereas all sea and land within this boundary, onshore, coastal waters and internal waters, is within the jurisdiction of the relevant state or territory government. As a result of this legislative framework, differing tax regimes exist for projects depending upon their geographic location.

- **Offshore:** Projects located outside the three nautical mile sea coastal waters zone are wholly covered by Commonwealth legislation and are subject to either petroleum resource rent tax (PRRT) or crude oil excise and royalty pertaining to North West Shelf projects as explained above. PRRT and excise revenues are retained wholly by the Commonwealth, while royalty from the North West Shelf project is shared with Western Australia.
- **Onshore:** This category refers to all production sourced from mainland Australia and includes the region from the low water mark in the respective state or territory to the three nautical mile baseline boundary (coastal waters). Production sourced from this region is subject to state royalty and Commonwealth crude oil excise, with the royalties collected from coastal waters being shared between the relevant state and the Commonwealth. Within Western Australian internal waters, royalties from certain licences (derived from pre-1979 leases) are shared with the Commonwealth.

## **Petroleum Resource Rent Tax (PRRT)**

The PRRT is a secondary tax based on a project's profitability. It is assessed on a project basis and is levied at a rate of 40% of net project revenues after exploration and development costs have been deducted. PRRT payments are deductible for company tax purposes. Undeducted exploration and general project expenditures are uplifted at various rates. Undeducted exploration expenditure incurred in PRRT liable waters is transferable to any PRRT liable projects, which have a notional taxable profit and are held by the same entity.

## **Excise on Stabilised Crude Oil Production**

Excise arrangements apply to eligible crude oil production from the North West Shelf project area. Excise is levied on the volume weighted average of realised (VOLWARE) f.o.b. price of all sales made in a producing region, at rates based on the timing of the discovery and/or the date of development as described below.

- "Old" oil (crude discovered before 18 September 1975) is excised on a progressive scale with a top marginal rate of 55% of the VOLWARE price.
- "Intermediate" oil (crude discovered before 18 September 1975 but not developed prior to 23 October 1984) is excised on a separate progressive scale with a top marginal rate of 55%.
- "New" oil (crude discovered after 18 September 1975) is excised on a progressive scale with a top marginal excise rate of 30%.

## **Petroleum Royalty**

Royalty is payable to the Commonwealth on the value of all petroleum (including gas) production from the North West Shelf project area and is shared with Western Australia as prescribed by Section 129 of the Petroleum (Submerged Lands) Act 1967 (PSLA). The royalty is levied as a percentage of the wellhead value calculated by subtracting excise, allowances for post-wellhead capital assets and depreciation, and operating costs such as processing and transportation, from sales receipts. The royalty rate for the North West Shelf is set at 10% of the wellhead value for primary production licences and 12.5% for secondary production licences.

The Commonwealth does not in general receive a share of onshore royalty receipts. However, in accordance with the 1979 OCS, the Commonwealth receives four percentage points of the royalties levied by the state or territory from production licences located in the coastal waters region. In addition, royalties from those production licences in Western Australia (WA) internal waters, derived from pre-1979 exploration leases, are also shared with the Commonwealth, with the Commonwealth receiving four percentage points.

## **Resource Rent Royalty (RRR)**

Under the Petroleum Revenue Act 1985, Commonwealth excise and state royalty may be waived where a state introduces an RRR on petroleum developments within its jurisdiction and where a revenue-sharing agreement is made between the state and the Commonwealth. RRR currently applies only to production from Barrow Island, Western Australia.

## **DOWNSTREAM TAXATION**

### **Goods and Services Tax (GST)**

Almost all Australian transactions are subject to the Goods and Services Tax (GST). The GST is comparable to what many countries refer to as a value-added tax (VAT) in that, while it is charged at each stage of production and distribution, payments of GST are in effect passed on to the ultimate consumer of the final product. Since its introduction on 1 July 2002, GST has been applied at a rate of 10%. It is applicable to sales of nearly all final energy products such as liquid fuels, natural gas and electricity.

### **Liquid Fuel Excise Taxes**

In addition to the GST, the other major downstream energy taxes are excise taxes on liquid fuels used in vehicles. As a general rule, all motor fuels face an excise tax of AUD 0.38143 per litre of fuel. There are, however, a number of exemptions. Liquefied petroleum gas (LPG) receives a complete exemption from the excise tax. In addition, biofuels (including both ethanol and biodiesel) receive production grants of AUD 0.38143 per litre of fuel. Since this is the exact amount of the excise tax itself, they are in effect fully exempted. This credit was introduced on 18 September 2002 for ethanol and on 18 September 2003 for biodiesel and will run through to 30 June 2011.

The federal government's June 2004 White Paper proposed a major reform of the excise tax system. The measures will remove around AUD 100 million in excise taxes from businesses and households in 2006/07, AUD 350 million in 2008/09 and AUD 310 million by 2012/13, totalling about AUD 1.5 billion over the whole period.

An excise credit will be available for all off-road business use of all fuel. The measure will be phased in, with new eligible off-road activities receiving a half credit from 1 July 2008 to 30 June 2012, and the full credit from 1 July 2012. The changes will provide excise relief to businesses involved in a range of activities (*e.g.* manufacturing, quarrying for cement, road-building materials and building stones, and construction). Other major beneficiaries include primary producers, mining and commercial power generation. Current fuel credit recipients (*e.g.* recipients in the farming and mining sectors who are the main beneficiaries of the current arrangements) will also benefit from the extension of excise relief to currently ineligible activities.

The excise system reform will focus primarily on business use of fuel in on-road applications in vehicles with a gross vehicle mass of less than 4.5 tonnes and private use of fuel in vehicles and certain off-road applications, meaning other fuel uses will be effectively free of excise. Consistent with this, diesel used in commercial power generation will be effectively excise-free from 1 July 2006. Gaseous fuels used for electricity generation will continue to be free of excise. This is intended to ensure competitive neutrality between all fuels used to generate electricity for business and household use. The current 7.557 cents per litre excise applying to burner fuels (heating oil, kerosene, fuel oil) used as a fuel but not in a vehicle, will be removed from 1 July 2006. This change will lower heating costs for as many as 90 000 households, a large number of which will be in regional and rural areas.

The preferential treatment given to alternative fuels such as biofuels and LPG will be decreased. From 1 July 2011, excise tax exemptions will be phased out in five equal steps to alternative fuels to a final rate of AUD 0.125 per litre for LPG and ethanol and AUD 0.191 per litre for biodiesel. While these discounts are dissimilar on a volume basis, they are intended to be equivalent on an energy basis. These final rates will apply from 1 July 2015 and will represent a 50% discount on the full energy content rate. The table below shows the proposed excise taxes when all of the White Paper proposals have been implemented.

Table 4

### Excise Taxes Following Full Implementation of White Paper Reforms

<i>Fuel type</i>	<i>Energy content (MJ/l)</i>	<i>Excise rate (AUD cents/l)</i>	<i>Discount (AUD cents/l)</i>
High energy-content fuels: petrol, diesel, biodiesel	Above 30	38.143	19.1 (biodiesel)
Mid energy-content fuels: LPG, ethanol	Between 20 and 30	25.0	12.5 (for all fuels)
Low energy-content fuels: methanol	Below 20	17.0	8.5 (methanol)
Other: compressed natural gas	Between 38 and 41 MJ/cubic metre	38.0 (cents/cubic metre)	19.0 (cents/cubic metre)

Source: Energy White Paper.

## CRITIQUE

Australian energy developments and energy policy are largely driven by the country's unique circumstances. As the IEA's third-largest country, Australia has by far the lowest population density. It has no land boundaries and is at a substantial distance from its major trading partners. As one of only five IEA

countries that are net energy exporters<sup>9</sup>, Australia has vast energy resources in coal, gas and uranium with significant though declining oil resources.

Australian energy policy has been largely successful in many important areas. The country has some of the cheapest energy prices in the world, it has a high level of energy security as well as contributing to global security through exports, and it has benefited enormously from the exploitation of its domestic fuel reserves. Its coal, oil and gas industries employ 120 000 people and provide AUD 24 billion in export revenues annually, or more than 20% of the country's entire export revenue.

Another successful aspect of the country's energy policy is its forward-thinking impetus towards reform that often takes place even in the absence of external pressures or emergency situations. Australia was a pioneer in energy market reform and has created one of the most transparent, open and competitive electricity markets in the world. Not content with this level of progress, the country has initiated a second reform to create gas and electricity markets with more of a national scope. The programme includes reforms to market governance, economic regulation, electricity transmission, gas markets and user participation. The new programme, to be implemented from 2003 to 2006, aims at creating a national energy market and improving consistency and clarity. A new single regulator, the AER, will replace the current eight gas regulators and 13 electricity regulators, and a new body, the AEMC, will be responsible for market design and rule-making. This move to a more nationally focused market is helpful to minimise regulatory overlap and ease the burden of companies wishing to work in multiple states. It may be particularly useful for the gas sector since it currently lags the electricity sector in its level of reform.

The federal government's White Paper on energy policy, "Securing Australia's Energy Future" outlines a strategy for the next decade and beyond. The White Paper is a commendable strategy document, both in terms of the process leading up to building national consensus and its challenging content. It creates a framework for energy policy-making that did not exist four years ago and can be considered an important improvement. While the White Paper does not introduce substantially new ideas for important policy changes, it does address all aspects of the energy sector, including energy market reform, resources development, energy efficiency, renewables and technology. While implementation of concrete policies based on the White Paper remains to be seen, such a comprehensive document that lays out a policy framework in a transparent manner gives a degree of comfort to all stakeholders and allows them to pursue their interests without worrying about near-term policy changes.

Australian energy security is both aided and hindered by the country's natural circumstances. The tremendous natural resources boost security with hundreds

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9. Australia, Norway, Denmark, the United Kingdom and Canada.



of years of coal production, extensive gas reserves and substantial albeit declining oil production. However, the country's location, its sparse population and absence of land boundaries give rise to added difficulties. On balance, however, these factors benefit the country in terms of security. While it is clear that energy security is a concern, as evidenced by the title of the White Paper, "Securing Australia's Energy Future", Australian energy security is generally quite sound. The distinction made in the White Paper between longer-term threats to security of supply, particularly the need to attract sufficient investment, and shorter-term threats such as supply disruptions is sound. Both the biennial review of energy security and the work of the Energy Infrastructure Assurance Advisory Group (the Energy Group) will be helpful tools in maintaining the country's energy security. The White Paper's observation that undue government involvement that overrides market forces will rarely improve security in the long term is consistent with the experiences of many IEA countries. Instead of viewing energy security as being a trade-off with market competition, the Australian government wisely establishes ways in which market efficiency and motivations can be used to enhance energy security. The only concern in this area is to ensure that, given the disaggregation resulting from market liberalisation, all actors can communicate well with one another, especially in times of crisis.

In contrast to its impressive economic efficiency and sound energy security, environmental sustainability is Australia's single biggest energy policy challenge. The issues related to environmental sustainability have not garnered as much attention in Australia as they have in other IEA countries. This is explained by a number of factors, namely Australia's large supply of domestic fuels; the economic and employment benefits related to exploitation of high carbon-content fuels; the boost to economic competitiveness from inexpensive energy; and a large land mass and dispersed population which mitigates local pollution. Nevertheless, a greater focus on environmental and sustainability issues represents an opportunity for Australia and, increasingly, a necessity. Two promising means of approaching environmental sustainability are: *i)* enhanced energy efficiency efforts and *ii)* a framework for creating a carbon price signal.

Australia's vast, reliable and inexpensive fuel resources have been a substantial factor in the country's economic growth. They have also led to a supply-side approach to energy rather than a demand-side approach and partly as a result, Australia has one of the highest energy intensities in the IEA. Australian TPES grew by 2.4% annually since 1970 while the IEA countries on average saw a 1.5% annual growth in TPES. Projections by ABARE forecast continued high energy demand growth well above IEA averages. Because of its abundant domestic energy resources, the country has had no apparent motive to pursue efficiency ambitiously and has had less experience in these areas than other IEA countries. Nevertheless, the advantages of greater demand-side attention are relevant to all aspects of the

Australian energy sector and should therefore be seen as a major opportunity across the board. The use of demand-side options to address energy questions could, in many cases, provide more attractive solutions than on the supply side. Benefits of greater efficiency would include, but are not limited to, reduced GHG and other emissions; increased energy security; improved productivity and hence competitiveness; greater economic efficiency in meeting peak needs that the market does not price well; reduced need for network and infrastructure expansion through suppressed demand and hence the ability to take advantage of more advanced technology; and greater macroeconomic resilience to international fuel price volatility, particularly in the oil markets. Some of these benefits can be captured efficiently by the market economy and there, the government's role would be to eliminate any market barriers to efficiency. In other cases, the market is not the best tool to achieve the efficiency improvements that would result in the associated benefits and thus government could have a more active role there. All of the benefits of greater efficiency, and the means to realise them, are explored further in Chapter 5.

## RECOMMENDATIONS

*The government of Australia should:*

- ▶ *Maintain the momentum of the collective government effort demonstrated in producing the White Paper in order to ensure a timely implementation on all levels of the measures and initiatives announced in the White Paper.*
- ▶ *Strengthen the efforts towards creating a National Energy Market, particularly in the gas sector, with the establishment of a national energy regulator (AER). This becomes more important if a carbon price signal is created that will enhance the demand for gas.*
- ▶ *Implement the plan to undertake biennial energy security reviews and continue the work of the Energy Group to maintain energy security; ensure that this work is widely discussed by all the relevant players of government and industry, particularly in light of guaranteeing security in the reformed market sectors.*
- ▶ *Consider stepping up demand-side energy policies to curb growth in energy demand by outlining an ambitious national energy efficiency strategy in order to approach best practices in other IEA countries.*
- ▶ *Look for new opportunities in climate change mitigation policy responding to evolving international and domestic circumstances through further development of the national climate change strategy engaging key stakeholders, in particular industry and state/territorial governments.*



## CLIMATE CHANGE

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In 2002, Australia represented about 1.5% of global greenhouse gas (GHG) emissions. Australia was a signatory to the Kyoto Protocol in 1998, under which the country was given a target to limit its GHG emissions to 108% of the 1990 level in the years 2008 to 2012. However, Australia has not yet ratified the Protocol and the government has stated that it will not do so arguing that, to be effective, action needs to include all major emitters. It points out that 70% of global emissions are not covered by emissions commitments under the Kyoto Protocol, that developing countries have no obligations under the Protocol and that the United States, the world's largest GHG emitter, has not ratified. Without ratification, the country has no binding commitment to limit emissions, but has committed itself to meeting their Kyoto target of 108% of its 1990 levels. Based on the most recent projections of GHG emissions released in December 2004, Australia is currently on track to meet its Kyoto target.

The federal government has stated its concern about the accumulation of GHG in the atmosphere and its commitment to reduce Australian emissions to meet the Kyoto target as part of a worldwide effort to address climate change. From the country's submission to the IEA, the federal government states that, "In recognition of the importance of reducing GHG emissions, the Australian government will ensure that Australia carries its fair share of the burden in global efforts to combat climate change through policy development and implementation."

## DOMESTIC EMISSIONS PROFILE

In 2003, Australia emitted 347.1 Mt of CO<sub>2</sub> from fuel combustion. This represented a 0.1% increase from 2002 and a 33.7% increase from 1990<sup>10</sup>. Coal accounted for the majority of the 2003 emissions with 54.8% of the total, followed by oil products (30.6%), natural gas (14.6%) and other (0.2%). The historical progression of emissions by fuel is shown in Figure 6.

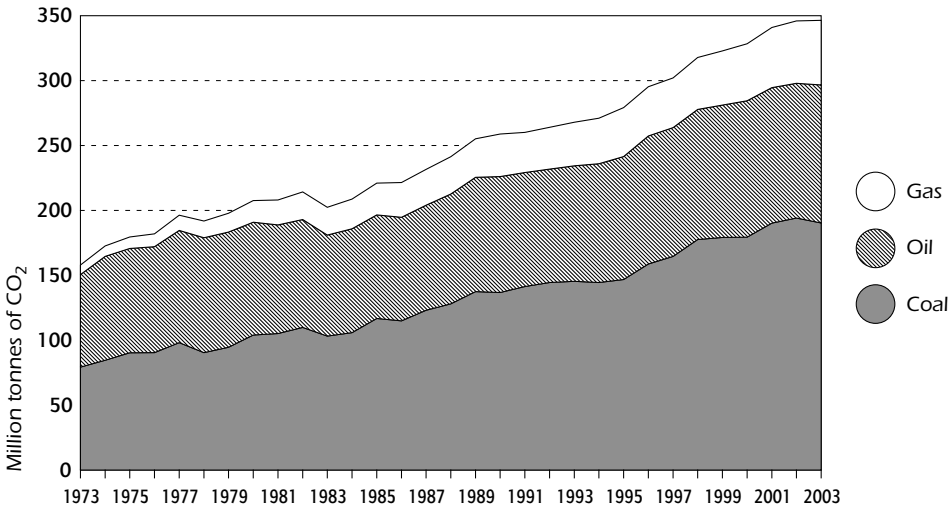
On a sectoral basis, the electricity and heat production accounts for the largest share of CO<sub>2</sub> emissions, in 2003 equal to 55% of the total. Transport was the second-most important sector with 22% of the total, followed by industry (11%), other energy industries (5%) and unallocated autoproducers of electricity and heat (2.5%).

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10. All figures come from IEA statistics unless otherwise indicated. It should be noted that emissions from fuel combustion are only part of the emissions profile for Australia. When other sectors are included, and using Kyoto accounting methods, Australia's total GHG emissions have increased by 1.3% between 1990 and 2002.

Figure 6

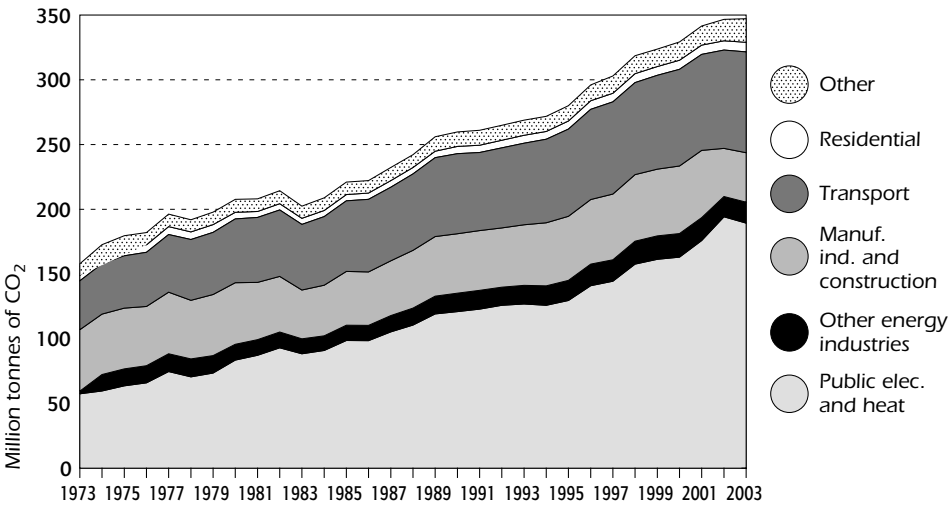
### CO<sub>2</sub> Emissions by Fuel\*, 1973 to 2003



\* estimated using the IPCC Sectoral Approach.  
Source: *CO<sub>2</sub> Emissions from Fuel Combustion*, IEA/OECD Paris, 2005.

Figure 7

### CO<sub>2</sub> Emissions by Sector\*, 1973 to 2003



\* estimated using the IPCC Sectoral Approach.  
Source: *CO<sub>2</sub> Emissions from Fuel Combustion*, IEA/OECD Paris, 2005.

A government analysis of the make-up of Australian GHG emissions by gas is shown in Table 5.

Table **5**  
**Emissions of Greenhouse Gases, 2002**

<i>Greenhouse gas</i>	<i>Mt CO<sub>2</sub>-eq</i>	<i>% of total</i>
CO <sub>2</sub>	384.6	69.9
CH <sub>4</sub>	122.6	22.3
N <sub>2</sub> O	34.9	6.3
PFCs and SF <sub>6</sub>	0.3	0.1
Other <sup>(1)</sup>	7.7	1.4
<b>Total</b>	<b>550.1</b>	<b>100.0%</b>

<sup>(1)</sup> Includes confidential data on nitric acid, ammonia and magnesium production, and soda ash production and use.

Source: National Greenhouse Gas Inventory, 2002.

Table 6 shows the evolution by sector from 1990 through 2002 of all the GHG combined. Using the Kyoto accounting rules as a basis for analysis, the largest percentage increases in emissions were in the stationary energy (34.0%), transport (27.7%), agriculture (11.0%) and waste (15.0%) sectors. Smaller increases occurred in the fugitive and industrial process sectors. Emissions from land use and forestry decreased by 75.7%. Net land use change and forestry emissions decreased by nearly 56% between 1990 and 2000.

Table **6**  
**Australian Greenhouse Gas Emissions by Sector, Mt CO<sub>2</sub>-eq.**

<i>Sector</i>	<i>1990</i>	<i>2002</i>	<i>Emission change</i>	<i>% change from 1990 to 2002</i>
Energy	286.3	371.3	85.0	29.7
<i>Stationary</i>	195.5	261.9	66.4	34.0
<i>Transport</i>	62.0	79.2	17.2	27.7
<i>Fugitive</i>	28.8	30.2	1.4	4.9
Industrial processes	26.1	26.4	0.3	1.1
Agriculture	95.1	105.6	10.5	11.0
Land-use and forestry	120.4	29.2	(91.2)	(75.7)
Waste	15.3	17.6	2.3	15.0
<b>Total emissions</b>	<b>543.1</b>	<b>550.1</b>	<b>7.0</b>	<b>1.3</b>

Source: Australian 3<sup>rd</sup> National Communication to UNFCCC

Energy-related emissions intensity – emissions per unit of GDP – declined by 8% from 1990 to 2002 owing to an increase in the efficiency of energy use, fuel substitution and changes in the structure of the economy. While the

figure is still higher than the IEA average, this is because of a number of factors, including the differences in energy resource bases (Australia has large resources of coal, few hydro resources and no nuclear energy), high energy intensity, which results in part from the presence of numerous energy-intensive industries and large distances between major cities.

## AUSTRALIAN EMISSIONS IN CONTEXT

It is important, however, to put this emissions growth in context. Australia accounts for 1.5% of global GHG emissions. Figure 8 shows the relative growth in GHG emissions from countries included in Annex I to the United Nations Framework Convention on Climate Change (UNFCCC). Australia's emissions growth was about 22% over this period and was surpassed by only four other IEA countries. This result was due in large part to strong economic growth over this period, with Australia recording an average economic growth of around 3.3% per year compared to the OECD average of 2.5% per year. It must be noted that the 22% figure and the emissions growth figures for the other countries in Figure 8 represent gross rather than net emissions. And thus the offsets Australia has from changes in land-use are not accounted for. With the inclusion of land-use change and forestry, Australia's total GHG emissions has only increased by 1.3% over the period 1990 to 2002.

Another way to see the Australian emissions profile in context is to look at CO<sub>2</sub> indicators in comparison to the other large IEA countries. With respect to indicators of CO<sub>2</sub> per unit of energy, GNP or population, these larger countries all have similar numbers, which tend to be substantially above the IEA average.

Table 7

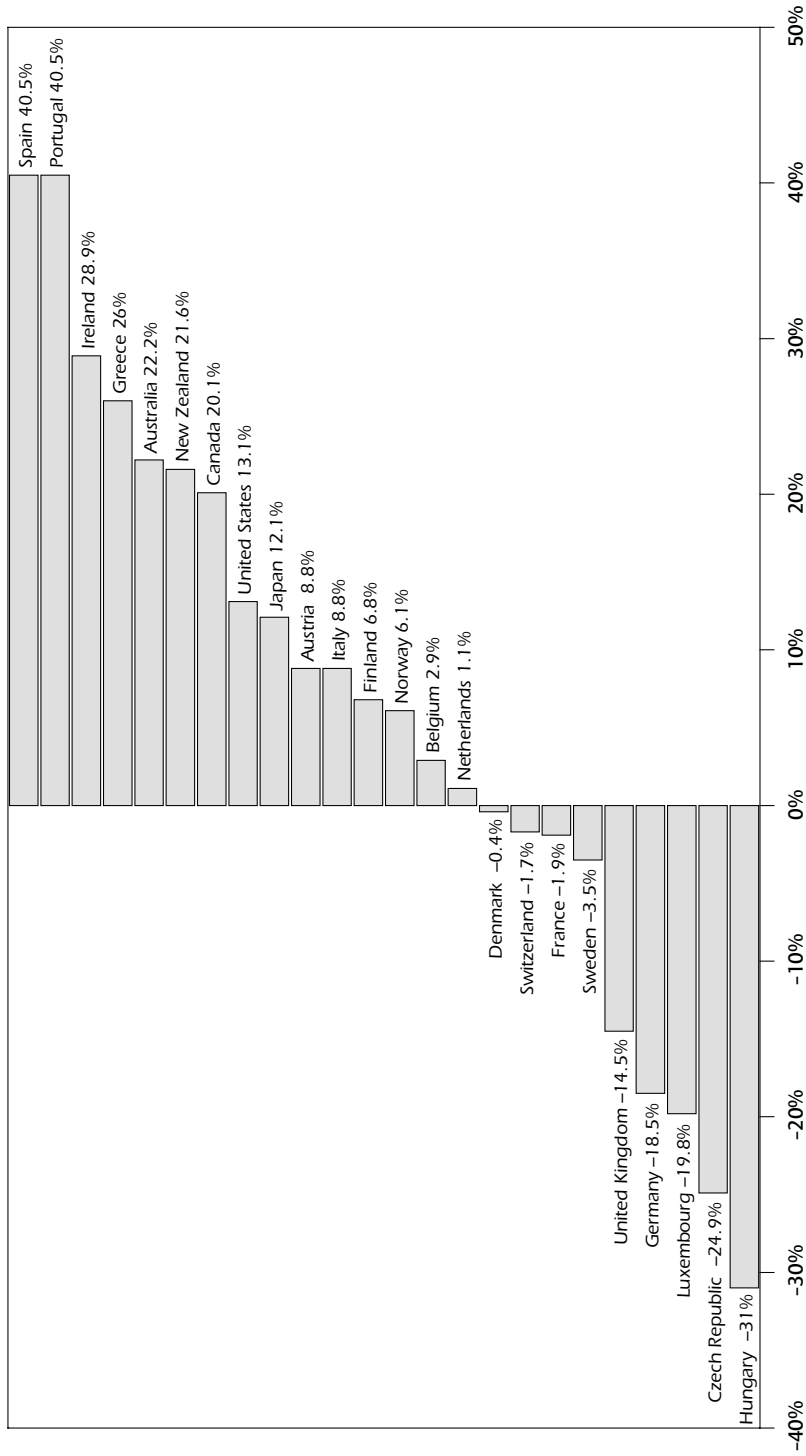
### Comparison of Emission Intensity Parameters

	2001				2002			
	IEA total	United States	Canada	Australia	IEA total	United States	Canada	Australia
CO <sub>2</sub> Sectoral Approach (Mt of CO <sub>2</sub> )	10 335	4 843	430	260	11 866	5 652	532	343
CO <sub>2</sub> /TPES (t CO <sub>2</sub> per TJ)	57.7	60.0	49.1	70.9	55.8	58.9	50.8	72.7
CO <sub>2</sub> /GDP (kg CO <sub>2</sub> per 1995 USD)	0.48	0.74	0.81	0.82	0.43	0.61	0.71	0.71
CO <sub>2</sub> /GDP (kg CO <sub>2</sub> per 1995 USD PPP)	0.57	0.74	0.72	0.80	0.49	0.61	0.63	0.70
CO <sub>2</sub> /population (t CO <sub>2</sub> per capita)	11.2	19.4	15.5	15.1	11.9	19.7	16.9	17.4

Source: CO<sub>2</sub> Emissions from Fuel Combustion, 1971-2002, IEA.

Figure 8

Total Aggregate GHG Emissions of Individual IEA Annex I Parties, 1990 to 2002



Sources: UNFCCC.



## GREENHOUSE GAS EMISSIONS PROJECTIONS

In December 2004, the Australian Greenhouse Office released "Tracking Kyoto 2004, Australia's Greenhouse Emissions Trends". Included in the report was a projection of Australian GHG emissions by sector, as shown in Table 8. This report indicated that Australia is on track to achieve its target of limiting GHG emissions to 108% of 1990 emissions over the period 2008-2012, as agreed at Kyoto.

Table 8

### Australian Greenhouse Gas Emissions by Sector, Mt CO<sub>2</sub>-eq

<i>Sector</i>	<i>1990</i>	<i>2008-12 BAU</i>	<i>2008-12 with measures enacted</i>	<i>% change in emissions (1990-2010) with measures enacted</i>
Energy	286	455	407	+ 43%
<i>Stationary</i>	195	322	285	+ 46%
<i>Transport</i>	61	91	87	+ 42%
<i>Fugitive</i>	29	42	35	+ 23%
Agriculture	93	105	42	+ 12%
Waste	15	25	15	- 1%
Industrial processes	27	51	42	+ 53%
Land-use and forestry	120	43	18	- 85%
<b>Total emissions</b>	<b>542</b>	<b>679</b>	<b>586</b>	<b>+ 8%</b>

BAU: business-as-usual.

Source: "Tracking Kyoto 2004, Australia's Greenhouse Emissions Trends", Australian Greenhouse Office, December 2004.

## NATIONAL CLIMATE POLICY

The lead for climate policy development in Australia rests with the Australian Greenhouse Office, which was established in 1998. While previously a federal government-wide office, it has recently been placed within the Department of Environment and Heritage (DEH), although it retains its lead functions within government. The government has committed over AUD 1.8 billion towards its climate change strategy as part of the 2004 Budget and Energy White Paper. Over AUD 700 million in new funding has been directed towards low-emission technologies.

The White Paper announced a number of measures to support industry to reduce its GHG emissions in the longer term. These measures are intended to increase business investment in low-emission technologies.

Key elements of the strategy include:

- AUD 500 million fund to support development of low-emission technologies, including renewable and fossil fuel technologies, for the longer term.

- AUD 100 million to support the development of renewable energy technologies.
- AUD 75 million to fund working demonstrations of sustainable energy systems through "Solar Cities".
- AUD 34 million to facilitate use of renewable energy through improved storage for intermittent generation and better wind forecasting.
- The Mandatory Renewable Energy Target (MRET), which is providing incentives for over AUD 2 billion in investment.
- Mandatory reporting of emissions and energy efficiency opportunities by Australia's largest energy users.
- Requirements for companies receiving more than AUD 3 million in fuel excise credits and proponents of large energy projects to join the Australian government's successful Greenhouse Challenge Program.
- New standards for heavy diesel trucks to ensure they meet criteria designed to show they are not heavy polluters.

The National Greenhouse Strategy was developed by federal, state and territory governments and launched in 1998. There are a variety of individual measures that are included in the strategy. They apply across eight sectors and "reflect the full range of policy approaches, from voluntary action and strategic investment to regulation and market measures."<sup>11</sup>

The goals of these policies and measures are to:

- Foster knowledge and understanding of greenhouse issues.
- Limit GHG emissions.
- Lay the foundations for adaptation to climate change.

The various programmes include those to promote energy efficiency, development and uptake of lower-emission technologies, reductions in transport emissions, and non-energy abatement. The Commonwealth government estimates that abatement measures already taken through partnerships with government, industry and the broader Australian community are expected to deliver an annual emissions abatement of some 94 Mt by 2008–2012, which is the equivalent of taking all of Australia's cars, trucks and buses off the road. Without these measures, GHG emissions were projected to be 125% of 1990 levels by 2008–2012. The partnerships include the following:

- The Greenhouse Challenge, a joint voluntary initiative between the Commonwealth and industry with over 700 members.

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11. White Paper.

- The Greenhouse Gas Abatement Program (GGAP), which is a major Commonwealth government initiative to assist in meeting its Kyoto Protocol target. The objective of GGAP is to reduce Australia's net GHG emissions by supporting activities that are likely to result in substantial emissions reductions or substantial sink enhancement, particularly in the first commitment period under the Kyoto Protocol (2008-2012). As of 2003, AUD 400 million had been allocated to the programme.
- Cities for Climate Protection™ (CCP™) Australia is a programme which assists local governments and their communities in reducing GHG emissions. The programme is funded through a commitment of AUD 13 million over five years.

The development and promotion of technology is the major thrust of the federal government's climate change strategy. The government has established a AUD 500 million Low-Emission Technology Development Fund to support industry-led projects that demonstrate low-emission technologies. To be considered in this programme, technologies must have the potential to lower Australia's emissions by at least 2% in the long term at a realistic uptake rate, and be commercially available by 2020 to 2030. The fund is designed to facilitate private-sector investment of at least AUD 1 billion.

Another important initiative that could reduce GHG emissions involves energy efficiency. The supply side of the energy equation has traditionally received more attention than the demand side and this, along with cheap, easily available energy sources, have made Australian energy intensity substantially above the IEA average. The energy White Paper targets the many potential benefits from improved energy efficiency and launches a number of programmes to achieve this potential. (More information is available in Chapter 5.)

Renewable energies can also curtail GHG emissions and the government has instituted a successful renewables certificates programme. This programme, the Mandatory Renewable Energy Target (MRET), is a tradable certificates scheme intended to increase electricity generation from renewable sources by 9 500 GWh in 2010, maintained to 2020. It has thus far resulted in renewable capacity investments of over AUD 1 billion. Another programme is designed to support earlier-stage and smaller-scale renewable energy technology development projects. This programme provides AUD 100 million over seven years for competitive grants to promote the strategic development of renewable energy technologies, systems and processes that have strong commercial potential. This programme, which will include AUD 50 million from the existing Commercial Ready programme, will continue support for innovative companies and technologies. (More information is available in Chapter 6.)

In the energy White Paper, the federal government opted not to pursue a carbon emissions trading scheme. The government believes that in the absence of a truly internationally agreed regime covering all major emitters,

and given that Australia is on track to meet its Kyoto 108% target, it would be premature to impose significant economy-wide costs to meet a specific long-term target, such as through an emissions trading regime.

## STATE AND TERRITORY EMISSIONS TRADING ACTIVITY

State governments are also taking action to reduce emissions and, in the absence of a federal government scheme, are investigating a possible state-based emissions trading scheme. The state and territory governments have established a working group to develop the parameters of a multi-jurisdictional emissions trading scheme to be considered. Their first report (December 2004) outlined some of the components of such a scheme:

- A cap and trade approach.
- The scheme would be national and sector-based.
- In setting the cap, consideration given to the overall national emissions abatement target, and how the abatement responsibility is allocated between sectors covered by the scheme and those outside the scheme.
- The scheme initially to cover the stationary energy sector (including electricity, gas and coal).
- The scheme to cover all six GHGs under the Kyoto Protocol.
- A penalty should be set to encourage compliance and to establish a price ceiling for the permit market.

On 31 March 2005, the Premiers and chief ministers of all of Australia's states and territories released a joint communiqué, which displayed their further interest in developing such a national emissions trading scheme. The working group will continue its work with analysis of:

- Costs of compliance.
- Impacts on specific industries (*e.g.* energy-intensive and trade exposed) and structural adjustment issues.
- Regional impacts of the scheme, and associated labour market issues.
- Impacts on consumer energy prices and small business.
- Macroeconomic impacts such as economic growth, employment, investment and inflation.

The working group is expected to report back on these questions in the second half of 2005 with a public discussion paper to be released later in 2005.

## OTHER ENERGY AND ENVIRONMENT ISSUES

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Australian sulphur oxide (SO<sub>x</sub>) and nitrogen oxide (NO<sub>x</sub>) emissions intensities are among the highest in the OECD. In 2002, the Australian SO<sub>x</sub> emission intensity was the highest in the OECD at 5.3 kg per USD 1 000 of GDP, or more than four times the OECD average. The Australian NO<sub>x</sub> emission intensity was the second-highest in the OECD (after Iceland) with 3.2 kg per USD 1 000 of GDP, or more than twice the OECD average.

Australian emissions of conventional air pollutants are all, however, on a downward trend despite vigorous economic growth over the last decade. There are national ambient air quality standards for carbon monoxide, nitrogen dioxide, sulphur dioxide, photochemical oxidants, particulates and lead. Several measures have been taken since the last review, including fuel standards, guidelines for vehicle efficiency, etc. It appears that Australian standards are somewhat behind best national practices in the OECD region, but goals for petrol standards, for example, are expected to reach equivalent levels around the end of the decade, assuming no change in the stringency of standards currently planned in best practice countries.

The OECD Environment Performance Review recently concluded that: "Urban air quality has improved over the past ten years as a result of both air pollution management (characterised by voluntary approaches and the case-by-case method of licensing stationary sources) and structural changes such as the increased use of natural gas. The introduction of three-way catalytic converters in new vehicles in 1986 helped reduce emissions of NO<sub>x</sub>, volatile organic compounds (VOCs) and carbon monoxide (CO). Recent reductions in airborne emissions of lead represent another achievement for Australia's air management policy, and one that can be considered exemplary in terms of co-operation among different levels of government, industry and the public."

While standards are somewhat below international best practice, Australian air quality is generally above levels found in other parts of the OECD region. This reflects the lower population density, favourable climatic conditions and topological conditions of its major cities. However, within the last decade or so, some cities have experienced adverse air quality episodes particularly associated with non-energy-related sources (*e.g.* bushfires, dust storms). Regional authorities and the national government have responded to these events by tightening regulations and taking other initiatives to avoid worsening air quality.

Australia's principal means for reducing sulphur emissions is fuel quality standards. The Fuel Quality Standards Act provides a legislative framework for setting national fuel quality and fuel quality information standards for Australia. The objectives of this act are to:

- Reduce the level of pollutants and emissions arising from the use of fuel that may cause environmental and health problems.
- Facilitate the adoption of better engine technology and emission control technology.
- Allow the more effective operation of engines.
- Ensure that, where appropriate, information about fuel is provided when the fuel is supplied.

Where a state or territory already has fuel quality standards in place, the federal standards operate concurrently. State or territory standards apply where they regulate a fuel characteristic not covered by the federal standards.

The standards regulate the supply of fuel to consumers, reduce toxic vehicle emissions and ensure that, by using clean fuels, modern vehicles fitted with advanced emissions control technologies operate at peak performance. In order to operate at peak capacity and efficiency, new cars require fuels that meet higher standards. For example, advanced catalysts for petrol and diesel vehicles, and particulate traps for diesel vehicles, require low-sulphur fuel to function properly.

Environmental management in Australia tends to be based on a partnership approach. It uses a mix of regulatory, economic and voluntary instruments, with voluntary measures and agreements between governments, industry and community groups playing a central part. Corporate environmental management drives environmental progress in the mining industry. The approach to environmental licensing is case by case, and there are wide differences among states in enforcement and in the availability of information on compliance.

Fuel quality standards are determined under the Fuel Quality Standards Act 2000 and have been put in place for petrol, diesel, biodiesel and LPG. Fuel quality information standards (*e.g.* labelling requirements) have been made for ethanol.

Residential and dispersed sources of pollution, such as heating with wood, backyard burning and domestic appliances, are small but numerous, and can be significant sources of air pollutants. Woodheaters and fireplaces are significant sources of particles and carbon monoxide. In some locations, they contribute more than half the total load and are responsible for regularly exceeding ambient air quality limits. In response, the Department of the Environment and Heritage is undertaking a number of initiatives designed to reduce wood smoke emissions.

Natural gas and LPG are widely used for cooking, and space and water heating. Nitrogen oxides (NO<sub>x</sub>) are the most significant accompanying

pollutants. However, technologies are available which can substantially reduce NO<sub>x</sub> emissions from these sources, *e.g.* low-NO<sub>x</sub> gas burners that produce one-tenth the NO<sub>x</sub> emissions for water heaters.

Leaded petrol was phased out in Australia on 1 January 2002.

## CRITIQUE

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Australia's national circumstances explain in large measure its GHG emissions profile, in particular that of CO<sub>2</sub> from energy sources. The country has abundant fossil fuel and mineral resources, in particular coal and natural gas, uranium, iron ore, bauxite and nickel; large geographic size – the world's sixth-largest country; a small, but relatively fast growing population in comparison to other developed countries; and the world's fourteenth-largest economy.

These national circumstances have contributed to the development of an economy heavily dependent on the production and export of fossil energy and energy-intensive industries, including aluminium, that have significant CO<sub>2</sub> emissions associated with their use of electricity. Fossil fuels are the dominant energy source, primarily because low-cost fossil fuels are abundant, hydro-electric resources are limited by available water and nuclear power is not utilised. Australia is also a significant energy exporter – over 70% of its total energy production was exported in 2000/01.

Despite Australia's carbon-intense resource base (*i.e.* coal-fired power) and its impressive economic expansion over the last ten years, the country is on track to meet its Kyoto target for 2008–2012. This is due in part to the target it negotiated in Kyoto in 1997 (108% of its 1990 emission levels), abatement achieved through measures that have been introduced over the last ten years and reductions it has been able to realise through changes in land-use and forestry. From 1990 to 2008–2012, the Australian Greenhouse Office projects that GHG emissions related to land-use change and forestry will decrease by 102 Mt of CO<sub>2</sub>-eq, or 85%. This substantial fall in emissions has ensured that even with emissions from energy growing by 43% over the same period, Australia will still meet its Kyoto target. However, this reduction from land-use will be impossible to continue beyond the 2008–2012 Kyoto window.

The federal government approach to climate change mitigation has included voluntary measures, government-funded subsidies for technology development and deployment and mandatory requirements. This approach is similar to that followed by other countries with large geographic size and significant fossil fuel resource endowments.

However, the federal government approach brings with it risks of its own. While some other industrialised countries and their industries develop the institutions and experience with emissions trading and project-based crediting

mechanisms, Australia does not. This approach has potential costs and benefits. Although the Australian government has rejected emissions trading at this time, it continues to observe and analyse the impact of other emissions trading schemes such as the European Union Emissions Trading Scheme (EU-ETS). This provides valuable lessons on the design, implementation and operation of such a scheme. Conversely, it could be argued that at some point in the future Australian industry may need to compete with other firms that have already developed significant expertise.

The lead taken by the states in this matter in the absence of federal participation could complicate the realisation of benefits to be gained from emissions trading in general. Victoria and New South Wales have shown enthusiasm for such a system and the leaders of the other six states and territories are now on board as evidenced by the joint communiqué of 31 March 2005. Should they proceed with their analysis of trading's costs and benefits and then move to implement such a system, Australian energy suppliers and consumers could see quite different circumstances across states, potentially raising costs above what they would have been had a domestic system been developed at the national level.

In addition, even if the Australian technology-driven approach succeeds in developing reasonably priced and effective climate change mitigation techniques, a carbon signal or some other government measure will probably still be needed to encourage its uptake. In the Australian context, new GHG mitigation technologies primarily mean carbon capture and storage as well as clean coal and hydrogen-based technologies. The best-case forecasts for the development of these technologies still suppose substantial additional costs in their use. A trading scheme is probably the best way to display the necessary carbon price signal and is in keeping with the country's successful market-based approach to energy issues.

Given that a carbon price signal will likely need to be given even if the technology approach to climate change works, the sooner the parameters of such a signal are outlined, the better supply and demand energy actors will be able to take informed decisions. Industry groups were split in their opinions on the introduction of an emissions trading scheme. Some worried that such a system would cause them additional costs that could substantially reduce their competitiveness and thus the Australian economy in general, while others wanted a degree of assurance and certainty that the introduction of such a scheme would represent. The government is encouraged to communicate as much and as soon as possible the probable shape and magnitude that any future carbon price signal would take.

Australia's favourable topological conditions and co-operative approach to environmental protection has provided generally good air quality. There is no apparent reason to diverge from this path for conventional air pollutants.



However, unconventional pollutants such as heavy metals are increasing concerns for other IEA countries and may do so for Australia as well. At the same time, preliminary studies in Australia suggest that the levels of emissions and exposure are low by international standards.

Fuel excise taxes have been a revenue source for the Australian government as they are for all IEA countries. However, such taxes have been justified in other countries to a great extent on the basis that they correct externalities associated with vehicle use (e.g. the environmental effects of emissions and the congestion that occurs). It is not apparent that Australia extends such market-based logic to its environmental protection efforts. Additionally, the fuel excise taxes are being reduced and countervailing environmental measures and road user charges are being implemented. The net effect of these tax reductions and the countervailing measures on transport energy use and resulting environmental consequences should be regularly reviewed.

## **RECOMMENDATIONS**

*The government of Australia should:*

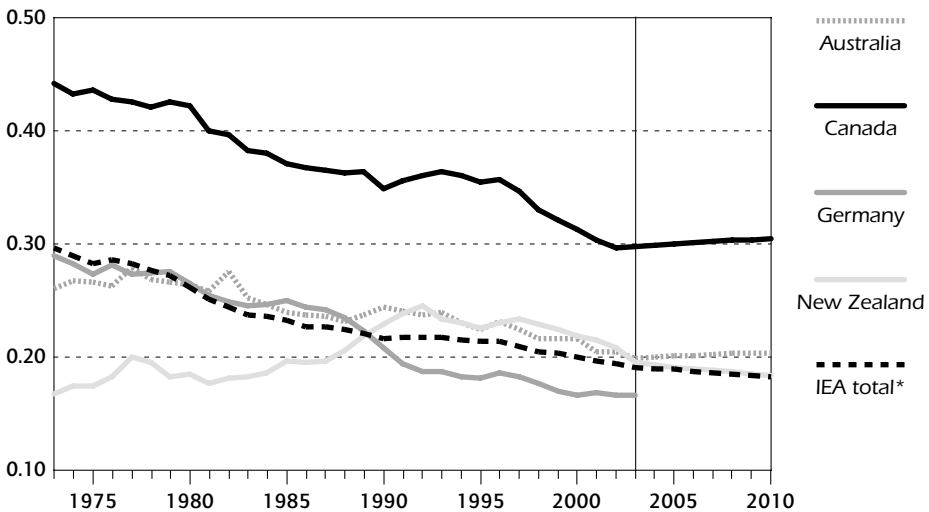
- ▶ *Reappraise as required the costs and benefits of a national emissions trading scheme, particularly in light of developments regarding further international and domestic climate change frameworks and technology advancements. Ensure that all stakeholders are kept abreast of these developments in order to keep supply and consumer decision-makers fully informed.*
- ▶ *Ensure consideration of the environmental consequences in future decisions on energy tax reform.*

## ENERGY INTENSITY MEASURES

In 2002, Australian aggregate energy intensity, as measured by a ratio of the country's TPES in tonnes of oil equivalent (toe) over its national GDP (in thousands of 2000 USD PPP), was 0.21 toe per USD 1 000. This was 7% higher than the average for all IEA countries but 35% higher when GDPs are compared on an exchange rate rather than a PPP basis. In 2002, Australia's TPES per capita was 5.7, or 12% higher than the IEA average. Figure 9 compares Australian national energy intensity to the IEA average as well as to selected countries.

**Figure 9**  
**Energy Intensity in Australia and in Other Selected IEA Countries, 1973 to 2010**

(toe per thousand USD at 2000 prices and purchasing power parities)



\* excluding Finland, Germany, Greece, Luxembourg and Norway throughout the series, as forecast data not available for these countries.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005; *National Accounts of OECD Countries*, OECD Paris, 2005; and country submissions.

Such snapshot aggregate measures of energy intensity, however, can lack statistical integrity. For example, the results depend to a great extent on the choice of a base year for the GDP figures and the means chosen to have national GDPs portrayed in the same units for all countries. While they are

helpful in providing general indications on energy use, a sounder and more revealing analysis can be gained from observing the progression of these figures over time. From 1973 to 2002, Australian TPES per unit of GDP fell by 21%. Over the same period, this intensity ratio fell by 35% for the IEA as a whole. Table 9 looks at the fall in energy intensity over a range of time periods for Australia, the IEA as a whole and three other countries with roughly similar profiles.

**Table 9**  
**Decrease in Energy Intensity Measured as TPES/GDP**  
(toe per thousand 2000 USD)

<i>Country/region</i>	<i>1973 to 2002</i>	<i>1992 to 2002</i>	<i>1997 to 2002</i>
Australia	21.3%	13.3%	8.5%
Canada	33.0%	18.1%	14.7%
Sweden	26.4%	13.7%	12.0%
United States	43.4%	16.1%	8.7%
IEA total	34.6%	9.5%	6.3%

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005.

Aggregate energy intensity figures can sometimes misrepresent the actual energy efficiency of a country or region owing to the influence of other factors. Such factors include the size of the country, climate and presence of energy-intensive industries. For example, the country's large size increases transport energy use. The transport sector is Australia's largest final energy consumer, accounting for 40% of final consumption in 2003. In 2002, Australia's transport consumption per unit of GDP was nearly 40% higher than the IEA average.

## POTENTIAL FOR ENERGY EFFICIENCY IMPROVEMENTS

The energy White Paper devotes a full chapter to energy efficiency. The first three key points of this chapter are:

- Increasing the uptake of commercial energy efficiency opportunities could increase GDP by AUD 975 million a year.
- Energy efficiency is a central element of cost-effective GHG abatement strategy.
- Australia's energy efficiency performance has not been as strong as other countries and improving this performance is a high priority for government.

The White Paper cites government programme experience and additional analysis which indicates that many businesses and households can save 10%

to 30% on their energy costs without reducing productivity or comfort levels. This would equate to AUD 5 to 15 billion in potential energy savings. Realisation of these savings would require significant investment and/or changes in practices but these investments would have a positive net present value over the life of the investment and many would have payback periods of six months or less.

Further information on sector-specific potential is shown in Table 10.

Table 10  
**Energy Efficiency Potential**

<i>Sector</i>	<i>Efficiency potential, %</i>	<i>Energy end use 2000/01, PJ</i>	<i>% of total energy use under study</i>	<i>Efficiency potential, PJ</i>	<i>% of efficiency potential under study</i>
Manufacturing and mining	6.2	1 250	67	78	51
Commercial	10.4	224	12	23	15
Residential	13.0	399	21	52	34
<b>Total</b>		<b>1 873</b>	<b>100</b>	<b>153</b>	<b>100</b>

Source: Energy White Paper (p. 110).

These assessments on efficiency potential cover only stationary energy use and thus exclude transport. However, indications are that transport has substantial potential. In 2003, the transport sector accounted for 40% of total final energy use. This compares to the IEA as a whole where transport accounted for 34% of total final energy use. Transport is the only sector that has substantially increased its share of the total final energy use over the medium and long term. Because of the relatively mild climate, Australian cars can stay on the road for a long time. As of 2001, 63% of the cars being operated in Australia were seven years old or older. Older cars are less efficient than new cars. The following table compares fleet vehicle age for different countries.

Table 11  
**Vehicle Fleet Age across Countries**

<i>Country/region</i>	<i>Average fleet age, years</i>	<i>Notes</i>
Australia	10.3	2004 data; passenger vehicle average age is 10.0.
United States	9.0 for automobiles, 8.0 for trucks	2000 data
European Union	7.6 for passenger vehicles	1999 data given for passenger vehicles only
Canada	8.3	1999 data
Japan	6.3	2000 data, passenger vehicle age is 5.8

Sources: U.S. Department of Transportation; JAMA; European Environmental Agency; Industry Canada; Australian Bureau of Statistics.

Significant work in assessing energy efficiency potential was carried out during the development of the National Framework for Energy Efficiency (NLEE). The NLEE was launched in response to a proposal by the Ministerial Council on Energy (MCE) to define future directions for energy efficiency policy and programmes in Australia. The initial work on this topic provided a range of assessments for improved efficiency potential. Using a low energy efficiency improvement scenario, employing current commercially available technologies in projects – with a payback period of four years and assuming only a 50% penetration – the following benefits could be expected at the twelfth year after improvements were begun:

- Real GDP would be AUD 0.98 billion higher, an increase of 0.1%.
- Employment would increase by about 2 600 jobs, a 0.02% rise in the number of jobs.
- There would be a 76 PJ reduction in stationary final energy consumption, equivalent to a 3% reduction from the business-as-usual figure.
- There would be a 10 Mt reduction in GHG emissions from the stationary energy sector, equivalent to a 3% reduction from the business-as-usual figure.

## **GOVERNMENT ENERGY EFFICIENCY PROGRAMMES BY SECTOR**

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The importance of energy efficiency is being increasingly recognised in Australia's energy policy setting. In the 2004 energy White Paper, energy efficiency was given prominence. Several initiatives were announced, including:

- Requiring large energy users to undertake a Mandatory Energy Efficiency Opportunity Assessment every five years starting in 2006, and publicly reporting the outcomes.
- Improving market signals and demand-side management (DSM), which will provide greater incentives for the uptake of energy efficiency.
- Expansions of the Minimum Energy Performance Standards (MEPS) programme to a greater range of appliances and buildings and applying more stringent standards.
- Continuing to improve the energy efficiency of federal government agencies.
- Streamlining the requirements between states and territories through their commitment to the National Framework for Energy Efficiency.
- The establishment of a Productivity Commission review of the potential economic and environmental benefits from improving energy efficiency.

The White Paper initiatives will be augmented by the work of the Ministerial Council on Energy to develop the National Framework for Energy Efficiency (NFEE). The purpose of the NFEE is to unlock the economic potential associated with the increased implementation of energy-efficient technologies and processes to deliver a least-cost approach to energy provision in Australia. In December 2004, the MCE released a statement on the NFEE plan for Stage One measures to be enacted from 2005 to 2007. The packages for Stage One include mandatory energy efficiency opportunity assessments and energy disclosure by Australia's 250 largest businesses, increasing minimum design and energy performance measures for commercial buildings and houses, and improvements to the efficiency of appliances and equipment. The measures have the potential to save around 50 PJ of energy a year by 2015, reduce GHG emissions equal to the operation of around 900 000 cars and provide GDP benefits of up to AUD 400 million annually. The eight areas in which these measures will be introduced are:

- Building performance.
- Appliances and equipment.
- Commercial and industrial energy efficiency.
- Commercial and industrial sector capacity building.
- Government energy efficiency.
- Trade and professional training.
- General consumer capacity building.
- Finance sector awareness.

More detailed descriptions of programmes broken down by sector are provided below.

## INDUSTRIAL SECTOR EFFICIENCY POLICIES

The federal, state and territory governments all have a range of programmes to improve industrial energy efficiency. Some of the major programmes and measures are included below:

- Businesses using more than 0.5 petajoules per year (about 250 companies nationwide) will be required to undertake a Mandatory Energy Efficiency Opportunity Assessment (MEEOA) to identify energy saving opportunities. The decision to implement these measures is up to the companies, however they must then publicly report on their outcomes. This begins in 2006 and has been allocated AUD 16.9 million over four years.

- The Victorian Environmental Protection Agency (EPA) requires businesses that are issued with EPA licences to report back to the EPA on their energy use and the measures they are undertaking to reduce this use. Medium to large energy users are also required to undertake an energy audit to Australian standards, and prepare implementation plans for initiatives with a payback period of three years or less. This is then reported back to the EPA as part of the companies' annual reporting.
- The Greenhouse Challenge is a voluntary programme involving the Australian government and industry. Its objective is to establish partnerships with industry to promote actions to reduce GHG emissions. Much of this activity focuses on energy-efficient technology and processes. It has around 800 members with coverage of approximately half of Australia's industry emissions. Member companies have now reported total abatements of more than 21Mt CO<sub>2</sub>-eq. by the end of 2003<sup>12</sup>.
- Under the National Appliance and Equipment Energy Efficiency Program (NAEEEP), the Minimum Energy Performance Standards (MEPS) for household appliances was introduced. The aim of MEPS is to reduce energy demand by requiring certain appliances to meet energy-efficient standards before they can be sold to the consumer. The range of appliances this programme extends to is currently being expanded to include some industrial equipment.
- As part of the reform of the Australian energy market, greater attention is being given to user participation. DSM measures are aimed at achieving effective competition and maximising the benefits of energy market reform for energy consumers. End-users may contribute to a sustainable energy supply by undertaking energy reduction activities in response to market signals, such as load reduction or load shifting.
- The Energy Efficiency Best Practice (EEBP) programme, which was concluded in 2003, funded energy efficiency demonstration projects in industry. This enabled firms to see the benefits of addressing energy efficiency from a business strategy perspective and to engage in projects involving innovative big step improvements and cultural change. The projects were documented as case studies and made available publicly so that the benefits of increased energy efficiency were more widely recognised.

## TRANSPORT SECTOR EFFICIENCY POLICIES

### **Automobile Fuel Efficiency**

The government has negotiated a National Average Fuel Consumption (NAFC) agreement with the car industry. This agreement involves a target to reduce

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12. Australian Greenhouse Office, 2004, *The Challenge – Summer 2004*.

the average fuel consumption of new cars sold in Australia from 8.43 litres per 100 km to 6.8 litres per 100 km by 2010. This agreement is voluntary with no penalties for non-compliance for those car manufacturers that do not meet it. The current fuel efficiency level is around 8 litres per 100 km. However, the agreement is currently being renegotiated with the standard to be converted into a CO<sub>2</sub> emitted per 100 km rather than a fuel consumption measure. It will also be expanded to include more vehicles such as jeeps and light trucks. Inclusion of these larger vehicles means that the overall fleet vehicle efficiency will appear poorer but the overall effect will be beneficial in curbing fuel use. Table 12 compares efficiency standards across selected countries.

Table 12  
**New Vehicle Fleet Efficiency Standards**

<i>Country/region</i>	<i>Existing standards, miles per gallon</i>	<i>Future standards, miles per gallon</i>	<i>Implementation</i>
United States	24.1	24.9 in 2007	Mandatory
California	25.4	25.0 in 2009, ramping to 35.6 in 2016	Voluntary
European Union	32.9	39.2 in 2008	Voluntary
Japan	34.3	35.6 in 2010	Mandatory
China	25.9	30.4 in 2005, 32.5 in 2008	Mandatory
Canada	25.6	32.0 in 2010 (proposed)	Voluntary
Australia	25.3	29.9 in 2010	Voluntary

Source: "Comparison of Passenger Vehicle Fuel Economy and Greenhouse Gas Emission Standards Around the World", Pew Center for Global Climate Change, December 2004.

## Energy Taxation

Energy taxation in the transport sector is primarily imposed via fuel excise. The current excise rate applying to petrol and diesel is 38.143 cents per litre (cpl). Biodiesel and ethanol are also taxed at AUD 0.38143 per litre, but this excise is fully offset by a production subsidy of AUD 0.38143 per litre, meaning that these fuels are effectively excise-free. There is currently no excise on liquefied petroleum gas (LPG), liquefied natural gas (LNG), methanol and compressed natural gas (CNG). Under the Energy Grants Credits Scheme (EGCS), the use of diesel in certain larger on-road vehicles working in remote areas is eligible for a credit which reduces the effective excise rate to AUD 0.19633 per litre.

From 1 July 2006 the government proposes to implement a staged reform of the fuel excise system. Under the reform, the off-road credit would be extended in stages to all uses of all fuels off-road for business purposes, while the partial on-road credit would be extended to all business use of all fuels in vehicles weighing over 4.5 tonnes gross vehicle mass (GVM). The reforms would limit the effective application of excise to business use of fuel in on-road applications in vehicles with a gross vehicle mass of less than 4.5 tonnes,



and private use of fuel in vehicles and certain off-road applications (except for power generation, which would be eligible for excise relief).

The government has decided that the introduction of excise for currently untaxed fuels will be gradually phased in from 1 July 2011 over five equal annual steps to final rates on 1 July 2015. Fuels that will become excisable from 1 July 2011 will include LPG, LNG and CNG when used in internal combustion engines. Also, the production subsidies for ethanol and biodiesel will be reduced at the same time over five equal annual steps, effectively introducing excise on these fuels. However, discounts on excise taxes would still be available for these fuels. More information on motor fuel taxation is available in the Energy Taxation section of Chapter 3.

## **Information**

The Green Vehicle Guide (GVG) provides information about the environmental performance of new light vehicles (up to 3.5 tonnes GVM) sold in Australia. A greenhouse rating, air pollution rating and overall rating as well as fuel consumption information are provided for each vehicle make, model and variant name, engine and transmission, body style, seating and fuel type. The GVG is a searchable, internet-based facility.

The Australian Design Rule (ADR) 81/01 came into force in July 2003. Fuel consumption labelling was introduced for new model vehicles, listing both fuel consumption and CO<sub>2</sub> emissions, from July 2003, and for existing models from January 2004. ADR 81/00 for fuel consumption labelling of most light vehicles came into effect in January 2001. The labels provide consumers with objective information on the comparative fuel consumption of individual models.

## **Public Transit and Modal Shifts**

The federal government considers state and territory governments best placed to deal with the metropolitan and local complexities of public transport. The federal government's role has focused, and will continue to focus, on interstate connectivity and trade and commerce between the states and with other nations. It is nevertheless focused on some modal shift activities, largely driven by emissions reduction concerns.

Announced in 2002, the AUD 2 million Travel Demand Management (TDM) programme delivered through the Australian Greenhouse Office aims to encourage a change in community attitudes away from a reliance on cars towards healthier, more sociable and less environmentally intensive travel modes, such as walking, cycling, public transport, and alternative options such as car-pooling and telecommuting. The programme provides financial support to state, territory, local governments and communities for initiatives to promote the uptake of various travel demand management approaches leading to a reduction in GHG emissions from passenger transport, particularly in urban centres.

TravelSmart activities occur across Australia with funding and support provided by federal, state and territory governments. A major theme of TravelSmart activities is voluntary behavioural change through active engagement of the community (as employees, householders or customers) and trip generating organisations.

## RESIDENTIAL/COMMERCIAL SECTOR EFFICIENCY POLICIES

In the energy White Paper, the federal government expressed its desire to improve the uptake of commercial energy efficiency opportunities and to improve the performance of the Australian residential sectors. An important policy setting is to improve the performance of markets (and market signals) through continued reform of energy markets. Improving the capacity for stronger demand-side participation in the development of the market and its operations is a key step in the reform agenda.

Specific measures include the following:

- The Solar Cities programme is designed to enable the trial of smart metering and other innovative approaches to energy pricing and DSM and to encourage greater energy efficiency.
- Extending the National Appliance and Equipment Energy Efficiency Program (NAEEEP) established in 1992. This programme has two elements to reduce energy demand through energy efficiency in appliances and equipment:
  - Industry regulation for minimum energy performance standards (MEPS).
  - Informed decision-making by consumers via labelling.

Nationally consistent labelling on appliances enables consumers to identify best practice appliances and encourages them to shift to more energy-efficient products.

- The Minimum Energy Performance Standards (MEPS) programme is being expanded with state and territory governments. It will be expanded to a wider range of appliances and commercial equipment, and higher standards will be placed on appliances that are already covered by MEPS. The MEPS programme is aiming to save a total of 134 Mt of CO<sub>2</sub>-eq. from 2003 to 2018.
- Providing information for consumers and businesses about the energy performance of commercial and residential buildings:
  - Energy performance standards for buildings will continue to be extended to multi-dwelling residences and commercial buildings. The standards are aimed at reducing heating and cooling costs through the use of more energy-efficient design and materials.

- The government will work with the states and territories to require landlords and building owners to disclose energy performance information in leases and sales agreements.
- On 1 January 2003 measures to increase energy efficiency for houses were introduced into the national Building Code of Australia (BCA). These measures have now been adopted in all states and territories.
- The Australian Building Greenhouse Rating Scheme (ABGRS) is a national programme run across various government agencies, but is administered by the government of New South Wales. The ABGRS provides accredited assessments of the greenhouse intensity of office buildings and housing by awarding a star rating on a scale of one to five. A building with a high star rating will be more energy-efficient and cheaper to run, and will result in lower GHG emissions. Three stars represent current market practice.

## **PRODUCTIVITY COMMISSION INQUIRY ON ENERGY EFFICIENCY**

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The federal government has asked the Productivity Commission (PC) to conduct an inquiry into the economic and environmental potential offered by energy efficiency improvements, which are cost-effective for the individual producers and consumers. This includes, but is not limited to, the policy option of introducing a national energy efficiency target. The key features of the terms of reference for this inquiry are:

- What are the environmental and economic costs and benefits of cost-effective energy efficiency improvements?
- What are the barriers and impediments to adopting cost-effective energy efficiency improvements?
- Would government intervention to address these barriers and impediments produce net benefits to the Australian community? What form should that intervention take?

The inquiry was launched on 31 August 2004. The PC accepted submissions from the public and held a series of public hearings. The final report is scheduled to be released on 31 August 2005.

## **CRITIQUE**

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Australian energy consumption per unit of GDP or per capita is above the IEA norm. This can partly be explained by the country's particular circumstances, including large spaces with a relatively sparse population and the presence of energy-intensive industries. It has also been the result of low energy prices for

electricity, coal and natural gas and the historical absence of any real concerns about security of supply. While a number of federal and state government programmes have been put in place to encourage conservation, energy efficiency has not historically been a major motivation in shaping overall energy policy. Most of the attention of both government and industry has been on the supply rather than the demand side.

This predominantly supply-side focus appears to be changing. The attention paid to energy efficiency in the White Paper, the work of the National Framework for Energy Efficiency and the ongoing inquiry of the Productivity Commission all suggest that energy efficiency is gaining greater attention of state, territory and the Australian governments. Energy efficiency is a valuable policy tool in addressing a wide range of issues in the energy sector and as such, the government's activities in this area are welcome and encouraged.

At the same time, a well thought-out strategy will be required to realise the benefits of improved efficiency. Australia has skilfully utilised the presence of abundant natural energy resources to build world class industries such as alumina that contribute substantially to the economy. In addition, Australia's liberal economic approach, largely free of government influence, where economic actors are trusted to act rationally in their own best interest has been successful in both the energy sector and the general economy. Any government initiatives that would seek to influence energy use and consumption patterns and thus modify this successful model must be shown to bring benefits in excess of any costs involved.

Assessments of energy efficiency often focus on the market failures that impede individual consumers from making truly economic choices. Owing to distortions and flaws in the market, consumers are not acting in their own best interest regarding energy use. A typical example of such a failure is lack of information where consumers either do not know the efficiency options available to them or are incapable of calculating the long-term benefits of more efficient choices. Another such obstacle is split incentives where the person making the choice on the amount and type of energy use (*e.g.* a landlord installing an air-conditioning system) is not the same person paying for the energy (*e.g.* the tenant).

Government efforts to eliminate these market failures are important and should be pursued where the costs of doing so do not outweigh the benefits. However, in addition to the benefits realised by individual consumers, there is an additional range of benefits for the community at large that results from greater energy efficiency. These benefits can be generally categorised as either minimising negative externalities or maximising positive externalities of energy use. Since the self-interested motivation of individual consumers will not reflect these externalities, government action can be justified, again where the benefits outweigh the costs. While the Australian government has thus far

focused on the market failures that impeded consumers from acting in their own self-interest, it has not yet fully appreciated the other benefits of improved efficiency. A selection of such benefits is discussed below.

Energy efficiency provides a valuable tool to *reduce GHG emissions*. The Australian government has stated that the accumulation of GHG could pose substantial global environmental hazards. Since no carbon price signal is currently in place, emissions constitute a negative externality and hence energy consumers become free riders of what is in effect a subsidised commodity. Reliance on inexpensive energy has deferred the introduction of a carbon price in Australia and thus suppliers and consumers are taking decisions based on incomplete or faulty information. Government efforts in promoting efficiency can act as an effective proxy for a carbon price, which would show the true energy price to the market.

The two main ways to reduce GHG emissions in the energy sector are improved energy efficiency and renewable energy. While renewable energy is accepted as currently having a cost greater than competing sources of energy and thus entitled to non-market support, energy efficiency in many applications can pay for itself. While this is not always the case, the reluctance to extend non-market support to energy efficiency (*e.g.* in the form of government payments or efficiency standards) is generally much greater than support extended to renewables even though they both provide very similar benefits. This is not to say that energy efficiency and renewable energy should "compete" against one another in the policy domain. But it is important to recognise that the low (or even negative) marginal cost of improved energy efficiency in reducing emissions probably makes it one of the least expensive means of reducing emissions.

Improved energy efficiency can also *increase national competitiveness*. The studies cited in the White Paper conclude that increasing the uptake of commercial energy efficiency opportunities could increase GDP by AUD 975 million a year. Analysis by the NFREE states that real GDP would be AUD 0.9 billion higher, an increase of 0.1%, and that about 2 600 jobs would be created by a moderate improvement in energy efficiency. Concerns about the possible costs imposed on businesses and households in the name of energy efficiency are very real and Australia's exposure to international competition for many of its products makes this issue particularly important. However, a great deal of analysis and real world experience has shown that in the medium to long term, the economic benefits of efficiency gains are positive.

Energy efficiency is also a valuable tool to *improve energy security*. This is less of an issue in Australia than in other IEA countries owing to its fossil fuel resources but it is becoming increasingly important in the oil sector as import reliance grows. The White Paper makes provision of reliable energy a major thrust for future policy. There is no more effective means of addressing problems with energy supply than simply eliminating the need for that supply.

In particular, more energy-efficient economies are better prepared to withstand energy price hikes. The economic difficulties seen in the early 1970s and the late 1970s and 1980s were caused to a great extent by unexpected jumps in oil prices. The rise of energy prices being experienced today (for oil, gas and coal) is having a much smaller effect, mainly because it takes less energy to produce a unit of GDP. Any increase in energy efficiency will make an economy more resilient and better able to withstand energy price increases without falling into recession.

Dampened demand for energy allows a country to *better take advantage of new technologies*. In the electricity sector, for example, every year that the need for a new power plant is delayed will mean a year of greater technological development for the plant that is eventually built. Australia is placing great reliance on energy technology to address energy and environmental issues. Most energy infrastructure investments are intended to last a long time, from ten years for an industrial engine up to 60 years and more for electricity transmission lines. The longer the technology has to develop, the more gains can be realised from this strategy.

Some of the benefits described above are easier to quantify than others. But they all relate to real costs borne by society that are not being reflected in energy prices. Thus, the system is not optimised economically and government action can help to at least partially rectify that. To date, however, the energy efficiency initiatives seen as part of the NFEE, in the White Paper and with the PC inquiry have focused primarily on the direct economic benefits of individual consumers who implement more efficient technology or practices. Given the country's low energy prices, this may not be one of the more compelling reasons to improve efficiency. A greater appreciation of the many different ways in which energy efficiency can benefit a country could help to determine the appropriate type and level of activity the government should undertake. Establishment of one or more quantitative targets on energy efficiency could be helpful in focusing efforts that improve efficiency and thus achieve the related benefits. Such targets could be on the macro national level, or more specific to a certain industry or geographical region. Introduction of emissions trading could also be helpful to drive such efforts.

Energy efficiency is also an effective means of *curbing the growing peak energy needs*, particularly for electricity. Even though Australia's electricity market is one of the most competitive and transparent in the world, it has thus far been poor at reflecting the time-of-use costs in prices seen by consumers. While some larger customers have the wholesale price variations passed on to them so that they can act accordingly, this does not happen with the smaller customers. In addition, the cost of transmission and distribution services is never cost-reflective in a time-of-use sense although the cost of building and maintaining a network to meet maximum peak load is extremely expensive. More efforts can and should be made on cost-reflective time-of-use pricing to get

greater demand-side participation to respond to a growing peak. At the same time, it should be borne in mind that prices will never fully be able to be truly cost-reflective and the smaller consumers will not be sufficiently motivated or even able to adjust their behaviour accordingly. Thus, government intervention in the form of more stringent efficiency standards on air-conditioners is justified in helping to bring about a more economic system overall.

Australian efficiency efforts could benefit greatly from added focus on the transport sector. Transport accounts for 40% of the country's final consumption and consumption in that sector is growing faster than in any other, increasing at an annual average rate of 2.5% from 1998 to 2003, compared to 0.7% for the rest of the economy. Nevertheless, transport appears to be receiving less attention than the other sectors. In the White Paper's analysis of the quantitative potential of improved efficiency, the transport sector is excluded. Similar NFEE assessments also exclude transport. In the set of measures proposed as Stage One of NFEE efficiency activities to be undertaken from 2005 to 2007, none of the eight areas deals with transport. In addition, the White Paper reform of the excise tax for vehicles will substantially lower the overall tax burden, decreasing government revenue in this area by AUD 1.5 billion over ten years. All other things being equal, this is likely to have the effect of increasing transport consumption. If the Australian government wants to deal with the overall energy efficiency of the economy, it should address transport energy use more forcefully.

Australia's circumstances – primarily its large size and dispersed populations – make transport a necessity for much of the population and important for a successful economy. As such, actions taken by governments in different countries and with different circumstances may not necessarily work well in Australia. Certainly taxation is one means of influencing transport energy use. If higher taxes are not politically viable, the government should at least take into account the overall consequences of the resulting higher energy use. The current and future vehicle fleet fuel efficiency standards are helpful. However, they are at the lower end of such standards among IEA member countries, comparable to those of the United States and Canada but below those of Japan and the EU countries. In addition, the standards are voluntary and there are no penalties for non-compliance, so it is not certain that the proposed efficiency standards will be reached. Australia's aging vehicle fleet also increases energy use through the older technologies in these cars and their general efficiency degradation over time. A number of European countries have employed buy-back schemes to get such older cars off the road, although the results have been mixed. Variable taxes on car registration based on engine size/energy efficiency may be appropriate in the Australian context. Under such a programme, taxes would be lowered for more efficient cars and raised for less efficient cars, in a revenue-neutral tax shift. Thus, the use of transport that is essential in many parts of the country would not be priced out of reach of anyone, but the preference for efficiency would be clearly felt.

The renewed focus on energy efficiency, including the work of the NFEE and the inquiry of the Productivity Commission, provides an opportunity to consolidate some of the disparate measures being taken across the country. Government efficiency programmes take place at the national, state and local levels. While this may be appropriate for certain measures (e.g. national vehicle fuel efficiency standards compared to local building codes), it can also lead to confusion for users and less effective policies. For example, the recently announced Mandatory Energy Efficiency Opportunity Assessment (MEEEOA), requiring certain large consumers to perform an energy audit, has many similarities with a programme put in place by the state government of Victoria. While not all measures must necessarily be standard over the entire country, a degree of consolidation may minimise overlap and confusion for those actors working in multiple states.

## RECOMMENDATIONS

*The government of Australia should:*

- ▶ *Develop a co-ordinated energy efficiency strategy that aims to realise all the benefits of improved efficiency such as emissions mitigation, increased productivity and hence competitiveness, the advantages of delaying infrastructure investments to gain technology advancements, and enhanced energy security.*
- ▶ *Consider targets for improved energy efficiency on a national or sector-specific basis and the appropriate means of achieving them.*
- ▶ *Address means of curbing peak electricity demand, for example through more cost-reflective pricing in meeting summer peaks and/or more stringent efficiency standards for peak energy consumers such as air-conditioning.*
- ▶ *Develop stronger means of improving energy efficiency in the transport sector, in particular through vehicle taxation and fuel efficiency standards.*
- ▶ *Consolidate the different levels of energy efficiency programmes to simplify them for users and/or improve their effectiveness.*





## **CURRENT AND HISTORICAL PRODUCTION**

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Australia's large land mass offers substantial natural resources for renewable energy use. These include wind resources, large solar power potential, power from waves and hot dry rock geothermal power. The country's biomass potential is also significant given its large size but the constraints on arable land and water resources, plus competing agricultural interests, will limit this resource. There is limited potential for new large hydropower developments. Renewable energy in Australia is also favoured by the country's space, which makes siting facilities less of a contentious issue than it is in other IEA countries.

In 2003, Australia produced 6.5 Mtoe of renewable energy, or 5.8% of the national TPES. Renewables' percentage share of Australian TPES has been slowly but steadily decreasing since the 1970s. The highest point was in 1971 when renewables accounted for 8.7% of TPES. Although renewables have been increasing on an absolute basis, they have not kept pace with other fuels. In 2002, the IEA countries as a whole had 5.9% of their TPES derived from renewable resources.

Biomass and hydropower dominate renewable energy production in Australia, as is the case in many countries. In 2003, biomass accounted for 77% of all renewable production, followed by hydropower (21%), solar thermal (1.4%), wind power (0.9%), and solar photovoltaics (0.01%). Australian biomass consists of bagasse (sugar cane waste), which is used to generate electricity, and wood for home heating. Although still a very minor part of the Australian energy picture (0.05% of TPES in 2003), wind power has seen the greatest increase in production in recent years. As recently as 1998, wind power generation was less than 1 Mtoe and from 2002 to 2003 alone, wind power nearly doubled, growing by 95%. As of May 2005, 380 MW of wind power had been installed in Australia, with another 367 MW under construction.

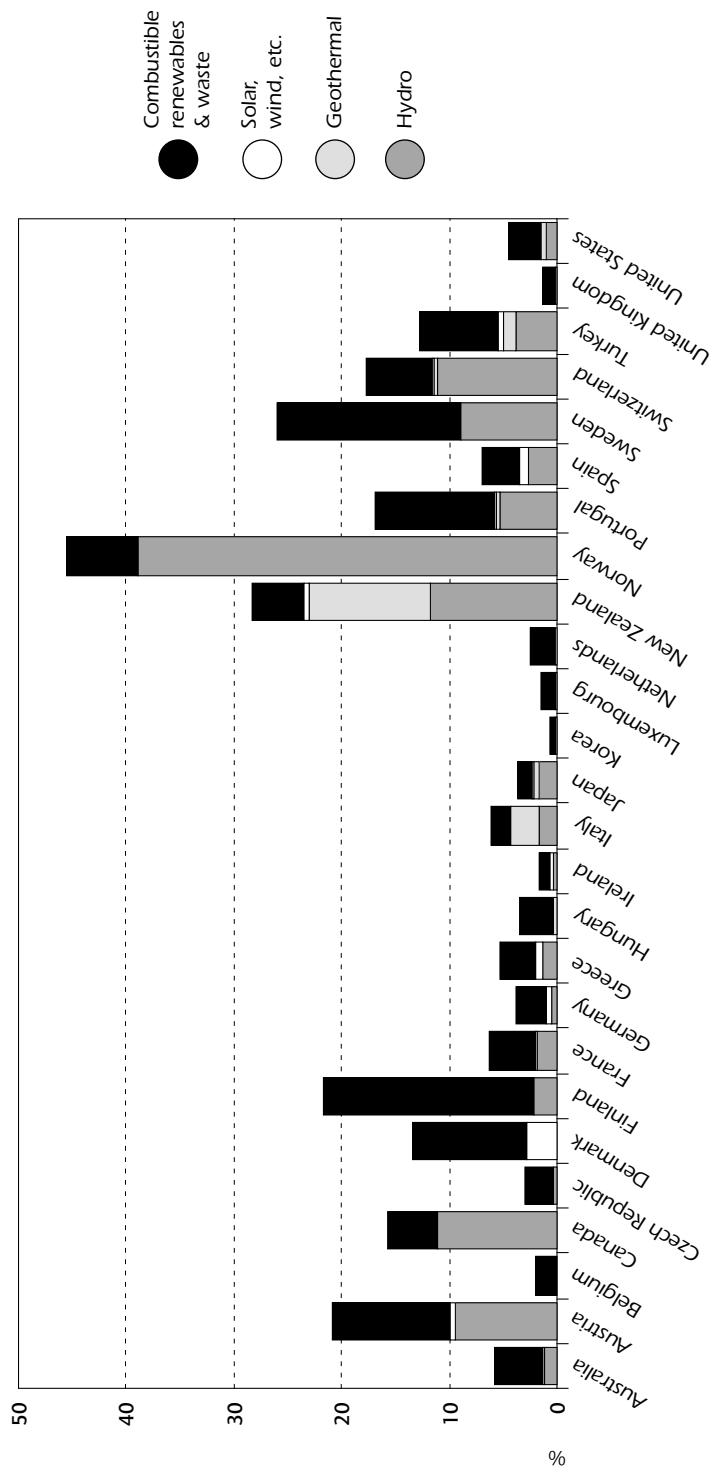
In terms of power generation, renewables accounted for 8.0% of total generation in 2003. The large majority of this was hydropower (88%), followed by biomass (8%) and solar and wind combined (3.9%).

## **GOVERNMENT POLICY AND SUPPORT MECHANISMS**

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The Australian government supports the development of renewable energy technology in a number of different ways. While the energy White Paper did not increase the target for the Mandatory Renewable Energy Target (see below for details), it did provide funding for a number of largely technology-

**Figure 10**  
**Renewable Energy as a Percentage of Total Primary Energy Supply in IEA Countries, 2003**



Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005.

focused initiatives to support renewables. These measures, which total over AUD 700 million, include:

- An AUD 500 million Low Emissions Technology Fund, which is intended to leverage at least AUD 1 billion in private-sector investment to demonstrate low-emission technologies, such as renewable energy, with significant long-term abatement potential.
- An AUD 75 million Solar Cities trial, which will demonstrate the economic benefits of solar technologies and demand management in reducing GHG emissions.
- An AUD 100 million Renewable Energy Development Initiative, which will support the development of renewable energy technologies with strong commercial potential.
- An AUD 20 million Advanced Electricity Storage Technologies initiative to support energy storage for intermittent renewable technologies, such as wind and solar.
- Up to AUD 14 million to develop a Wind Forecasting Capability.

## MANDATORY RENEWABLE ENERGY TARGET (MRET)

The Mandatory Renewable Energy Target (MRET) continues to be Australia's major initiative to stimulate the development of renewable energy. Commencing in April 2001, the MRET scheme involves phased annual targets for new renewable generation reaching 9 500 GWh by 2010 with this level kept in place until 2020. It is expected to produce a 60% increase in electricity generation from renewable sources over a decade.

The measure applies nationally and places a legal liability on all electricity retailers and wholesale electricity buyers on grids of over 100 MW installed capacity. All retailers covered under the programme must acquire renewable energy certificates (RECs) proportionate to their share of the desired renewable level at any point in time. For example, if a liable party purchases 10% of the electricity in the country, it must also acquire RECs equal to 10% of the interim target level for that year.

The target levels will be increased as indicated in Table 13.

The following technologies or fuel types are classified as eligible renewable energy sources under the Renewable Energy Electricity Act 2000 and thus their generation entitles them to RECs. In order to qualify, generation must be above the 1997 baseline for plants already in place at that time or for plants brought on line in 1998 or after.

Table 13

### Required Level of Renewable Generation under MRET

<i>Year</i>	<i>Required additional GWh</i>	<i>MRET target's share of total generation</i>	<i>MRET target's share of generation increase</i>
2001	300	0.1%	
2002	1 100	0.5%	19%
2003	1 800	0.8%	16%
2004	2 600	1.1%	15%
2005	3 400	1.4%	15%
2006	4 500	1.8%	15%
2007	5 600	2.2%	15%
2008	6 800	2.6%	16%
2009	8 100	3.0%	16%
2010-2020	9 500	3.4%	17%

Source: Office of the Renewable Energy Regulator (ORER), Australian Energy: National and State Projections to 2019/20, ABARE eReport 04.11, Canberra.

- Solar
- Wind
- Ocean, wave and tidal
- Hydro (including large hydro)
- Geothermal
- Bioenergy
- Solar water heating
- Renewable component of Remote Area Power Supply (RAPS) systems
- Co-firing renewables with fossil fuels
- Fuel cells using a renewable fuel

All of these technologies generate electricity with the exception of the solar hot water heaters. Their RECs are calculated on the basis of the electricity consumption they displace.

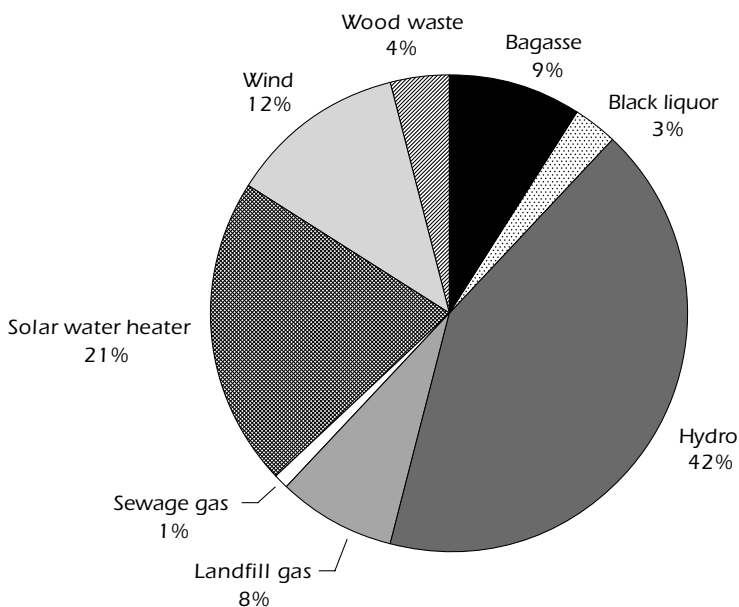
Liable parties are required to make their own arrangements to meet their obligation. They can either develop their own contracts with renewable energy generators or trade in RECs at a price negotiated on the market. Either way, they must annually surrender RECs to the Office of the Renewable Energy Regulator (ORER) equal to their obligation. Failure to meet one's obligations results in a penalty of AUD 40 per MWh. However, since the penalties are not tax-deductible while the purchase of the RECs is tax-deductible, the tax-

neutral penalty in relation to the price of a REC is around AUD 57 per MWh and this creates the effective ceiling on REC prices.

In order to capture the generation from smaller renewable generators without making the compliance costs unduly burdensome, the MRET has created a system for "deemed" participants. For smaller renewable energy technologies eligible to be deemed, their generation levels are determined by a benchmark corresponding to the technology, the model being used and its location. Deeming applies primarily to solar hot water heaters. For these units, and other deemed technologies, the amount of RECs received is not determined by their actual production, but by the corresponding benchmark production previously determined by the regulator. As of year-end 2004, there were about 88 000 deemed participants in the MRET system who had created 21% of the total RECs produced.

The market has responded to the demand for RECs with increased generation from eligible producers. As of year-end 2004, slightly more than 10 million RECs had been created since the programme's origin, compared to a cumulative obligation over that time of just 5.8 million. The breakdown by technology of all RECs created as of 31 December 2004 is shown in the figure below.

Figure 11  
Breakdown of RECs by Eligible Renewable Energy Source



Source: Office of the Renewable Energy Regulator (ORER).

All RECs are bankable, so if not used in the year created, they can be saved for use in subsequent periods. However, despite the apparent oversupply of RECs in the market compared with the obligation levels, prices for the certificates have been higher than originally forecast by ORER. In a series of sensitivity analyses for REC price forecasts, the ORER projected REC prices to be approximately AUD 25 per MWh on average throughout the obligation period (*i.e.* through 2020). However, as of February 2005, prices were closer to AUD 36 per MWh<sup>13</sup>. While this is in the high end of the sensitivity analyses run, it is still well below the effective ceiling from the penalty of AUD 57 per MWh.

Compliance by liable parties in securing the sufficient number of RECs has improved. There have thus far been four compliance years, from 2001 through 2004. In 2001, there were shortfalls of 25 842 RECs by 19 liable parties. In 2003, there were only shortfalls of 790 RECs by five liable parties. Statistics on 2004 are still being calculated.

The MRET has acted as an investment incentive for the renewables industry. Since coming into effect in 2001, the MRET has generated investment of more than AUD 1 billion in new renewable energy projects, with an additional AUD 1 billion either committed or planned.

The ORER has estimated that final retail electricity prices to customers could rise by between 0.5% and 1.3% by 2010 when the obligation level reaches its final highest amount. The lower price increases in percentage terms would be seen by residences since a smaller share of their final price comes from the energy component of the bill, with the opposite being the case of larger industrial customers. If the certificates stay at the AUD 36 per MWh, this would equal payments to support renewables of approximately AUD 342 million annually once the obligation level reaches its final 9 500 GWh level in 2010 through 2020. If REC prices reach the level originally projected by ORER (*i.e.* AUD 25 per MWh), the annual cost of supplying the necessary number of certificates when MRET reaches its maximum obligation level would be AUD 237.5 million. If REC prices rise to the effective ceiling of AUD 57 per MWh, the annual cost would be AUD 541.5 million.

## BENEFICIAL BIOMASS TAXATION

Biofuels are taxed favourably with regard to comparable fossil fuels. Both ethanol and biodiesel receive production grants of AUD 0.38143 per litre of fuel. Since this is the exact amount of the excise tax, they are fully exempted. This credit was introduced on 18 September 2002 for ethanol and 18 September 2003 for

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13. Many REC transactions are conducted bilaterally with confidential pricing. They may also be sold as part of a package with the electricity itself and therefore splitting out the value of the REC itself is not obvious. However, the AUD 36 per MWh figure represents the best estimate of the ORER for that time.

biodiesel and will run through 30 June 2011. After that date, excise tax exemptions will be phased out in five equal steps to a final rate of AUD 0.125 per litre for LPG and ethanol and AUD 0.191 per litre for biodiesel. While these discounts are dissimilar on a volume basis, they are intended to be equivalent on an energy basis. These final rates will apply from 1 July 2015 and will represent a 50% discount from full excise taxes calculated on the full energy content rate.

## RENEWABLE ENERGY COMMERCIALISATION PROGRAM (RECP)

The Renewable Energy Commercialisation Program (RECP) is a five-year competitive grants programme, which has made over AUD 50 million available to foster the development of the renewable energy industry in Australia. The RECP has two components, commercialisation and industry development. Some 49 projects were supported under the commercialisation component, including biomass to energy projects for the sugar industry, large-scale thermal and solar photovoltaic (PV) projects, building integrated PV, landfill gas power generation, hot dry rock resource assessment, wind power and enabling technologies for renewable energy systems such as batteries and inverters. A further 35 projects were supported under the industry development component to assess renewable energy resources, provide standards and best practice guidelines to improve the quality of renewable energy projects and equipment, and increase the availability of training and education in renewable energy to promote skills and public commitment.

## PHOTOVOLTAIC REBATE PROGRAM (PVRP)

The federal government has provided AUD 40.4 million over six years from 2000 to 2005 for the Photovoltaic Rebate Program (PVRP) to encourage the long-term use of photovoltaic technology. Key objectives of the PVRP are to: *i)* reduce GHG emissions, *ii)* assist in the development of the Australian PV industry and *iii)* increase public awareness of renewable energy.

Rebates of up to AUD 4 000 per household are available. The programme also includes a component for residential property developers to apply for funding to install PV on new housing.

## RENEWABLE REMOTE POWER GENERATION PROGRAM (RRPGP)

The Renewable Remote Power Generation Program (RRPGP) aims to increase the uptake of renewable energy technology as a replacement for diesel generation in remote areas of Australia. Programme funding is derived from



excise taxes on diesel fuel used for remote, off-grid public power generation. The objectives of the RRPGP are to:

- Help in providing an effective electricity supply to remote users.
- Assist the development of the Australian renewable energy industry.
- Help meet the energy infrastructure needs of indigenous communities.
- Lead to long-term greenhouse gas reductions.

The Australian government has recently approved an extension to the deadline for commitment of programme funds to 2010. In addition, the maximum RRPGP rebate has also been increased from 50% to 70% and eligibility for funding under the programme has been expanded.

## RENEWABLE ENERGY EQUITY FUND (REEF)

The Renewable Energy Equity Fund (REEF) provides venture capital for small innovative renewable energy companies. This includes companies that are commercialising renewable energy technologies and services, such as manufacturers of PV cells or the inverters to convert this to useful electricity. The fund was launched with a one-off sum of AUD 17.7 million provided by the federal government to be matched on a 2:1 basis with private-sector capital. CVC REEF Investment Managers Ltd, the fund manager, makes investments in accordance with guidelines approved by the Industry Research and Development Board (IR&D Board) in consultation with the Australian Greenhouse Office (AGO). The Australian government is not directly involved in making investment decisions.

## STATE GOVERNMENT SUPPORT FOR RENEWABLE ENERGY

In addition to the federal government initiatives described above, a number of states are pursuing programmes to increase the contribution from renewable resources.

The Victorian government has set a target that by 2010, 10% of Victoria's electricity consumption will be from renewable sources. Victoria has implemented a number of programmes to assist in meeting this target such as the Energy Smart Business Program, which involves a corporate commitment programme providing acknowledgments and rewards to participants. Funds are available for up to 20% of the capital cost of medium-scale renewable energy projects.

The Renewable Energy Support Fund (RESF) is a key initiative of the Victorian Greenhouse Strategy and is administered by the Sustainable Energy Authority

of Victoria (SEAV). The objective of RESF is to encourage innovative applications of medium-scale proven renewable energy technologies in Victoria, such as energy generated from farm waste or mini-hydro projects. By demonstrating successful application of renewable energy, the fund aims to reduce barriers for future projects, enabling widespread replication.

In New South Wales, the Department of Energy, Utilities and Sustainability (DEUS) has launched the Renewables Investment Program (RIP), which promotes new renewable electricity generation or the substitution of fossil fuels by renewables. The programme focuses on developing, demonstrating and commercialising new technologies or the new application of existing technologies. The support is for generators with an output of more than 25 kW with funding of up to AUD 2 million available in the form of concessional interest loans.

The Queensland government currently provides direct support to sustainable energy technologies via the Queensland Sustainable Energy Innovation Fund, which offers grants to assist commercialisation of innovative renewable and energy-efficient technologies. A further programme is the Solar Hot Water Rebate scheme, which provides savings of approximately 40% on electricity bills and reduces CO<sub>2</sub> emissions by an average of 3 tonnes per year.

The South Australian government offers a Solar Hot Water Rebate. This scheme provides South Australians with access to rebates for installations of solar hot water systems that meet certain eligibility criteria.

The Western Australia government provides a solar water heater subsidy, designed to reduce GHG emissions through the uptake of renewable energy, and to assist in the long-term development of the solar water heater industry. The Sustainable Energy Development Office (SEDO) provides funding and grants to support renewable energy and energy efficiency projects in Western Australia (WA).

The Australian Capital Territory (ACT) has set in place a Solar Hot Water Rebate scheme to reduce the cost of installing solar hot water systems to ACT households.

## **CRITIQUE**

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Australia has many characteristics that are favourable to renewable energy. First, it has substantial natural resources, including those for wind, solar, geothermal and hydropower, although exploitation of hydropower may already be maximised. Second, it has an open, transparent electricity market, which allows for the relatively easy introduction of new entrants, as renewable energy additions tend to be. Third, Australia has more open space than any other IEA country and this makes siting less difficult.

In 2003, Australia produced 6.5 Mtoe of renewable energy. This accounted for 5.8% of national TPES, which very closely matches the 5.9% of TPES coming from renewables for the IEA countries as a whole. A full 98% of the Australian renewables comes from either hydropower or biomass. As is the case in most countries, both hydropower and biomass were developed for their inherent cost advantages, rather than as a result of government programmes supporting renewable energy technologies. In terms of other renewable energies (such as wind or solar), which are normally brought on line as a result of government initiatives, Australia's share of these technologies is well below the IEA average.

A key characteristic working against the development of renewable energies in Australia is the predominance of accessible, well-located, inexpensive fossil fuels and an approach to climate change that is based on securing least-cost abatement opportunities. In addition, Australia has maintained a technology-neutral approach to supporting renewables rather than a selective technologies approach adopted in some other IEA countries. Nevertheless, government activity supporting renewable energy has risen in recent years with additional renewable support programmes being put in place, notably the Mandatory Renewable Energy Target (MRET). As in all countries, renewable energy enhances energy security through supply diversity, boosts technology and industry development and reduces environmentally harmful emissions. Renewable energy is also generally more expensive than other supply options, necessitating government financial support to achieve any type of substantial industry development and penetration.

The MRET is a certificate type system, which was the forerunner for similar schemes that have since been introduced in the United Kingdom and Sweden. While certificate systems are recognised for their ability to keep costs down and promote greater efficiencies in equipment and operation, there have been some questions as to whether they can actually deliver the desired new installed capacity as effectively as other instruments, such as feed-in tariffs or whether they can support a range of technologies rather than just the least expensive technology. In this context, the Australian MRET has been very successful. The government estimates that AUD 1 billion of investment has resulted from MRET to date with an additional AUD 1 billion either committed or planned. Generation from eligible renewable generators is actually higher than the MRET obligation level at this point. In addition, no single technology is dominating the certificates market.

The MRET system seems to be supporting renewable energy at a relatively low cost. At the current REC price of AUD 36 per MWh, and taking an average wholesale pool price of AUD 36.50 per MWh<sup>14</sup>, the total price received by the

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14. The average electricity price in the four states of New South Wales, Victoria, South Australia and Queensland for the 12 months ending in February 2005 was AUD 36.47 per MWh.

renewable generators in the MRET system is AUD 71 per MWh, or EUR 42.37 per MWh. Both the certificate systems and particularly the feed-in tariffs seen in Europe have prices that are well above that level. This low price comes from Australia's favourable natural conditions, the sound design and implementation of MRET and the general downward price pressures brought about by Australia's competitive electricity market. Nevertheless, the government announced in the energy White Paper, that it will not increase the MRET obligation level beyond 9 500 GWh (as some shareholders were encouraging) owing to the economic costs that a higher target would impose. While this target is below what many IEA countries are aiming for, it may make sense in an Australian context of low, secure energy prices and many attractive opportunities for possible future GHG emissions reduction in the efficiency field.

To date, the MRET has attracted an impressive array of renewable energy technologies with five different energy sources capturing at least 8% of the REC market. It is also likely that the share of the largest contributor, hydropower with 42% of the share of RECs generated to year-end 2004, will decline as opportunities for increased generation in that area are exhausted and there will be further diversity among renewable energy technologies. Large hydropower is not normally included in renewable certificates schemes because it is believed to be commercially viable without support and therefore: *i)* has no need for support, and *ii)* will dominate the certificates market and thus restrict the entry of other technologies. Lack of appropriate sites and environmental restrictions in Australia will limit the expansion of large-scale hydropower. The government should nevertheless monitor the certificates market and assess the implications to the long-term viability of the Australian energy industry should hydropower, or any one technology, receive all the benefits in the certificates market.

Given the government decision not to raise the renewable target, the ways to benefit from the apparent cost advantage of Australian renewables are not obvious. It is clear that uniquely as a tool for emissions reduction, Australian renewables cannot currently survive on carbon emissions certificates, even if Australia decided to adopt such a trading programme. Assuming that every MWh of electricity displaced in Australia from new renewable energy is coal, and that coal-fired plants emit 0.91 tonnes of CO<sub>2</sub> per MWh generated, the cost for reduced emissions from renewables is expensive at about AUD 39.50 per tonne, or EUR 23.61 per tonne. This is more than double the current price of carbon in the EU Emissions Trading Scheme. However, one way to benefit from a relative renewable cost advantage would be through international renewable electricity certificates. A number of European countries such as Sweden and Norway are trying to develop a cross-border certificates trading system. While it is not yet mature and would not include non-European countries, such a system on a wider scheme could provide a means for Australia to profit from its renewables sector. Another way to benefit from

relatively lower-cost renewable energy is through the development of renewable industries. If the deployment of a critical mass of a certain technology is cheaper in Australia than elsewhere, Australian companies can enjoy a competitive advantage internationally.

The White Paper states that “Renewable energy will play an important part in Australia’s long-term climate challenge.” The White Paper focuses on technology development to further advance renewable energy. While the R&D and implementation programmes included therein are undoubtedly helpful, their translation into substantial expansion of renewable resources will likely require a price signal as well. That is, even with cost reductions and performance improvements from R&D, further support from the government will likely be required, at least in the short term, to achieve significant further penetration of renewable technologies into the energy landscape. Just as a price signal is ineffective without technology advancement, technology advancement without a market support will also fail to expand the contribution from renewables to any significant degree. It is likely that Australia will have to expand its market support framework for renewables beyond current levels if it aims to reach the goal for renewables stated in the White Paper.

The success of a renewable support programme rests not only on the timing of its commencement and the details of its mechanisms, but also on its length and the timing and manner of its expiration. The guarantee offered by extending the MRET obligations through 2020 has been crucial in giving comfort to investors so they can make the necessary long-term commitments. However, investment will likely drop off precipitously, not only owing to the MRET’s target of 9 500 GWh being reached, but also given that some type of guaranteed revenue stream will be required for all or most of a renewable project’s lifetime, say ten to 15 years. Investments made today, or certainly in the coming few years, will begin to run into financing difficulties given the termination of support in 2020. The same effect may be seen when the excise tax advantages for biofuels are reduced. Biofuel use is likely to fall when these advantages are reduced by 50%, as envisioned in the White Paper. The federal government must stay fully aware of the decrease in renewable supply that will result as support programmes expire and try to think as long-term as possible in providing continued policy certainty to investors.

Renewable energy has two specific benefits that can be especially realised in an Australian context. The first is use in off-grid locations of which Australia has more than most countries given its low population density. The second is for meeting peak electricity needs, which are growing significantly in Australia. Certain renewable energies, particularly solar power, have supply profiles that match up very well with these burgeoning peak power demands. Thus, renewable energies which cannot compete against a coal-fired plant to provide grid power could be cost-effective for these niche uses.

## RECOMMENDATIONS

*The government of Australia should:*

- ▶ *Maintain an efficient market-oriented approach to renewables development such as the MRET, while also supporting the most promising renewable energies that still need additional assistance.*
- ▶ *Exploit those renewable energies where Australia enjoys a relative cost advantage over other countries.*
- ▶ *Continue to give a long-term perspective to the renewable industry, by assessing the effect of government support programmes (and their expiration schedules) and responding if renewables development is not consistent with the goal of making renewable energy an important part of the long-term strategy.*
- ▶ *Maintain focus on cost reduction of renewables technologies and on energy needs where renewables may be more cost-effective, such as remote area power generation and summer electricity peaks.*



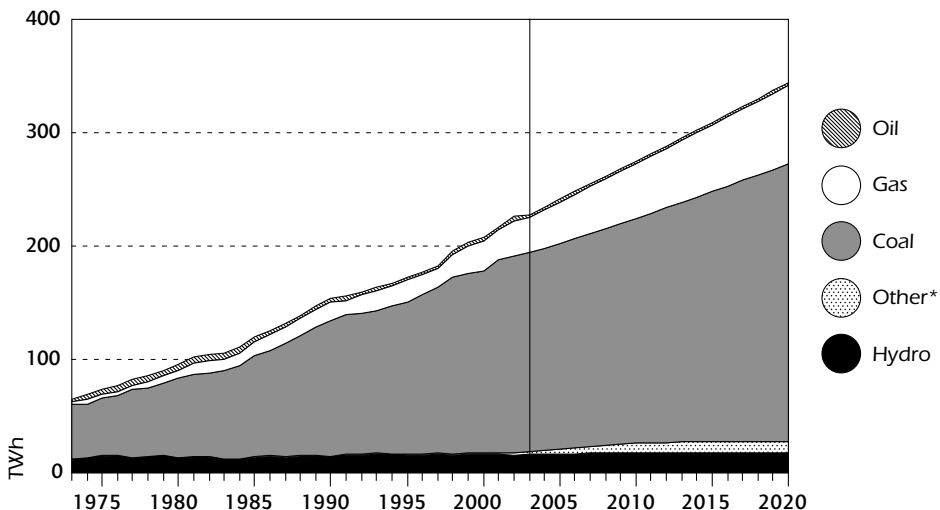
## ELECTRICITY SUPPLY AND DEMAND

### SUPPLY

Australian electricity generation is dominated by coal. In 2003, coal-fired power plants generated 77.2% of the country's total electricity production. This was followed by natural gas (13.8%), hydropower (7.0%), oil (1.0%), biomass (0.6%) and solar and wind combined (0.3%). Coal has been dominant for more than 30 years, accounting for 74.9% of total electricity generation in 1973. Its share has fallen below 70% only four times since 1970 and not since 1979. The Australian government projects that coal's dominance will continue with the fuel accounting for 71.1% of electricity generation in 2020. The only significant change in electricity shares has been the increase in gas-fired generation at the expense of hydropower. Although absolute hydropower has been steady or increased, it has not kept pace with the overall generation increase. Figure 12 shows the trend in generation for the last 30 years, as well as a forecast to 2020 issued by the Australian government.

Figure 12

Electricity Generation by Source, 1973 to 2020



\* includes solar, wind, combustible renewables and waste.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005; and country submission.



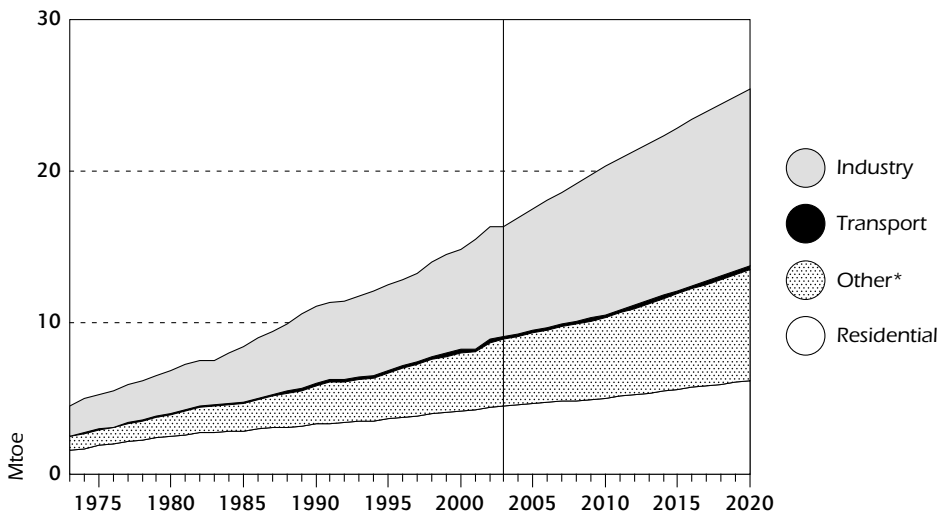
Coal-fired plants also constitute a clear majority of electricity generating capacity in Australia. In 2003, coal-fired plants made up 58.4% of the total capacity, followed by hydropower (19.1%, of which 17% is pumped storage), natural gas (13.5%), liquid/gas fossil fuel-switching plants (5.4%), oil products (2.9%), wind power (0.4%), biomass (0.2%) and solar (0.1%).

## DEMAND

Australian electricity demand has grown faster than overall energy consumption. In 1970, electricity accounted for only 10.3% of the total final consumption (TFC) for all fuels, while in 2003 it accounted for 22.6%. Over that period, demand for electricity grew by 4.7% annually while consumption of all fuels grew by 2.2% annually. While IEA countries in general have undergone greater electrification and used more electricity, Australian electricity demand has still grown at one of the fastest rates in the OECD over the last 30 years. For IEA countries as a whole, electricity consumption grew by 2.8% annually from 1973 to 2002 and TFC grew by 0.9%. Australian electricity consumption per unit of GDP is 0.4314 kWh per 1995 USD and 10 502 kWh per person. This was substantially above the figures for the IEA as a whole (0.3185 kWh per 1995 USD of GDP and 8 864 kWh per person).

Figure 13

Final Consumption of Electricity by Sector, 1973 to 2020



\* includes commercial, public service and agricultural sectors.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005; and country submission.

In recent years, Australia has seen its peak electricity demand rise faster than overall electricity demand. Over the last five years, peak demand has risen by 18%, largely as a result of the continued penetration of air-conditioning, which requires power at peak times. This trend is expected to continue although it may slow as air-conditioning reaches a saturation point. NEMMCO's "Statement of Opportunities 2004" predicts that on a non-weighted average of all the states, total electricity demand will rise by 2.1% annually over the next ten years while peak demand will rise by 2.6% annually. On a weighted average basis, the discrepancy would be even higher since the largest states of New South Wales and Victoria are forecast to have the greatest peak demand increases.

In 2003, industry accounted for 44.6% of TFC of electricity, followed by residential (27.4%), commercial and public services combined (26.9%) and transport (1.1%). These shares have remained quite steady over both the short and the long term with the only significant shift being a relative rise in commercial electricity use with a consequent decline in residential electricity use.

## **REGULATORY STRUCTURE**

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### **EXISTING REGULATORY STRUCTURE**

Australia was one of the first countries to undertake substantial market reform in the electricity sector. Limited wholesale market trading began between New South Wales (NSW) and Victoria as early as 1994. The National Electricity Market (NEM) commenced operation in 1998 as part of the process of deregulation of the Australian electricity supply industry (ESI) and involved the separation of the previously vertically integrated supply chain of generation, transmission, distribution and supply. The NEM is the wholesale market for the supply and purchase of electricity combined with an open access regime for use of the transmission and distribution networks. Legally, the NEM was established under state legislation. This reflects the nature of the Australian Constitution, which does not assign responsibility for energy matters to the national government. The powers of the Australian government in this area are indirect, through responsibility for such things as trade and commerce and corporations. The NEM jurisdictions are interconnected and include the Australian Capital Territory (ACT), NSW, Queensland, South Australia (SA) and Victoria. Tasmania joined the NEM on 29 May 2005. The regulatory and market arrangements applied from that date, although Tasmania will not be connected to the power systems of the other NEM states until the commissioning of the undersea transmission line to Victoria, scheduled for completion in April 2006. Including Tasmania, the NEM accounted for 93% of total Australian generation in 2002.

The NEM is structured around a common pool, or spot market, for trading wholesale electricity. All electricity generated by licensed market participants with a minimum of 30 MW of capacity must be traded through the pool. A

single central dispatch process determines the merit order for the dispatch of generation (with the lowest-priced generator dispatched first subject to system and other operating constraints) based on a five-minute dispatch cycle and 30-minute trading intervals. Electricity is valued at one price (*i.e.* no separate provision for capacity payments) with a spot price cap of AUD 10 000 per MWh.

The NEM is intended to provide a maximum level of market transparency. It has been designed to ensure that the market trading rules do not constrain bilateral trading between participants in the form of financial instruments which may be used to hedge against price and volume risks in contracting for electricity. The structure of the NEM also provides locational price signals to generators, customers and network service providers based on zones that roughly correspond to state jurisdictional boundaries with the Snowy Hydropower scheme having its own region.

The National Electricity Market Management Company (NEMMCO) is both the system and market operator. Its responsibilities include operating and administering the spot market; managing the day-to-day operation of the bulk transmission network and maintaining system security; making provision for short-term forward markets; contracting for the provision of ancillary services and system reserve; and providing a spot price settlement service for the wholesale market. NEMMCO is subject to the national corporations and trade practices law and the founding members are the governments of NSW, Victoria, Queensland, SA and the ACT.

Retail market opening, or full retail contestability (FRC) as it is termed in Australia, was introduced from 1 January 2002 in NSW, 13 January 2002 in Victoria, 1 January 2003 in SA and 1 July 2003 in the ACT. FRC gives all electricity customers the right to choose their retail supplier for electricity according to their individual needs. Even where FRC is available, customers can opt not to enter a contestable market and can remain under what is called the "franchised load" or "standing offer" arrangement at fully regulated electricity tariffs.

In Queensland, retail contestability was granted from 1 July 2004 to connection points consuming more than 100 MWh per year. The Queensland government has decided not to introduce FRC at this stage. The decision not to implement FRC was based on a state government cost-benefit analysis in 2001 which indicated that the benefits of introducing FRC did not outweigh the costs at that time. In particular, the Queensland government was concerned that FRC could result in significant price rises for regional customers. The Queensland government will review the decision regarding FRC in the future.

Tasmania joined the NEM as a participating jurisdiction in May 2005, introducing a contestable wholesale electricity market to be followed by phased introduction of retail competition. In July 2006, retail contestability

will be granted to customers using more than 20 GWh per year, followed by customers using more than 4 GWh per year in July 2007. Businesses using more than 0.75 GWh a year will become contestable customers in July 2008, followed by those businesses using more than 0.15 GWh in July 2009. The contestability of the final class of residential and business customers will be subject to a review in 2009 by the Tasmanian government.

The Snowy Mountains Hydro Electric Scheme operates as an independent entity in the NEM with 2 256 MW of hydropower. While Snowy is part of a separate region in the NEM, it is connected to both NSW and Victoria allowing trade between regions that is critical to the smooth operation of the NEM. As a peaking plant, with generation limited by the available water supply, Snowy Hydro also aims to compete in the higher-priced peak periods of the NEM trading day to maximise its return. Snowy Hydro also has an important system security function in the supply of ancillary services to the NEM.

Information on electricity sector regulation in the states and territories that are not a part of the NEM is included below.

## **Western Australia**

The Western Australian (WA) electricity industry is characterised by a small and geographically diverse load with minimal grid development beyond the south-west and a large number of isolated power plants. In 2002, it accounted for 6.9% of total Australian generation. WA's relative isolation has prevented it from being connected to the NEM. The main electricity supplier is Western Power, a state-owned corporation composed of four ring-fenced units covering generation, transmission, distribution and sales, the Pilbara interconnected system and isolated regional systems. In addition, five private electricity supply authorities service townships in remote locations.

The WA government established the Electricity Reform Task Force in August 2001 to develop recommendations regarding the disaggregation of Western Power; the structure of the electricity market to be established in WA; a Western Australian Electricity Code; and arrangements for full retail contestability. The legislation to disaggregate Western Power was withdrawn after not achieving the required support.

Retail contestability has existed to a limited degree since 1997. Since then, more tranches have been opened up increasingly allowing consumers to choose their electricity supplier. However, smaller electricity consumers do not have access to choice of electricity supplier. The WA Office of Energy's Electricity Reform Implementation Unit is establishing a more competitive framework for the South West Interconnected System (SWIS) comprising a new access framework, a customer protection code, ombudsman scheme and licensing arrangements. A wholesale electricity market will be in place for WA by July 2006, which will have key elements such as bilateral contracts,

a residual trading market and balancing mechanisms. These arrangements are intended to encourage competition in the WA market.

## Northern Territory

In the Northern Territory (NT), the ESI is characterised by a small and geographically dispersed load with minimal grid development. In 2002, the NT accounted for 0.9% of national generation. Electricity is supplied primarily by Power and Water, a state-owned corporation, but private ownership of generation and distribution facilities is permitted. On 1 April 2000, the NT introduced retail contestability for customers with an annual consumption of at least 4 GWh and on 1 April 2002, customers with annual loads greater than 750 MWh became contestable. The NT government has decided to defer the remaining contestability tranches for up to five years. This decision has been taken after NT Power exited the market, which left Power and Water Corporation as the only supplier of electricity to the vast majority of NT customers.

## ONGOING REFORMS

At its meeting on 8 June 2001, the Council of Australian Governments (COAG) agreed to establish the Ministerial Council on Energy (MCE) which comprises the Energy Ministers from all states and territories and the Commonwealth. The MCE provides: *i)* national oversight and co-ordination of energy policy and *ii)* national leadership to integrate a broader convergence issues and environmental impacts on energy sector decision-making.

At the same time, COAG agreed to initiate an independent review of energy market directions, to identify strategic issues for Australian energy markets and the policies required from Commonwealth, state and territory governments. COAG requested that the MCE oversee the review process. The final report of the review (also called the Parer Review and titled "Towards a Truly National and Efficient Energy Market") was published on 20 December 2002.

Following its consideration of the findings of the Parer Review, the MCE reported to COAG on 11 December 2003 with a communiqué and an accompanying document entitled "Reform of Energy Markets". The overall thrust of this document and associated initiative will be to create electricity and natural gas markets that have true national scopes rather than being state-based. The recommendations of that report have been endorsed by COAG.

The primary institutional change in this reform is the creation of two new bodies. The first is the Australian Energy Market Commission (AEMC) with responsibility for rule-making and market development while the other is the Australian Energy Regulator (AER) with responsibility for energy regulation. The motivation behind the creation of these two separate entities is to

separate out the rule-making function from the administration of the rules. Both the AEMC and the AER were to have been established and operational by July 2004 but owing to administrative difficulties and ongoing negotiations on the final structure and membership of these organisations, their creation has been delayed. They are now scheduled to start work in June 2005.

Another major proposal of the energy market reform concerns electricity transmission. A new planning process will be established to improve consistency, transparency and economic efficiency, particularly for connections between states. An Annual National Transmission Statement (ANTS) is now developed by NEMMCO. This assessment details the major transmission flow paths, forecasts interconnector constraints and identifies options to relieve constraints. A new regulatory test for transmission additions will be developed to recognise the full economic benefits of additional lines, including mitigation of market power and enhanced competition. The nature of this new test and other proposed changes are discussed in greater detail in the Transmission section below.

Specific tasks to be completed in pursuit of the new reform agenda include:

- Finalisation of an intergovernmental agreement and enactment of co-operative legislation.
- Establishment of the AER and the AEMC.
- Implementation of electricity transmission reforms.
- Development of a national approach to energy access.
- Establishment of an agreed national framework for distribution and retailing.
- Enhancing user participation in energy markets.

## **INDUSTRY STRUCTURE**

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An overview of the NEM market structure, including the number of generators, distributors and retailers in each state, is provided in Table 14.

## **GENERATION**

In 2002, Australian generating capacity was approximately 44 771 MW. Distributed and on-site generation accounts for approximately 10% of this. The majority of generating companies in Victoria and South Australia are privately-owned following asset divestitures in the 1990s<sup>15</sup>.

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15. Generation assets in South Australia remain legally under government ownership but leased to private companies which control all operations and outputs under long-term leasing contracts.

Table 14

## Overview of Market Structure

<i>National Electricity Market industry structure</i>						
<i>State</i>	<i>Generation</i>		<i>Transmission</i>	<i>Distributors</i>		<i>Retailers</i>
	<i>State</i>	<i>Private</i>		<i>State</i>	<i>Private</i>	
NSW	3	3	TransGrid* EnergyAustralia*	6	-	17
Vic		9	SPI PowerNet**	-	7	12
Qld	6		Powerlink*	2		15
SA***	-	6	ElectraNet SA***	1		10
ACT	-	-	Transgrid*		1	12
WA	1	9	Western Power*	1	1	1
Tas		1	Transend*		1	1
NT	1	3	Power and Water*	1		1

\* State-owned.

\*\* Privately-owned.

\*\*\* State-owned assets are privately managed under long-term leases.

Source: Country submission.

Table 15

## Generating Companies by State, 2004

<i>State</i>	<i>Generating company</i>	<i>Ownership</i>	<i>Capacity, MW<sup>(1)</sup></i>	<i>% of state total<sup>(1)</sup></i>	<i>Generation type(s)</i>
<b>New South Wales</b>					
	Macquarie Generation	NSW government	4 770	39.9%	Steam/coal, gas turbine/oil
	Delta Electricity	NSW government	4 240	35.5%	Steam/coal
	Eraring Energy	NSW government	2 938	24.6%	Steam/coal, hydro/pumped storage, gas turbine/oil
<i>Total<sup>(1)</sup></i>			<i>11 948</i>	<i>100%</i>	
<b>Snowy Mountains Hydro Electric Scheme</b>					
	Snowy Hydro Corp	NSW, Vic & Fed govt	2 256	100%	Hydro/pumping
<b>Victoria</b>					
	Loy Yang Power	AGL, Great Energy Alliance Corp (GEAC), Others	2 045	24.3%	Steam/coal
	Meridian Energy Aus	Meridian Energy Australia	428	5.1%	Hydro
	Yallourn Energy	CLP Power Asia	1 480	17.6%	Steam/coal
	Hazelwood Power	International Power, Commonwealth Financial	1 600	19.0%	Steam/coal
	Edison Mission Energy (EME)	International Power	1 000	11.9%	Steam/coal, gas turbine
	Ecogen Energy	Prime Infrastructure, Babcock & Brown, other	978	11.6%	Steam/gas, gas turbine
	Others		872	10.4%	Steam coal, gas turbine
<i>Total<sup>(1)</sup></i>			<i>8 403</i>	<i>100%</i>	

Table 15

## Generating Companies by State, 2004 (continued)

State	Generating company	Ownership	Capacity, MW <sup>(1)</sup>	% of state total <sup>(1)</sup>	Generation type(s)
<b>South Australia<sup>(2)</sup></b>					
	TXU Australia	Singapore Power	1 280	37.2%	Steam/gas
	NRG Flinders	NRG Asia Pacific	700	20.4%	Steam/coal
	International Power (IPA)	International Power (IPA)	480	14.0%	CCGT-GT gas, CCGT-steam/gas
	Synergen Energy (IPA)	Synergen Energy (IPA)	399	11.6%	Simple cycle fuelled with gas, distillate and diesel
	AGL	AGL	220	6.4%	Gas turbine/distillate
	ATCO/Origin	ATCO/Origin	180	5.2%	Co-generation/gas
	Origin Energy	Origin Energy	180	5.2%	Co-generation/gas
	<i>Total<sup>(1)</sup></i>		<i>3 439</i>	<i>100%</i>	
<b>Queensland</b>					
	NRG Gladstone	NRG Asia-Pacific Comalco	1 695	16.9%	Steam/coal/gas turbine/oil
	Tarong Energy	Qld government	2 365	23.5%	Steam/coal, Gas turbine/oil, hydro
	Stanwell Corporation	Qld government	1 566	15.6%	Steam/coal, gas turbine/oil, hydro
	CS Energy	Qld government	2 494	24.8%	Steam/coal, gas turbine/oil, GT/natural gas
	OzGen	Intergen Australia	852	8.5%	Steam/coal
	Others		1 075	10.7%	Steam (coal and fuel oil, CCGT)
	<i>Total<sup>(1)</sup></i>		<i>10 047</i>	<i>100%</i>	
<b>Western Australia</b>					
	Alcoa	Alcoa	268	6.3%	Steam/gas (co-gen)
	Western Power Corp	WA government	3 500	82.9%	Steam coal, oil, gas turbine
	Others		455	10.8%	Gas turbine, co-gen (gas and coal)
	<i>Total<sup>(1)</sup></i>		<i>4 223</i>	<i>100%</i>	
<b>Tasmania</b>					
	Hydro Tasmania	Tasmanian government	<b>2 604</b>	100%	Hydro, steam/gas, wind, diesel
<b>Northern Territory</b>					
	PAWC (Power and Water Corporation)	NT government	427	100%	Gas turbine/jet fuel, steam/gas, gas reciprocation, gas/diesel

<sup>(1)</sup> Capacities listed in this table cover only those plants greater than 200 MW. This cut-off will slightly distort capacity totals for the companies and the states as well as the market shares of companies in each state.

<sup>(2)</sup> South Australian assets still owned by state government but leased long-term to private companies.

Source: ESAA, Electricity Australia 2004.



## Co-generation

Subsidies have been made indirectly available for co-generation projects by means of the Greenhouse Gas Abatement Program (GGAP). The GGAP is a federal government initiative to reduce Australia's net GHG emissions by supporting activities likely to reduce emissions or enhance sinks, particularly in the first commitment period under the Kyoto Protocol (2008-2012).

Table 16

### Co-generation Installed Capacity, 1999-2002 (MW)

<i>Plant Type</i>	<i>1999</i>	<i>2000</i>	<i>2001</i>	<i>2002</i>
Combined cycle (on-grid)	130	682	1 157	1 441
Steam	1 436	1 132	844	869
Gas turbine	268	482	630	620
Reciprocating engines	43	77	52	57
<b>Total</b>	<b>1 877</b>	<b>2 373</b>	<b>2 683</b>	<b>2 987</b>

Source: ESAA 2003.

## Renewable Energy

In 2003, renewable energy contributed a combined 8.0% of Australia's total electricity generation. Hydropower accounted for 7.0%, followed by biomass (0.6%), wind power (0.3%), and solar photovoltaic (0.002%). Renewable energy is supported by a certificate scheme called the Mandatory Renewable Energy Target (MRET). Information on this programme and renewable energy in general is found in Chapter 6.

## TRANSMISSION

Australian transmission ownership and operation is organised on the state level as shown in Table 16 below with a map of the system in Figure 14.

Table 17

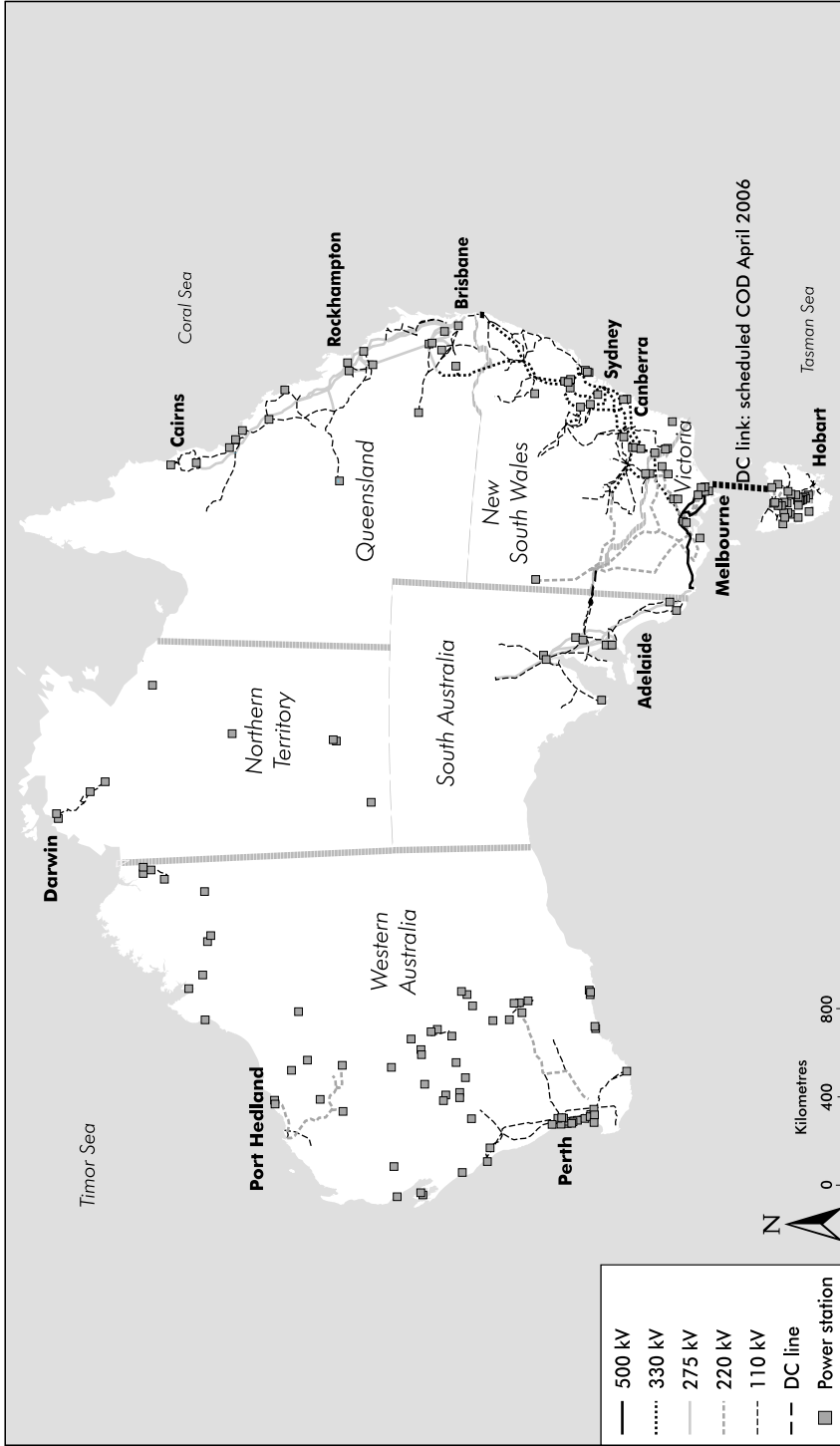
### Transmission Networks (excluding interconnectors)

<i>Network</i>	<i>State</i>	<i>Ownership</i>	<i>Operator</i>
TransGrid	NSW	TransGrid (NSW government)	TransGrid
SPI Powernet	Vic	Singapore Power	SPI Powernet
Powerlink	Qld	Qld government	Powerlink
ElectraNet SA	SA	ElectraNet SA	ElectraNet SA
Transend	Tas	Tas government	Transend
Western Power	WA	WA government	Western Power
Power and Water	NT	NT government	Power and Water

Source: ESAA 2003.

Figure 14

### Map of Australian Transmission System



Source: Department of Industry, Tourism and Resources.

High-voltage interconnections between states are shown in Table 18. In addition, a 600 MW subsea transmission line linking Tasmania with Victoria (Basslink) is scheduled to begin operation in April 2006.

Table 18

**Transmission Interconnections and their Share of Peak Demand**

<i>Importing region</i>	<i>Exporting region</i>	<i>Summer</i>	<i>Winter</i>	<i>Average</i>	<i>% of peak of importing region</i>
New South Wales	Queensland	950	950	<b>950</b>	32.0%
	Snowy	3 012	3 065	<b>3 038</b>	
Queensland	NSW	555	675	<b>615</b>	8.5%
Snowy	NSW	1 150	1 150	<b>1 150</b>	n/a
	Victoria	1 100	1 100	<b>1 100</b>	
South Australia	Victoria	627	627	<b>627</b>	22.5%
Victoria	South Australia	379	379	<b>379</b>	26.5%
	Snowy	1 892	1 892	<b>1 892</b>	

Source: "List of Regional Boundaries and Marginal Loss Factors for 2004/05, Version 3.5", NEMMCO (1 March 2005) and "Statement of Opportunities 2004", NEMMCO (31 July 2004).

Electricity transmission in Australia is open access. Prices for most transmission assets in the NEM are regulated, subject to a revenue cap, but it is also possible for new assets to be unregulated and earn market rates. Private companies initiate plans for such unregulated links, which are entitled to retain the value of energy from the interconnector less the value flowing into it in each spot trading interval. The revenue of transmission companies in the NEM is regulated by the Australian Competition and Consumer Commission (function soon to be transferred to the AER). The maximum annual revenue allowed for transmission is subject to a CPI-X revenue cap, fixed for a period of at least five years that reduces transmission charges over time in real terms.

Transmission pricing arrangements in the NEM include:

- Entry and exit charges recovered through a fixed annual charge on users at each connection point.
- Net transmission use of system charges (TUOS) recovered through a combination of cost-reflective network pricing and postage stamp pricing.
- Common service charges recovered through a postage stamp charge on each connection point with individual users at each connection point paying an energy-based variable charge.

Transmission companies may also receive revenue from interregional congestion. Settlement residue rights are auctioned by NEMMCO to market participants to manage interregional trading risk. The auction proceeds are used to reduce

customer transmission charges (TUOS). When there are constraints between regions, prices are higher in the importing region. The difference in revenue in the importing region is used by the holder of settlement residue rights to offset any deficits in the financial contracts written between those regions.

These arrangements were based on transitional pricing mechanisms to facilitate NEM commencement and the MCE considered them not particularly cost-reflective and providing ineffective signals for efficient use of transmission networks, especially when they were physically constrained. The reliance on averaging and postage stamping also mutes locational pricing signals for new investment, both in transmission and generation.

In its December 2003 publication, the MCE adopted the following principles to underpin transmission policy:

- The transmission system fulfils three key roles: *i)* provides a transportation service from generation source to load centre; *ii)* facilitates competition; and *iii)* ensures secure and reliable supply.
- There is a central and ongoing role for the regulated provision of transmission, with some scope for competitive (market) provision.
- Transmission investment decisions should be timely, transparent, predictable and nationally consistent, at the lowest sustainable costs.
- The regulatory framework should maximise the economic value of transmission, including through the efficient removal of regional price differences in the operation of the NEM.

Consistent with these principles the following reforms were agreed upon:

### **National Transmission Planning**

An Annual National Transmission Statement (ANTS) will be developed by NEMMCO to detail national transmission flow paths, forecast interconnector constraints and identify options to relieve those constraints. The first ANTS was published in the annual Statement of Opportunities (SOO) in July 2004.

### **New Regulatory Test**

The regulatory test is an economic cost-benefit test used by network businesses in the NEM to evaluate the efficiency of network investment. The ACCC has recently completed a review of the test to better recognise the benefits of competition arising from greater interconnection capabilities. A policy group is reviewing dispute resolution and information requirements.

### **Regional Boundaries**

An independent economic study has been commissioned to evaluate a more transparent process for assessment of regional boundary changes. Consideration

is being given to measures to improve market efficiency, including through the incorporation of dynamic constraint and loss factors in the NEMMCO dispatch engine and consistent treatment of transmission constraints.

### **Interregional Financial Trading**

Work is being undertaken on measures to enhance interregional trading arrangements by looking at mechanisms for pricing transmission constraints.

### **Transmission Availability Incentives**

The ACCC is currently evaluating measures to more closely align transmission performance measures with their market impact.

## **DISTRIBUTION AND RETAIL**

The individual states are responsible for the distribution networks within their jurisdictions. Each state and territory is responsible for regulations and reliability service standards to which distribution network operators must conform. Annual reviews are conducted by jurisdictions on the performance of their distribution networks. The performance reviews monitor reliability and quality of electricity supply to customers amongst other issues. Details on distribution companies are shown in Table 19. However, as part of the ongoing MCE reforms, the AER will assume responsibility for national regulation of distribution and retailing (other than retail pricing) by December 2006 following development of an agreed national framework.

## **SYSTEM SECURITY**

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The NEMMCO has the responsibility to publish the "Statement of Opportunities" (SOO) on 31 July each year. The SOO includes NEMMCO's assessment of the future of the supply-demand balance and (for the first time in 2004) the Annual National Transmission Statement. It is intended to assist market participants in assessing: *i)* the future need for electricity capacity, *ii)* demand management capacity, and *iii)* augmentation of the transmission network to support NEM operations.

The supply-demand balance presents NEMMCO's assessment of the adequacy of electricity supply to meet projected demand for the next ten years. It begins by defining the minimum reserve levels each state must have to meet the Reliability Standard which mandates that, over the long term, 99.998% of customer demand be met. The SOO's minimum reserve levels in 2003 and 2004 are shown in Table 20.

Table 19

### Australian Electricity Distribution Networks

<i>State</i>	<i>Operator</i>	<i>Ownership</i>	<i>Consumption</i>
ACT	ActewAGL	AGL and ACTEW Corporation	
NSW	EnergyAustralia	EnergyAustralia	NSW & ACT (2002) 63 329 GWh
	Integral Energy	NSW government	
	Country Energy	Country Energy	
	Australian Inland	NSW government	
Qld and NSW	ENERGEX	ENERGEX (Qld government)	QLD
Qld	Ergon Energy	Ergon Energy (Qld government)	39 544 GWh
South Australia	ETSA Utilities	ETSA Utilities, member of the Cheung Kong Group	SA 11 213 GWh
Tasmania	Aurora Energy	Aurora Energy	TAS 9 546 GWh
Victoria	AGL Electricity	AGL	VIC 39 007 GWh
	Citipower	Cheung Kong Infrastructure and Hong Kong Electric Holdings	
	Powercor Australia	Cheung Kong Infrastructure and Hong Kong Electric Holdings	
	TXU	TXU Corp	
Western Australia	United Energy – Alinta	United Energy, Power Partnership, Alinta & AMP Henderson	WA 12 081 GWh
Northern Territory	Power and Water Corporation	NT government	NT 1 559 GWh

Source: compiled by DITR from various sources.

Table 20

### Minimum Reserve Levels from SOO 2003 and SOO 2004, MW

	<i>Queensland</i>	<i>New South Wales</i>	<i>Victoria and South Australia</i>	<i>Tasmania</i>	<i>Total</i>
SOO 2004	610	- 290	530	144	994
SOO 2003	450	700	795	288	2 233
Change	+ 160	- 990	- 265	- 144	- 1 239

Source: "Statement of Opportunities" July 2004.

As shown, aggregate minimum reserve levels needed to meet the Reliability Standard have been reduced by 1 239 MW. This change reflects the:

- Ability of interconnectors to share reserves between regions.
- Effect of demand diversity between regions (*i.e.* peaks are non-concurrent in different states, allowing greater reserve sharing across interconnectors).

The SOO then goes on to determine what it terms Low Reserve Conditions (LRC) points. These are the years in which reliability could be expected to fall below the Reliability Standards if no action is taken to bring new capacity to the market or to dampen demand below expectations. The LRC point does not indicate insufficient capacity to meet expected demand, or probable supply interruptions<sup>16</sup>.

Table 21

### Projected Years of Low Reserve Conditions

<i>State</i>	<i>LRC point</i>	<i>Reserve Deficit at LRC point</i>
Queensland	2009/10	132 MW
New South Wales	2008/09	157 MW
Victoria/South Australia (combined)	2004/05 <sup>(1)</sup> 2006/07	356 MW 321 MW
Tasmania	beyond 2013/14	-

<sup>(1)</sup> The initial LRC point identified for Victoria and South Australia combined (2004/05) passed during the summer months without any difficulties or shortages. The reason a second LRC is given is that the Basslink 600 MW subsea interconnector with Tasmania was scheduled to come on line in 2005, delaying the need for more capacity. Now that the commercial operation of Basslink has been postponed to 2006, the LRC point would presumably be moved up a year.

Source: "Statement of Opportunities" July 2004.

The Annual National Transmission Statement, a part of the SOO, provides an overview of the current state and potential development of major transmission flow paths. Market simulations are used to develop a range of initial flow path development indicators that broadly assess the need for network capacity over a ten-year time horizon. This flow path analysis identified three interconnections that warranted further investigation for expansion, while the supply-demand balance identified a fourth. The SOO stresses that this analysis does not constitute a recommendation for expansion, but rather pointers for further analysis. The four interconnections are:

16. NEMMCO published the "2004 Statement of Opportunities Update" on 31 January 2005, which concludes that there have been "no significant changes to the supply-demand balance set out in the 2004 SOO."

- Victoria towards the Snowy Mountains.
- Queensland towards New South Wales.
- Victoria towards South Australia.
- Snowy towards Victoria.

## **ELECTRICITY PRICES**

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### **RETAIL PRICES**

Australia has some of the lowest retail electricity prices in the IEA. For industrial customers, Australia had the second-lowest ex tax retail prices in the IEA in 2002<sup>17</sup>. Prices in Australia are 38% below the average retail price. For household customers, Australian prices were the third-lowest in 2002, behind New Zealand and Norway<sup>18</sup>. Australian prices were 31% below the average for IEA prices. Figure 15 shows electricity prices for industrial and household customers compared against selected IEA countries.

### **WHOLESALE PRICES AND INTERNATIONAL COMPARISONS**

Wholesale electricity prices in Australia appear to be substantially below those in other countries that have developed liberalised markets with accompanying power pools. Based on an analysis of pool prices over 2003 and 2004, the average Australian pool price was 44% below Nordpool, 37% below Germany and 46% below the pool price in the Pennsylvania-New Jersey-Maryland Interconnection (PJM) in the eastern United States. Table 22 shows the non-weighted average monthly prices for four Australian states and three other regions.

While the figures in Table 22 are indicative of significant price differences between regions, care should be taken in using them for a full assessment of the efficiency of the different electricity systems. Pool prices can be affected by: *i*) the different stages of the investment cycle, *ii*) overcapacity remaining from regulated regimes, *iii*) unusual meteorological conditions (*e.g.* rainfall, temperature), *iv*) different input fuel costs and general availability, and *v*) the use of average exchange rates by year rather than month.

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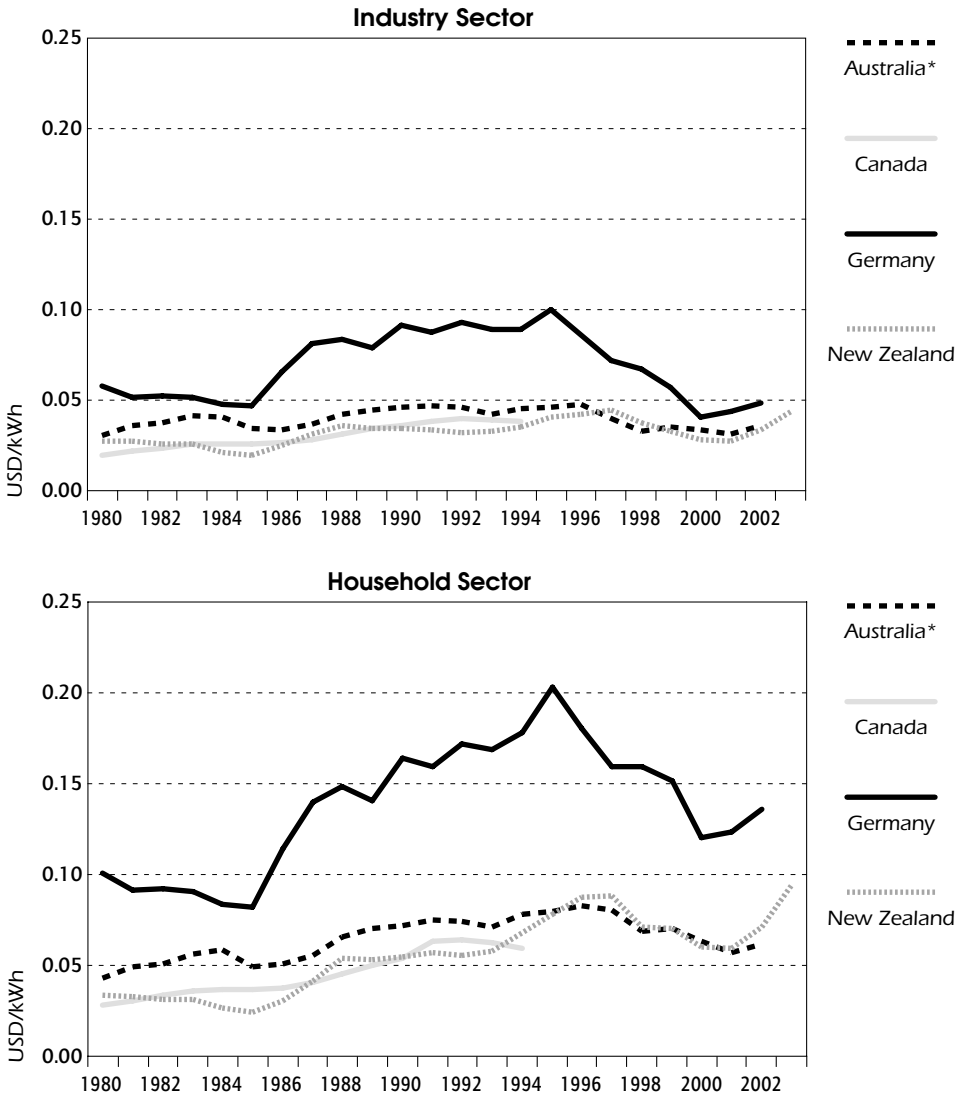
17. Data on industrial electricity prices exclude Austria, Belgium, Canada, Luxembourg, the Netherlands, Norway and Sweden. The most recently available data from Australia are for 2002.

18. Data on household electricity prices exclude Belgium, Canada and Sweden.



Figure 15

Electricity Prices in Australia and in Other Selected IEA Countries, 1980 to 2003



\* ex-tax price.

Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2005.

There has been a general upward trend in Australian pool prices from 2003 to 2004. Year on year, the pool prices rose approximately by 50%. This is due in part to a general tightening of the supply-demand balance and the lack of new generation investment in 2004 (partly as a result of anticipating the low-

Table 22

**Wholesale Pool Prices in Different Australian States and Other Countries, 2003 and 2004 (AUD/MWh except for final row in EUR/MWh)**

Month	Australia					Other countries		
	NSW	QLD	SA	VIC	Avg Aus	Nordpool	Germany	PJM <sup>(1)</sup>
January-03	48.3	31.2	33.7	26.1	34.8	124.7	50.6	
February-03	19.1	18.2	21.6	18.4	19.3	84.0	60.0	
March-03	17.3	15.2	24.3	21.7	19.6	68.6	46.5	90.2
April-03	15.6	14.8	20.8	14.7	16.5	54.8	41.4	56.0
May-03	19.7	16.9	28.7	21.3	21.6	51.3	36.7	52.1
June-03	49.5	38.5	28.9	41.5	39.6	43.1	50.5	48.3
July-03	46.8	43.8	27.1	25.6	35.8	48.1	62.5	60.4
August-03	19.6	16.9	22.8	20.2	19.9	57.4	54.4	60.4
September-03	21.1	16.1	23.3	20.7	20.3	56.2	50.7	44.5
October-03	17.5	14.9	25.1	20.7	19.6	61.1	59.2	41.5
November-03	18.4	20.7	32.5	21.2	23.2	63.1	53.9	43.2
December-03	23.4	22.7	30.8	25.0	25.4	54.1	49.6	55.8
January-04	26.8	23.1	32.7	22.5	26.3	49.0	47.0	74.7
February-04	58.5	40.7	86.8	38.6	56.2	46.4	44.8	59.1
March-04	63.7	55.9	41.8	21.5	45.7	49.1	52.2	52.4
April-04	30.3	28.3	31.5	29.5	29.9	48.7	43.3	57.0
May-04	32.1	28.9	34.1	31.3	31.6	46.8	45.3	63.4
June-04	31.2	26.5	32.6	28.6	29.7	53.8	45.2	53.3
July-04	35.6	25.2	39.5	31.4	32.9	47.6	46.0	57.7
August-04	23.6	24.5	32.4	22.6	25.8	54.8	49.2	52.8
September-04	28.2	27.7	30.7	27.2	28.4	49.1	52.9	52.7
October-04	69.6	51.2	41.3	44.9	51.7	46.7	51.1	50.7
November-04	77.7	50.9	64.9	35.7	57.3	49.1	48.6	52.1
December-04	64.9	31.7	33.8	27.4	39.4	44.1	51.4	53.7
<b>Average, AUD/MWh</b>	<b>35.8</b>	<b>28.5</b>	<b>34.2</b>	<b>26.6</b>	<b>31.3</b>	<b>56.3</b>	<b>49.7</b>	<b>56.0</b>
<b>Average, EUR/MWh</b>	<b>21.5</b>	<b>17.1</b>	<b>20.5</b>	<b>15.9</b>	<b>18.8</b>	<b>33.8</b>	<b>29.8</b>	<b>33.6</b>

<sup>(1)</sup> PJM stands for the Pennsylvania-New Jersey-Maryland Interconnection, a regional transmission organisation in the eastern United States.

Sources: NEMMCO, Eltra (transmission system operator in western Denmark), PJM.

priced Tasmanian imports that will likely result from the completion of Basslink). However, this increase is also a result of particularly low prices seen in 2003, so the price level in 2004 can be seen as a return to form of the prices in 2002 and before. It is generally accepted that the prices at the 2004

levels do not yet justify the construction of a major baseload plant such as a coal-fired plant. However, the prices are close to the necessary level for such a new plant and will likely rise as demand rises. Over the longer term, since the start of the market in 1999, prices have been relatively steady with a modest downward trend. The average price in 1999 was AUD 33 per MWh, while the highest annual average price of AUD 43 per MWh was in 2000. Since then, there has been a modest decline with the exception of the rise seen in 2004 which is nevertheless below 2000 prices.

## PRICE DIVERGENCE BETWEEN STATES

The NEMMCO pool mechanism matches supply and demand offers, and thus determines market prices, for each region simultaneously. Trade between regions based on economic optimisation is allowed unless physical transmission constraints (or reliability concerns) intervene. Barring such constraints, pool prices will tend to converge, whereas if there are constraints, price differences between regions will occur.

The second impediment to interstate price convergence is more substantial and concerns the physical constraints on the transmission lines. Interregional transmission capacities are shown in Table 18 above. Table 23 below shows the hours during which these interconnections were constrained in 2002 and 2003. The data show that the number of hours during which there was a constraint on the interregional transmission system more than doubled between 2002 and 2003<sup>19</sup>.

Table 23

### Hours of Binding Interregional Constraints, 2002 and 2003

<i>Flow</i>	<i>2002</i>	<i>2003</i>
NSW to Qld	533	1 696
Vic & NSW to Qld	81	21
Snowy to NSW	3	10
Vic to Snowy	495	847
Vic to SA	1 128	2 051
<b>Total</b>	<b>2 240</b>	<b>4 625</b>

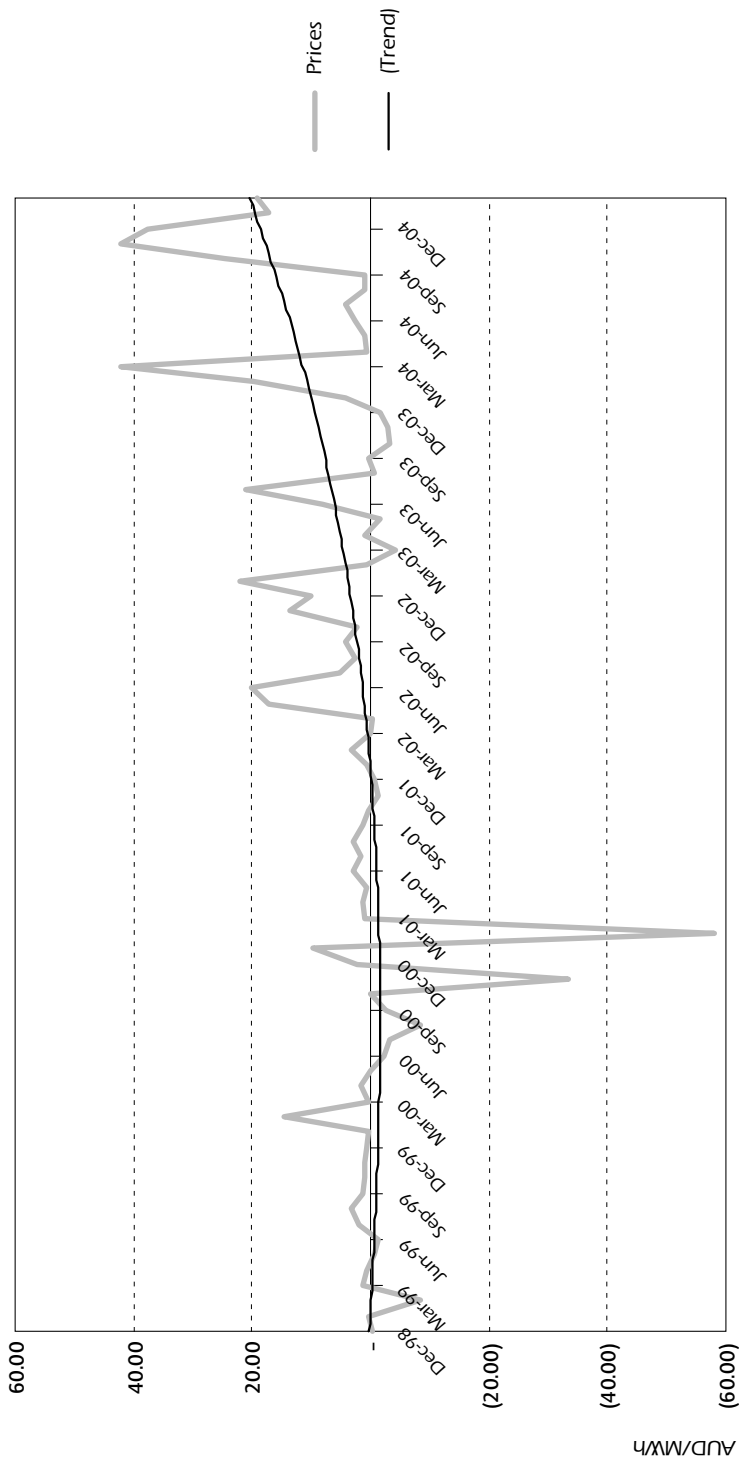
Source: "List of Regional Boundaries and Marginal Loss Factors for 2004/05, Version 3.5", NEMMCO (1 March 2005).

Interconnection constraints can lead to divergence of pool prices between regions. Figure 16 shows the divergence of pool prices between NSW and Victoria with a curve fit through regression of the raw data.

19. Information on constraints for 2004 is not yet available although anecdotal evidence suggests that the trend of increasing constraints has continued, although perhaps not at such a rapid pace.

Figure 16

Difference between NSW and Victoria Pool Prices, December 1998 to February 2005



Source: NEMMCO.

## ELECTRICITY TARIFF EQUALISATION FUND (ETEF)

On 1 January 2001, the NSW government instituted the Electricity Tariff Equalisation Fund (ETEF). Under ETEF, standard retail suppliers in the state are required to pay money into a fund when the NSW pool price is below the regulated energy component (REC) that is allowed to be recovered through regulated tariffs and receive money from this fund when the pool price is above the REC. ETEF operates as a financial hedge for retailers or what is termed a contract for difference (CFD) in the Australian market. With this protection, they are free to earn what is essentially a guaranteed margin on the volume of their sales. Generators still receive the prices determined by the pool. However, if the fund develops a negative balance as a result of pool prices being substantially above the REC for a sufficient time, the state-owned generators are required to contribute funds needed to keep the fund solvent. ETEF would then repay generator contributions over time as pool prices rise and the fund balance recovers.

## CRITIQUE

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The electricity sector plays a pivotal role in the Australian economy and is important for international competitiveness, industrial employment and economic development. It also has great consequences for the environment as 50% of Australian GHG come from power generation. Australian electricity intensity is substantially above the IEA average as are growth rates in electricity demand. Given the predominance of electricity-intensive industries in Australia and their exposure to competitive international markets, maintaining a reliable, low-cost electricity sector is crucial for the country.

Australia was one of the pioneers in sector reform and should be commended for its vision and implementation of a liberalised market. The country now has one of the most transparent and competitive electricity markets in the world. New entrants face relatively minor barriers to entry and there is robust third-party access (TPA) to transmission and distribution lines. For the most part, there is a sufficient diversity of suppliers to mitigate market power abuse<sup>20</sup>. The implementation of this reform in a federal system with substantial state power has impressively led to a market with roughly the same rules in the major states and generally greater regulatory consistency than is seen in other federal countries. Wholesale electricity prices are low, and retail prices for households

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20. Some stakeholders assert that generator market power does exist in certain states and thus prices are uncompetitively high. While such market gaming may take place in selected, usually peak, hours, its practice does not appear widespread. In addition, any measures implemented to try to combat this would have their own costs, which would have to be balanced against their benefits. In any event, this issue receives substantial attention in Australia and is a regular issue for review by the federal and state governments.

and industry are generally below those found in the IEA and in the rest of the world. Electricity security is sound, although it will bear monitoring as in all IEA countries. While the sector has some of the highest levels of GHG emissions in the IEA owing to its coal plants, the transparency and responsiveness of the system would make it very well suited to an emissions trading system if Australia chooses to pursue that option in the future.

Despite these important successes, the market still has room for improvement. It is commendable that the government and other stakeholders were not content with the market conditions and initiated further reform along the lines of MCE's December 2003 publication, "Reform of Energy Markets". The main thrust of this reform is greater integration of the market and the creation of an electricity sector with more of a national than a state-level scope. The two major elements of this process are: *i)* the further integration of the market, particularly with regard to regulatory and rule-making bodies, and *ii)* improvements in the decision-making process for transmission interconnector additions. Both are worthy endeavours and should improve the operation of the electricity sector.

The creation of the Australian Energy Market Commission (AEMC) and the Australian Energy Regulator (AER) will give a more national scope to rule-making and regulation. These bodies can contribute to a more streamlined and efficient regulatory process. They can also create greater regulatory consistency across state lines, which will make market participation easier and less costly and will probably lead more suppliers from other states to enter, thus making the markets more competitive. Such trade also improves security of supply. The government is encouraged to resolve the administrative obstacles that have delayed operation of these two new entities.

At the same time, regulatory consistency alone will be insufficient to properly link the states. Transmission interconnections are becoming increasingly constrained, with the number of hours of constraint more than doubling between 2002 and 2003. The effect of these constraints can be seen in the increasingly common divergence, or de-coupling, of prices in adjoining states. The best example of this is in NSW and Victoria. The planning system for new transmission lines is not as transparent as the rest of the market. In this regard, the new rules laid out by the MCE report on the methodology to assess the cost-effectiveness of such investments are very welcome. The new rules should not just consider interregional constraints but also the impact of any intraregional constraints, which can manifest themselves as border connection issues in such a long and "stringy" transmission system as Australia's. Since physical integration of state markets is by its nature an interstate issue, the federal government can and should play an important role in facilitating this work.

The security and reliability of the Australian electricity sector is sound. The SOO is a very useful document and strikes a good balance between government involvement and reliance on market forces. While it is important

that a non-market player make an objective and informed assessment of the coming needs, no formal provisions are in place for government investments in the name of energy security that could crowd out or paralyse private-sector involvement. States that have government ownership may be pressured to act in certain ways in the name of energy security although there is no clear evidence that they have done so to the detriment of the market. Of course, government is ultimately responsible for security, and provision of reliable electricity will be more important than gaining added efficiencies in the market. Government can seek to guarantee security directly through ownership of the electricity supply industry's assets or through the creation of a suitably regulated market in which private actors participate. What Australia has done well is to avoid framing the problem as a trade-off between security and market efficiency. It has instead used market incentives and resulting efficiencies as a guarantor for security.

Any risks to security would be on a localised level. National peak demand is about 30 GW while maximum capacity is around 44 GW for a reserve capacity of over 45%. This is clearly more than sufficient but masks the dangers of underserved load pockets resulting from insufficient interconnections. Thus, the reforms mentioned above on better decision-making in interconnections are especially important. The inclusion of the Annual National Transmission Statement (ANTS) in the SOO is a positive development although it could be enhanced substantially to make firmer conclusions and recommendations (as the SOO makes with the supply-demand balances) rather than just pointing to certain lines for suggested further analysis.

Australia has a mix of states with predominantly state-ownership and states with predominantly private ownership. Experiences in other IEA countries show that either model can work to provide efficient, secure markets. One consideration, however, are potential conflicts of interest in states with government ownership and the appearance of political involvement in the electricity sector that can drive off private actors that may be necessary for new investments. In NSW, the government owns the generators, the transmission company and the distributors. It also has some responsibility on setting and enforcing market rules. Thus, the desire to benefit from company revenues is in apparent conflict with the desire to bring low prices to citizens and industry. The ETEF was established largely as a means of mitigating risks in the market for these government-owned companies. However, the ETEF has also muted competition through market distortion. The REC is set at a low price that makes it difficult for new entrants to beat and thus gain market share. In addition, the retailers' exposure to the market that could spur innovation and efficiency is reduced substantially. Finally, the effective hedge that the ETEF represents has probably impeded development of a financial market that, through long-term contracts between retailers and generators, could have provided the same risk protection in a more transparent and efficient manner.

Now that NSW will soon be facing the need for new generating capacity, this apparent conflict of interest is receiving increased attention. The state government does not want to invest in new plants but private actors to date have been reluctant to enter the market since it would bring them into competition with the state-owned companies. Public-private partnerships are being explored as a possible solution but nothing has yet been resolved. The difficulties in bringing in new private entrants to invest in needed capacity should underscore the problems with the current situation in NSW. This does not mean that privatisation is necessarily the best option for the state. In any event, this is a decision to be made at the state political level. However, if the government wants to continue as an owner and operator in the marketplace, then it should do a better job of separating out its financial interest from its legal and political responsibilities. The government is encouraged to consider Nordpool a highly competitive region where publicly-owned and fully private operators compete on a level playing field.

While the market is very responsive on the supply side, it is less so on the demand side. The growth in Australian electricity demand is being seen largely in the peak hours, driven by increasing penetration of air-conditioning. This has resulted in high peak prices and at least a partial response from the supply side in terms of new gas-fired peaking plants. A stronger response from the demand side would contribute to the efficiency of the system. Most customers, and almost all the smaller customers, do not see time-of-use rates and therefore have no incentive to reduce load when demand is high. The government is encouraged to look at ways to allow electricity customers to act rationally in response to price signals and, with the tools at their disposal, reduce demand in a timely fashion.

## RECOMMENDATIONS

*The government of Australia should:*

- ▶ *Continue taking measures of transparency, openness and competition as tools for creating a low-priced reliable electricity sector.*
- ▶ *Encourage the process of integrating the markets, with the view to strengthening a fully competitive market with full contestability for all consumers.*
- ▶ *Implement plans for improved decision-making on new interregional transmission investment to enhance reliability, check market power and improve system-wide economic efficiency.*
- ▶ *Accelerate the process of further streamlining and simplifying the regulatory framework with the aim of a more nationally focused regulatory regime.*



- ▶ *Monitor closely the market response to growing generation needs and be prepared to take appropriate action to achieve security of supply; further incorporate the Annual National Transmission Statement (ANTS) into the Statement of Opportunities (SOO) with more concrete suggestions in recognition of transmission's ability to address regional needs.*
- ▶ *Consider the effects of mixed ownership in the generation sector between state and private actors; ensure there is a level playing field between all participants.*
- ▶ *Address the issue of how the market could more efficiently and reliably meet peak demand. Encourage market actors to increase demand-side participation, in order to make electricity demand more responsive to price signals.*

## SUPPLY, TRADE AND DEMAND

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In 2003, coal accounted for 48.0 Mtoe of primary energy supply, or 42.6% of national TPES. This percentage share has been roughly steady since 1973 when coal accounted for 39.2% of Australian TPES. Government figures project that coal will remain the major Australian fuel, although dropping slightly as a share of total supply to 38.4% in 2010 and to 37.2% in 2020.

Australia is the fourth-largest coal producing country in the world with 185.0 Mtoe mined in 2003, behind China, the US and India. Of this amount, 50% (by energy content) was black steam coal, 41% was coking coal and 8% was brown coal. Australia accounted for 7% of global black coal production. The growth in overall coal production has been substantial in recent years, rising by 4.8% annually in the 15 years from 1988 to 2003 and 4.4% from 1998 to 2003. Initial government estimates are that coal production grew by more than 7% from 2003 to 2004. The government projects that coal production will continue to grow by 2.1% annually from 2003 to 2020.

Seventy-three per cent (135.5 Mtoe) of 2003 production was exported, making Australia the world's biggest coal exporter. Australian coal accounts for 30% of total world coal trade and 50% of coking coal trade. Twenty out of the 30 OECD countries use coal that has been mined in Australia in addition to many non-OECD countries. In 2003, coal accounted for AUD 16 billion in export revenues or more than 10% of export revenues for the whole country. Coal export revenues for 2004 are expected to be even higher as both world coal prices and Australian exports have risen. The government expects coal exports to grow by 2.3% annually from 2003 to 2020. Table 24 shows the major export markets for Australian coking and steam coal. (Brown coal has high moisture content – up to 60% – making it unsuitable for transporting and export without major processing.)

The electricity industry dominates coal use in Australia. Of the 48.0 Mtoe of coal used in Australia in 2003, only 2.7 Mtoe, or 5.6%, was used in direct applications as a final energy product. The remainder was used in coal-fired electricity generating plants, which accounted for 77.2% of total electricity generation in Australia. Coal's share of electricity generation has been above 70% at least since 1973 and is expected to continue as the dominant, accounting for 71.1% of total generation in 2020. In 2004, there were 28 350 MW of coal-fired capacity with an average efficiency of 33% on a sent-out electricity higher heating value (HHV) basis.

Table 24

## Australian Coal Export Destinations, 2003

	<i>Coking coal</i>		<i>Steam coal</i>	
	<i>kilotonnes</i>	<i>% of total</i>	<i>kilotonnes</i>	<i>% of total</i>
<b>Total exports</b>	<b>107 794</b>		<b>99 950</b>	
OECD	70 428	65.3%	77 925	78.0%
Non-OECD	28 283	26.2%	22 025	22.0%
Non-specified	9 083	8.4%	-	0.0%
Japan	41 316	38.3%	52 440	52.5%
India	14 108	13.1%	1 446	1.4%
Korea	7 442	6.9%	14 197	14.2%
Brazil	4 464	4.1%	50	0.1%
France	4 421	4.1%	403	0.4%
United Kingdom	4 088	3.8%	1 277	1.3%
Chinese Taipei	3 824	3.5%	10 817	10.8%
Netherlands	3 385	3.1%	1 821	1.8%
Spain	2 492	2.3%	946	0.9%
Mexico	497	0.5%	3 264	3.3%
Israel	161	0.1%	1 295	1.3%
Other	21 596	20.0%	11 994	12.0%

Source: IEA Coal Information 2004.

## INDUSTRY STRUCTURE

The Australian coal industry can be divided into the brown and the black coal industry. Brown coal production in 2003 accounted for only 8% of total production on an energy content basis. Brown coal is found primarily in the state of Victoria although other known resources are found in Western Australia, South Australia and Tasmania. Australian brown coal is used almost exclusively at mine-mouth electricity generating stations in Victoria. Brown coal's low energy content and high moisture content make it uneconomic for export or even transport over any substantial distances within Australia. All brown coal mines are owned jointly with the related power generation facilities and all are privately-owned. Brown coal is extracted using open-cut techniques. At current mining rates, the brown coal reserves could last several hundred years.

The Australian black coal industry is located almost entirely in the states of NSW and Queensland. Black coal in NSW is mined near the eastern and western edges of the large Sydney-Gunnedah Basin. Underground mines operate in the Wollongong-Appin-Bulli area, the Burragorang Valley and in the Lithgow-Mudgee area, while mines in the Hunter Valley from Newcastle to Muswellbrook and those near Gunnedah are mainly open cut mines. Most

black coal in Queensland comes from the Bowen Basin, extending south from Collinsville to Blackwater and Moura, and at Newlands, Blair Athol and near Brisbane. NSW has 32 114 Mt of black coal resources, Queensland has 36 276 Mt and the rest of the country has 8 138 Mt for a total of 76 528 Mt. At current rates of production, these resources would last approximately 220 years.

As of December 2001, there were nearly 20 000 people employed in black coal mines, about 10 000 in NSW, 9 000 in Queensland and the remaining 1 000 in other states. Approximately 8 000 of these employees worked in underground mines while almost 12 000 worked in open-cut mines. Labour productivity at Australian black coal mines has advanced dramatically in recent years. From 1992 to 2001, the output of saleable coal per employee hour has risen from 3.5 tonnes to 6.9 tonnes as a combined average for both underground and open-cut mines.

With more than 70% of Australian black coal exported, efficient coal loading at each of the country's nine major ports is paramount. If coal is loaded quickly, ships spend less time in port and freight costs are reduced. The loading facility is also an important buffer storage area between discharge from road or rail trucks and loading onto the ship and can blend different coals to produce the specific composition required by individual customers. The Port of Newcastle in NSW operates the world's largest export coal handling operation and has storage for 3.5 Mt of coal in stockpile areas at its two coal loaders. Queensland's largest capacity coal loader at Hay Point near Mackay can load an average of 10 000 tonnes per hour. Most of the coal arrives by rail and is unloaded from wagons into receival hoppers under the track. Each wagon is fitted with automatic discharge doors which are triggered to discharge the payload of coal. From the hoppers, the coal is either loaded directly on board ship or taken by conveyor to a stockpile. The road and rail receival hoppers and conveyors are mostly enclosed to minimise airborne emissions. The system can also be used to blend coal as it is received.

Driven by high demand and high prices in the international market, coal exports rose substantially from 2003 to 2004. Looking at the first three quarters of 2004 versus the same period a year earlier, coal exports rose by more than 8%. As a consequence, coal export facilities have been strained. At the world's largest coal export facility in Newcastle, the Port Waratah Coal Services (PWCS), throughput has risen from 69 Mt in 2003 to a planned 84.3 Mt in 2005 which is the facility's current maximum capacity. This increase was realised without any substantial capacity upgrades, merely a more efficient use of existing equipment. Actual demand for PWCS facilities is thought to be 5 Mt to 10 Mt greater than current capabilities. The owners of PWCS (70% Australian black coal mining companies and 30% Japanese coal customers) have plans to upgrade the facility. In the short term (two to three years) they would like to increase export capability from around 85 Mt to 102 Mt. Longer-range plans include expansion to 120 Mt by 2011/12.

The NSW government is also considering applications to build a third coal loader terminal at Newcastle which could commence operations by the end of the decade and have an initial capacity of up to 60 Mt per year. Announcements on this project are expected to be made in August 2005. Other major expansions are being undertaken at coal export terminals in Queensland, including at BHP Billiton's own coal terminal at Hay Point, the Dalrymple Bay Coal Terminal and at Gladstone. The Queensland government is also investigating options for developing rail links to connect the northern Bowen Basin coal fields to the Abbot Point, which will provide additional capacity and enhance the security of exiting coal supply chains.

There are four major coal mining companies in Australia, namely Rio Tinto, BHP Billiton, Xstrata and Anglo Coal. Together they account for 55% of Australian coal production. Through consolidation, the majors' share is up from around 40% four or five years ago. Capacity expansion is also planned for coal mining. As of early 2005, 17 new black coal projects were under consideration with a combined capacity of 86.5 Mt, or about 20% of current production. These production expansions would have a total capital expenditure of AUD 3 billion and involve all the major mining companies operating in Australia.

## **FUTURE COAL PROSEPECTS**

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The substantial use of coal in Australia makes the country's GHG emissions intensity among the highest in the world. Coal itself is more carbon-intense than other fossil fuels and coal-fired plants are generally less efficient than other plants such as gas-fired combined-cycle plants. The IEA has estimated that coal-fired plants emit 0.918 tonnes of CO<sub>2</sub> per MWh of electricity generated. While the government has decided neither to ratify the Kyoto Protocol nor to introduce a carbon price signal at this point in time, it has expressed its concern over the accumulation of GHG in the atmosphere and its willingness to pursue and participate in a global climate change plan that involves all the world's major emitters. A number of stakeholders have decided to take a proactive approach. Consistent with Australia's technological approach to climate change in general, the government and the coal industry have launched a number of initiatives to explore technological solutions to address the future of coal in a carbon-constrained world.

### **COAL21**

COAL21 is a partnership established in March 2003 between coal and electricity industries, unions, federal and state governments and the research community. It was launched at the initiative of the Australian Coal Association, a black coal mining group. COAL21 members recognise the need

to stabilise GHG concentrations in the atmosphere at levels that would prevent adverse climate impacts. At the same time, they acknowledge the many benefits of fossil fuels, particularly coal in the Australian context, and the numerous difficulties that would result from a substantial forced reduction of these fuels on climate change grounds. COAL21 is committed to finding ways to continue fossil fuel use while minimising any potential climate damage. For COAL21, these solutions will tend to be technological. The primary objective for COAL21 is to create a national plan to scope, develop, demonstrate and implement near-zero emission coal-based electricity generation that will reduce GHG emissions while still maintaining Australia's low-cost electricity advantage.

COAL21 has examined a number of technological options to achieve its aims. The range of technologies associated with carbon capture and storage (CCS) have been identified as the key to achieving deep cuts in coal-based electricity generation. Other technologies that meet one or more of the criteria include Integrated Gasification Combined Cycle (IGCC), Oxy-fuel Combustion, Lignite Dewatering and Drying, and Ultra Clean Coal (UCC).

## LOW EMISSIONS TECHNOLOGY FUND

The federal government announced in the energy White Paper that it intends to establish a AUD 500 million Low Emission Technology Fund to support industry-led projects that demonstrate the commercial viability of new energy technologies that have low GHG emissions. Included among the technologies covered by this fund will be carbon capture and storage. Technologies eligible for the fund must be expected to achieve commercial viability between 2020 and 2030. The fund is designed to leverage at least AUD 1 billion in private-sector investment.

## CO-OPERATIVE RESEARCH CENTRES

A number of co-operative research centres<sup>21</sup> (CRC) work in the coal field to advance technologies that can lower emissions from coal. The CRC for Clean Power from Lignite develops technologies that reduce GHG emissions from lignite-based power plants by improving efficiency. The CRC for Coal in Sustainable Development (CCSD) undertakes research that focuses on the economic, environmental and social performance of black coal use.

The Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC) researches the logistic, technical, financial and environmental issues of storing

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21. CRCs are collaborative research centres that link the public and private sectors. See Chapter 11 for more information on CRCs.

industrial CO<sub>2</sub> emissions in deep geological formations. The CRC also researches the capture and separation of CO<sub>2</sub> from industrial systems. CO<sub>2</sub>CRC is focusing its efforts on the development and application of technologies to more effectively capture and geologically store carbon dioxide. CO<sub>2</sub>CRC is involved in national and international research activities and in the provision of technical advice to bodies such as the Carbon Sequestration Leadership Forum (CSLF) and the Intergovernmental Panel for Climate Change (IPCC). Potential research project sites being investigated are the Otway, Perth and Bowen-Surat Basins. The aim of the research project is to simulate the capture of CO<sub>2</sub> from power stations. During the project, scientists will extract the naturally occurring CO<sub>2</sub> and methane from a natural gas well, separate the methane from the CO<sub>2</sub> and use the methane to drive a compressor. The compressor condenses the CO<sub>2</sub> to liquid so it can be transported via pipeline to the well-head of a depleted natural gas field. The compressed CO<sub>2</sub> is injected at least 800 metres underground where it will be stored for thousands of years.

## CRITIQUE

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Coal plays a major role in providing Australia with low energy prices and sound energy security. In 2003, coal accounted for 43% of TPES and 77% of electricity production. Coal continues to be a major player in all future energy scenarios with increased production, domestic supply and exports. Australia is the fourth-largest coal-producing country in the world and the largest coal-exporting country. In 2003, coal accounted for AUD 16 billion in export revenues, or more than 10% of export revenues for the whole country. There is a highly developed and sophisticated industry to mine and export the coal. The coal industry contributes to employment and general economic well-being. The cheap electricity derived from domestic coal-fired plants makes many Australian industries competitive in international markets. The 200-year plus resources of coal in the ground in Australia substantially improve the country's energy security.

One of the major concerns facing the coal industry now is how to maximise use of the export infrastructure to sell as much coal as possible on the international market. Since the entire process of mining, transport to the coast, sorting and loading on ships is functionally integrated, any bottlenecks in the system will impede the whole process. This can result in lost sales and lost profits for the domestic coal industry, thereby damaging the Australian economy. While expansion of production and export infrastructure is largely the responsibility of industry – and several major expansions are planned – the federal and state governments can nevertheless help in a number of important ways. These include playing an active role in approving Environmental Impact Statement (EIS) applications in a timely manner, providing leasing for rail tracks, making any state-owned land available for

appropriate development and facilitating a dialogue with the governments of purchasing countries to co-ordinate their offtake with the domestic supply chain. These and other strategies aimed at further enhancing Australia's capacity to meet expansion in world coal demand are being considered by Commonwealth ministers.

Emissions from coal-fired electricity plants are more than twice the emissions from gas-fired plants per unit of electricity generated. The Australian government has indicated substantial enthusiasm for post-Kyoto climate change action – provided certain conditions are met – and any such agreements would likely involve more stringent emissions targets than seen in Kyoto in order to stabilise emissions at safe levels. Without development of a suitable technology to curb the high emissions from coal combustion, Australia would only be able to embrace serious climate change plans with substantial economic costs, not only because of the widespread use of coal domestically but also because of more stringent GHG targets in coal-importing countries, which would affect the future of Australia's most valuable export product.

The Australian government and other stakeholders are promoting the development of technological solutions to address this problem. Carbon capture and sequestration is the only technology that really promises the magnitude of CO<sub>2</sub> emission cuts that will be needed. Technological advances can be utilised in the next generation of coal plants even before comprehensive carbon-trapping technologies have been proven. Higher efficiencies (and thus lower per unit emissions) through super-critical plants are available today and can contribute to coal lowering its GHG profile in the near-term as a bridge to longer-term solutions.

The COAL21 agenda is a commendable approach to a problem that affects multiple stakeholders and to which multiple stakeholders can contribute towards a solution. Other R&D efforts like the low-emission technology fund and the CRCs will also help in this regard. However, while collaboration is a good starting point, significant amounts of money will need to be spent to have a chance of finding solutions to coal emissions. COAL21 is only a venue for discussing and formulating a strategy. Its work needs to be backed up with funds, such as through the Low Emissions Technology Demonstration Fund, from both government and industry.

At the same time, it should be borne in mind that the timing of the development of carbon capture and storage into an economic option is still uncertain. In particular, it is not likely to happen before a post-Kyoto regime is established when more stringent reduction efforts could affect the future of coal. Even if such a technology is developed, its implementation will still have costs. The Australian government is encouraged to anticipate a world where the carbon content of coal results in higher costs for the fuel and related electricity.



## RECOMMENDATIONS

*The government of Australia should:*

- ▶ *Work in close co-operation with states and industry to alleviate the bottlenecks in the coal supply value chain, particularly those associated with transportation needs in the immediate and longer term.*
- ▶ *Support the development of the necessary technologies for the next generation of coal use as part of a larger effort to consider how the expanding future use of coal in domestic and international environments can accommodate future carbon constraints.*
- ▶ *Co-ordinate activities between coal producers, electricity companies, government and researchers to address the challenges facing coal's future given its high carbon content, particularly in garnering sufficient funds to develop emission-cutting technology.*
- ▶ *Anticipate the effects of higher energy prices owing to coal's high carbon content.*

## DEMAND AND SUPPLY

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### NATURAL GAS DEMAND

Since the beginning of the development of the gas industry at the end of the 1960s, growth in natural gas consumption has continued almost unbroken and reached 1 008 PJ (25 bcm) in 2002/03. This represented 19.7% of TPES (16.6% in 1991). Although this growth is significant, natural gas share in TPES is still modest compared with gas's share in other large producing/exporting countries (e.g. 46% in the Netherlands, 28% in Canada). This is mainly explained by the availability of cheap coal resources in eastern Australia, which strongly compete with natural gas, in particular for electricity generation.

Development of gas resources has historically been state-based along with transmission infrastructure, which was not interconnected on the east coast. The reforms of the 1990s were intended to develop a "national gas market" and although a degree of integration took place between states, Australia can now best be characterised as having three regional markets:

- The Western Australia market.
- The Northern Territory market.
- The integrated Victoria, NSW, SA, Queensland and Tasmania market.

Demand for gas by sector differs significantly across states and territories (Table 25). The manufacturing sector is the highest gas consumer with a share of almost 40% of Australian gas consumption. The largest consumers in this sector include the metal product industries, the chemical industry and the glass, brick and cement industries. A quarter of gas demand comes from the power sector and gas generates 14% of power generation. Gas penetration as a fuel for electricity varies greatly on a regional basis. Natural gas accounts for 24% of energy for electricity generation in WA, 63% in SA, 96% in the NT, 4.1% in Queensland, 1.2% in Victoria, 1.6% in NSW, and 3.4% in Tasmania. It is worthwhile noting that although 76% of Australia's gas-fired electricity generation is in the NT, WA and SA, the east coast market generates 76% of Australian electricity. The mining sector consumes a relatively large proportion of natural gas (15% of Australian gas consumption), mainly in WA. Although 46.7% of houses in Australia are connected to natural gas, their gas demand is relatively small (12% of the gas market) as they principally use gas for water heating and cooking. Household connectivity varies strongly among states: Victoria (85.4%), ACT (62.4%), WA (58.5%), SA (53.8%). In Victoria, around

one-third of natural gas is consumed in the residential sector. For most other states and territories, the proportion is less than 10%.

Table 25

**Natural Gas Consumption by State and Territory and Sector, 2001 (PJ)**

	<i>NSW</i>	<i>Vic</i>	<i>QLD</i>	<i>SA</i>	<i>WA</i>	<i>NT</i>	<i>Total</i>	<i>% of sector</i>
Manufacturing	80	93	46	29	145	0	393	39.5
Electricity, gas and water	21	28	24	69	99	20	260	26.1
Mining	0	22	6	23	104	0	154	15.5
Residential	21	82	1	8	9	0	122	12.2
Other	20	26	2	6	12	1	68	6.8
<b>TOTAL</b>	<b>142</b>	<b>251</b>	<b>79</b>	<b>135</b>	<b>369</b>	<b>21</b>	<b>996</b>	<b>100.0</b>
<b>% of market share</b>	<b>14.3</b>	<b>25.2</b>	<b>7.9</b>	<b>13.6</b>	<b>37.0</b>	<b>2.1</b>	<b>100.0</b>	

Source: Productivity Commission Review, June 2004.

ABARE's "Australian energy national and state projections to 2019/20" projects that natural gas consumption will increase by 3.7% a year over the period 2001/02 to 2019/20. The use of natural gas is projected to double to 1 828 PJ (46 bcm) in 2019/20, accounting for 36% of the growth in total energy consumption over the entire outlook period. As a result, natural gas in the energy mix is estimated to increase by 5% to more than 24% by the end of the outlook period. Although the use of natural gas is expected to grow in most sectors, almost 87% of the increase in gas use is projected to occur in just three sectors: mining (21%), manufacturing (33%) and electricity generation (33%).

Power generation from natural gas is forecast to grow by 4.7% a year, more than doubling total output to 69 TWh by 2019/20 and generating 20% of electricity at that date. Growth in gas-fired electricity generation is projected to be particularly strong in the medium term up to 2009/10 (6.2% a year), largely reflecting the impact of a number of policy initiatives, such as Queensland 13% Gas Scheme<sup>22</sup>, NSW benchmark scheme and investment in peak capacity. ABARE's energy projections imply the addition of 4 660 MW of gas-fired capacity at a cost of approximately AUD 5 billion. Most of the additions will be built in Queensland, where gas-fired electricity generation is expected to quadruple by 2019/20.

22. The Queensland government has put in place the 13% Gas Scheme to provide stimulus for development of the QLD gas industry. The scheme requires electricity retailers and other liable parties to source at least 13% of their electricity sold in QLD from gas-fired generation from 1 January 2005.

The challenging areas for growth of gas in electricity generation are Victoria and NSW, where the share of gas in power generation is currently particularly low, owing to strong competition from low-cost coal. Gas has potential in peak and intermediate-load electricity. It allows for the installation of small to medium capacity close to load areas and is particularly important to provide peak power as gas-fired stations are flexible and can be brought on line and taken off line much more rapidly than coal-fired stations. Although gas-fired plants are cheaper to build than coal-fired stations they are more expensive to run, owing to the low market price for coal relative to the market price for gas and to the manner in which electricity transmission prices are set (on a basis that does not reflect the ability of gas-fired generation to be located close to a large load). In addition, state governments have an incentive to prefer coal-fired power generation because coal creates more employment and usually attracts a state excise or royalty, whereas offshore gas is subject to the Commonwealth Petroleum Resource Rent Tax (PRRT).

## NATURAL GAS SUPPLY/PRODUCTION

Australia has abundant gas reserves. Geoscience Australia, the Australian government's geoscience agency, estimates Australian identified gas resources<sup>23</sup> as 3 921 bcm at 1 January 2004. These resources represent 120 years of current production; 20% of these reserves are considered commercially proven (783 bcm). While gas resources are abundant, most of them are located in the western and north-western areas of Australia, far from the major consuming centres. The gas basins with the largest recoverable reserves are the Carnarvon and Browse basins in WA, the Bonaparte basin in the Northern Territory, the Gippsland and Otway basins in Victoria and the Cooper-Eromanga basin that straddles SA and Queensland. Although less important than in WA, gas reserves in and around Victorian offshore waters are nevertheless far from negligible: 170-200 bcm or 25-30 years of consumption. Figure 17 shows the location of these basins and the distribution of gas resources in Australia.

In addition to natural gas, Australia owns a large potential for deposits of coal seam methane (CSM). The majority of these deposits are located in the black coal deposits of Queensland and NSW, relatively close to the Sydney and Brisbane markets. CSM resources are estimated at 250 000 PJ (equivalent to 6 250 bcm) although it is unclear how much of this could be commercially produced. CSM production was 0.88 bcm in 2002. It now supplies over 25%

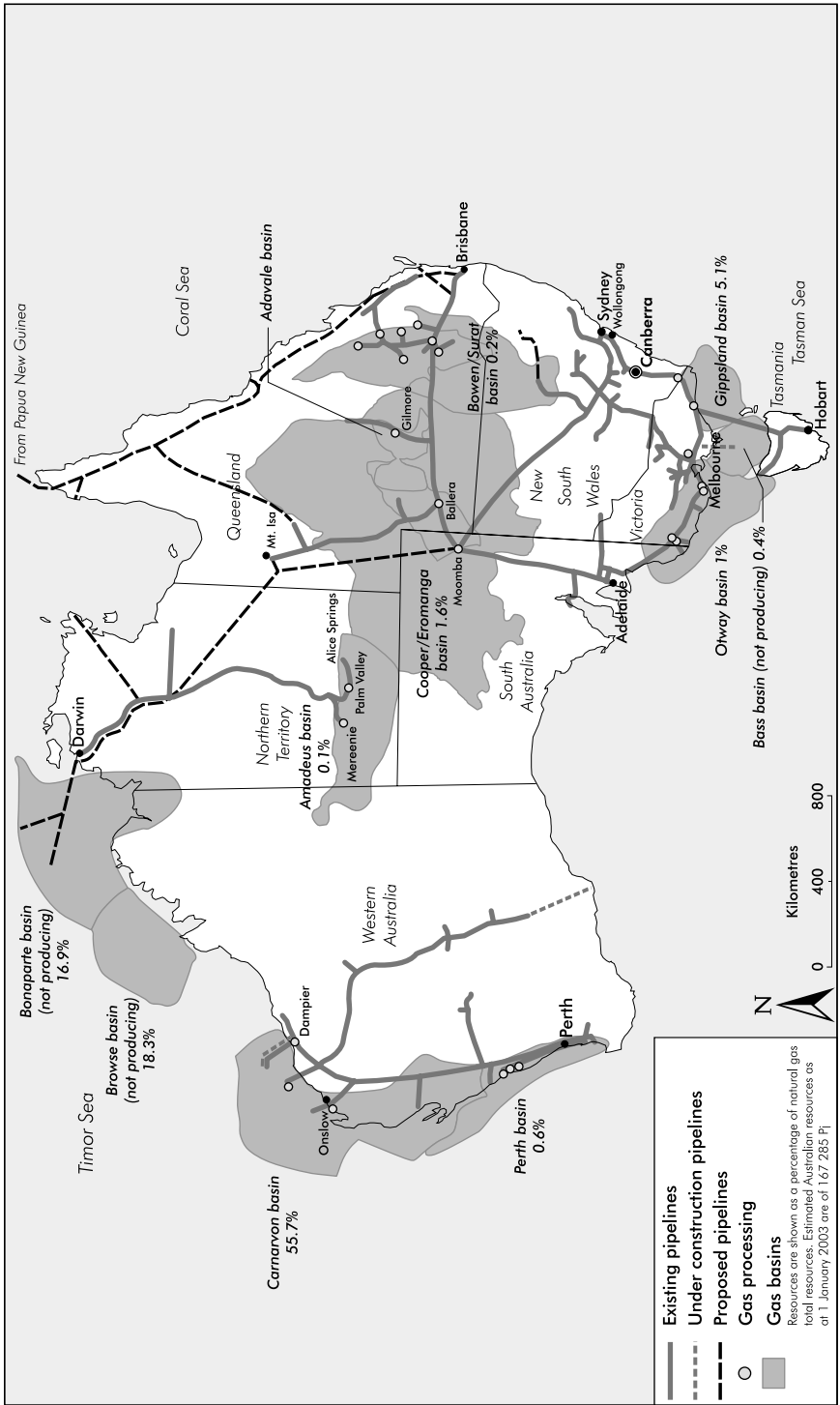
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23. Geoscience Australia classifies Australian gas resources as:

- Known, which are then subdivided into: those considered to be commercially developable, that is, those reserves that have been proven and can be supplied to markets profitably considering the current costs of production and the price of gas, and those considered non-commercial, that is those that are recoverable, but are not yet profitable to produce.
- Potentially discoverable.

Figure 17

### Location of Gas Resources and Major Pipelines



of the Queensland gas market and is also being supplied to the Sydney market. In addition, a new CSM-fired power generation has recently been announced in northern NSW.

In 2003/04, Australian natural gas production amounted to 33.2 bcm, of which 62% was produced in WA. The majority of WA gas is sourced from the North West Shelf. The Goodwyn and North Rankin fields are operated by Woodside Energy as part of the North West Shelf Gas project. Natural gas production in SA and Queensland accounted for about 12% of Australian total production in 2003/04, coming from the onshore Cooper-Eromanga basin. Victoria's offshore Gippsland basin and the onshore Otway basin accounted for another 22%. Several gas fields off the southern coast of Victoria in the Bass and Otway basins are also being developed. Gas produced in Queensland's onshore Bowen-Surat and Adavale basins and the Northern Territory's Amadeus basin in central Australia together accounted for 4% of total Australian production.

ABARE foresees a very strong growth in natural gas production in the next 15 years, driven by a large increase in LNG exports as well as rising domestic demand. Total production is expected to increase by 5.7% a year from 2001/02 to 2019/20, from 1 365 PJ (34 bcm) in 2001/02 to 3 727 PJ (93 bcm) in 2019/20. The share of total production accounted for by LNG exports is projected to increase from 30% currently to 51% by 2019/20.

Joint venture consortia undertake almost all natural gas exploration and production in Australia, primarily as a mechanism for risk- and cost-sharing. In 2001/02, almost 94% of natural gas supplied to the east Australian market (SA, Victoria, NSW, Queensland and Tasmania) was from the Esso/BHP Gippsland basin joint venture and the Santos-led Cooper-Eromanga basin joint venture. In WA, while the Carnarvon basin dominates supplies to this market, there are several producers supplying gas to the domestic market of this region.

## **TRANSPORTATION AND DISTRIBUTION**

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Australia's gas transmission network length has grown by 43% since the establishment of the gas access regime, going from 14 093 km in 1997/98 to 20 109 km in 2001/02<sup>24</sup>. The growth in the transmission network has facilitated the emergence of an interconnected pipeline system linking major gas supply basins and demand centres in south-eastern markets. New transmission pipeline investment enables gas to flow between the states of SA, NSW, Victoria and Tasmania. Most major consuming regions in Australia now have, or will soon have, two pipelines providing gas from alternative sources of supply. New investment has occurred at rates of return on new investments that are relatively competitive and attractive compared to other

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24. Australian Gas Association, *Gas Statistics Australia*, various years.

investments with a similar risk profile: the weighted average costs of capital for new pipelines is 11.955% (pre tax real)<sup>25</sup>. Figure 17 and Table 26 show major transmission pipelines and majority owners and operators.

**Table 26**  
**Current Major Transmission Pipelines**

<i>Route</i>	<i>Length (km)</i>	<i>Throughput (PJ/year)<sup>(a)</sup></i>	<i>Owner</i>	<i>Operator</i>
Moomba-Sydney	2 013	152	Australian Pipeline Trust (APT)	East Australian Pipeline Limited (EAPL)
Longford-Sydney	795	65	Alinta	Alinta
Amadeus Basin-Darwin	1 656	15	NT Gas	NT Gas
Roma (Wallumbilla)-Brisbane	440	28	APT	APT Petroleum Pipelines Limited
Roma (Wallumbilla)-Gladstone	627	32	Alinta	Alinta
Ballera-Wallumbilla	756	28	Hastings Fund Management	Epic Energy
Ballera-Mt Isa	840	30	APT / SWQ Producers	Roverton
Moomba-Adelaide	1 102	104	Hastings Fund Management	Epic Energy
Port Campbell-Adelaide	680	125	Origin Energy, Australian National Power and TXU	South East Australia Gas
Victorian transmission system	1 930	211	GasNet Australia	GasNet Australia
Dongara-Perth/Pinjarra	445	10	APT	APT
Dampier-Bunbury	1 845	221	Diversified utilities Energy Trust, Alcoa, Alinta	Alinta
Yarraloola-Newman/Kalgoorlie	1 375	28-35	APT (majority owner)	APT
Longford-Bell Bay (Hobart)	732	50	Alinta	Alinta

<sup>(a)</sup> Approximate.

Sources: Government submission, Productivity Commission Review and companies' websites.

Although there are several companies involved in transportation, APT (whose largest shareholders are Australia Gas Light (AGL) and Malaysian Petronas) is the largest operator. Alinta, which bought most of Duke Energy's gas transportation assets and a 20% interest in the former Epic Energy-owned Dampier to Bunbury Pipeline, is the other leading owner of gas pipelines. Since the beginning of 2004, the transportation sector has seen substantial

25. Source: Final approval request for the proposed Central Ranges Pipeline., ACCC, 2004.

changes in ownership, marked by two trends: *i*) consolidation between pipeline companies, and *ii*) the acquisition by customers of major pipelines. Duke Energy sold its pipeline assets to Alinta, including the Eastern Gas Pipeline, the Queensland Gas Pipeline, the Goldfields Gas Pipeline and the Tasmanian Gas Pipeline. TXU sold its assets to SingPower, which is now reselling part of its assets to the Hong-Kong-based China Light and Power, CLP. Epic Energy has also sold its assets, including the DBNGP, to a consortium of major customers including DUET, Alinta and Alcoa.

New gas pipelines recently commissioned include Enertrade's Moranbah-Townsville Pipeline and GasNet Australia's Port Hedland-Telfer Pipeline. Currently, several pipelines are under construction or planned (see Table 27). There is a project to build a 3 200 km pipeline from Papua New Guinea to northern Queensland (the Highlands project, led by ExxonMobil). The project has been on the drawing board for several years, and recently gained enough foundation customers to enable it to proceed to front-end engineering and design stage. However, no decision has been taken yet on project financing.

Table 27

### Proposed New Transmission Gas Pipeline Projects

<i>Proponent/developer</i>	<i>Route</i>	<i>Length (km)</i>	<i>Status</i>
Woodside	Wadeye to Gove	1 000	APT and ANZ Infrastructure Services has been selected as the successful tender to build, own and operate the pipeline
GasNet	Pt Headland to Telfer	500	Recently completed
WorleyParsons – Burns & Roe	Kambalda to Esperance	250	Recently completed
AGL/Petronas	Papua NG to Queensland		Proposed
Epic	Ballera-Moomba		Proposed
APT	Ballera – Moomba-Sydney		Proposed
Central Ranges Natural Gas and Telecommunications Association	Dubbo to Tamworth		Europacific Consortium selected as successful tenderer
Enertrade	Moranbah to Townsville/Yabalu	391	Commissioned
Eastern Star	Cooranbah to Narrabri	20	Commissioned
Mosaic Oil	Wallumbilla to Newcastle		Proposed
Amity Oil	Whicher Range to Bunbury		Proposed

Source: Government submission.



The sector has encountered major problems as pipeline owners are debating with regulators about gas tariffs. These problems culminated in 2004 with the sale of Epic's DBNGP to Alinta. Epic decided to sell the pipeline after it failed to win a long-running regulatory battle over transport tariffs. In setting the tariff, WA gas regulator (offGAR) valued the pipeline at just AUD 1.55 billion. It was sold to the consortium at 1.86 billion in September 2004, lower than what was paid by Epic to the WA government when the pipeline was privatised in 1998.

Australia has four gas storage facilities, all developed in depleted gas fields:

- Moomba underground storage owned by Santos in South Australia.
- Iona underground storage owned by TXU Australia in Victoria.
- Mondarra Gas storage owned by APT in Western Australia.
- Newstead in the Surat Basin.

Their working capacity totals 1.3 bcm and their peak daily output 20.2 mcm. In addition, there is an LNG peak-shaving unit at Dandenong.

At this stage, the Australian gas market has led to the development of only one formal gas hub, VicHub in Longford, Victoria. VicHub, established by Duke Energy International in February 2003, is now owned by Alinta. It serves as the interconnector for the Eastern Gas Pipeline, Tasmanian Gas Pipeline and the GasNet transmission system. It facilitates the trading of gas between Victoria, NSW and Tasmania and provides financial risk management services.

**Table 28**  
**Major Distribution Companies**

<i>Company</i>	<i>Area</i>	<i>Customer base</i>	<i>Comments</i>
AGL	NSW, ACT, Vic	808 000	Australia's largest listed energy retailer
United Energy/Multinet	Vic	1 100 000	Majority owned by Alinta
SingPower	Vic	415 000	Bought by CLP in March 2005. Formerly assets belonged to TXU
Envestra	SA, Vic, NSW, QLD, NT	905 000	Fully listed company: Origin Energy and Cheung Kong Infrastructure each hold 18.6%.
Origin Energy	SA, Vic, QLD, NT	835 000	
ENERGEX/Allgas Energy Ltd	NSW, QLD	1 000 000	Owned by Queensland government
Alinta	WA	400 000	Formerly state-owned gas supply company of WA, now privatised

Source: World Market Analysis, government submission.

The natural gas distribution sector reticulated approximately 450 PJ (11 bcm) to around 3.4 million residential households and to some 105 000 commercial and industrial users in 2002 (Australian Gas Association, 2003). There were around 75 500 km of distribution networks in 2002. Distribution networks reticulate all of Australia's mainland capital cities and some regional towns. A new major distribution network is under construction in Tasmania. Major distribution companies include AGL Gas Networks, Alinta Gas Networks, Allgas Energy/ENERGEX, Envestra, TXU Networks, Multinet Gas Network and Actew AGL Distribution.

## **LIQUEFIED NATURAL GAS (LNG) TRADE**

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In 2004, Australian LNG exports were 7.9 Mt (10.7 bcm). This represented 6% of world LNG trade. The vast majority of these exports were to Japan under long-term contracts. LNG exports under a mid-term contract with Korea commenced in late 2003. In the recent past, Australia has also exported spot cargoes to customers in Turkey, Spain, India and the United States. According to ABARE, Australian LNG exports are expected to reach 21.3 Mt per year by 2009/10 and increase to 35 Mt per year in 2019/20 (29 and 48 bcm respectively). That would account for over half the nation's total gas production for that year.

Australia has currently one LNG liquefaction plant, the North West Shelf (NWS), located at Karratha in WA. The capacity of the plant reached 11.7 Mt per year with the completion of a fourth train in 2004 and will increase to 15.9 Mt per year in 2008 with the expected completion of a fifth train. LNG from the NWS is marketed through a consortium, North West Shelf Australia LNG, which consists of six partners with equal shares: BHP Billiton Petroleum, BP Developments Australia, ChevronTexaco Australia, Japan Australia LNG, Shell Development (Australia) and the project operator Woodside Petroleum. In 2004, NWS partners finalised a landmark 25-year contract with the Chinese National Offshore Oil Corp. (CNOOC) to supply 3.3 Mt per year of LNG to the first LNG regasification plant built in China at Guangdong. Deliveries are expected to start by mid-2006. CNOOC has taken 25% in the new venture, China LNG, set up within the NWS project to supply the Guangdong contract. This equates to CNOOC having around 5.3% of the NWS gas reserves.

Australia's LNG exports are expected to grow rapidly in the coming decade on the basis of new liquefaction plants under consideration and proposed, in addition to expansion of the NWS project (see Table 29). There is one LNG project in Australia currently under construction: the Darwin LNG plant, which is part of the Bayu-Undan project in the Australia-East Timor Joint Petroleum Development Area. The plant with an annual capacity of 3.5 Mt per year is expected to start deliveries to Japanese customers by 2006.

There are five other projects under consideration in Australia:

- *The Gorgon LNG project* on Barrow Island is expected to commence operations in 2009/10. The project consisting of two trains of 5 Mt per year each is seeking to supply markets in North Asia and the North American west coast. Gas will be sourced from the Gorgon fields (operator: ChevronTexaco) and the deepwater I<sub>0</sub>/Jansz fields (operator: ExxonMobil), located to the south-west of the North West Shelf.
- *The Greater Sunrise project* (operator: Woodside) in the Timor Sea. The operator has suspended the development pending resolution of issues surrounding the maritime boundary and sharing of royalties between Australia and East Timor.
- *The Browse LNG project* with a capacity of 10 Mt per year on the Kimberley coast is under consideration by Woodside and is seeking markets in North Asia post 2010.
- BHP Billiton (50%) and ExxonMobil (50%) are considering an LNG plant near Onslow in Western Australia, *the Pilbara LNG project*, to supply the US market with gas from the Scarborough field.

If all these plants were built according to schedule, Australia's annual capacity could rise to 50 Mt per year by 2011. The extent to which this LNG export capacity is realised is highly dependent on finding markets in a very competitive LNG market.

Table 29

**Planned LNG Projects<sup>(1)</sup>**

<i>Project</i>	<i>Capacity Mt/year</i>	<i>Start-up date</i>	<i>Operator</i>
Darwin LNG, Northern Territory	3.5	2006	ConocoPhillips
NWS Train 5, Western Australia	4.2	2008	Woodside Energy
Gorgon, Western Australia	10	2009/10	ChevronTexaco, ExxonMobil
Sunrise, Northern Territory	5.3	2010+	Woodside Energy
Browse, Western Australia	10	2010+	Woodside Energy
Pilbara LNG, Western Australia	6	2010+	ExxonMobil
<b>TOTAL</b>	<b>39.0</b>		

<sup>(1)</sup> The Darwin project is the only one under construction as of May 2005; all others are planned.  
Source: Government submission and company information.

## LNG ACTION AGENDA

To facilitate LNG exports, the Australian government launched the LNG Action Agenda in 2000. The agenda committed the government to developing

policies that would enhance the competitiveness of the industry and remove or mitigate impediments to growth. The agenda identified seven key issues that need to be addressed to make Australia the preferred LNG supplier for new demand. These issues were: clarification of greenhouse policy; customs and import arrangements; taxation arrangements; Australian industry participation; streamlining the project approval process; effective industry/government marketing; and resolution of uncertainties related to the Timor Gap Zone of Cooperation.

The government has implemented measures addressing these issues. The government announced GHG emission policies, which enabled expansion of the industry to proceed. Changes were made to Project By Laws and to Item 22 of the Customs Tariff Act allowing duty-free entry of goods that are used directly in connection with exploration and development of petroleum deposits. Streamlined project approval processes were put in place to facilitate duty-free entry of goods used in major projects. Improvements were also made to taxation arrangements for the petroleum industry. The federal government has been active in developing bilateral relationships with the governments of major LNG importing countries and has published studies into Asia-Pacific LNG markets. The government successfully negotiated with East Timor to remove uncertainties relating to petroleum developments within the Joint Petroleum Development Area (JPDA) shared with East Timor. Consequently, Bayu Undan has been developed as a producing field within the JPDA and the related Darwin LNG plant is under construction. Negotiations are continuing over maritime boundaries and sharing of royalties with East Timor in disputed areas outside the JPDA. These last mentioned issues have delayed the development of the Greater Sunrise fields.

## **FEDERAL MARKET REFORMS**

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The nature of the gas market has changed markedly since the commencement of the reforms in the early nineties. Many of the vertically integrated public gas utilities have been structurally disaggregated and the separated entities privatised. Retail competition is being progressively introduced in most jurisdictions. There is emerging competition between independent gas basins and transmission pipelines servicing specific markets. As the interconnectivity of the grid has increased, market opportunities and competition are increasing. The federal government is implementing significant reforms to the energy/natural gas sectors, with the broad objectives to improve consistency of regulation and efficiency of the rules. In the area of natural gas, reforms include: *i)* the COAG energy market review; *ii)* upstream issues; *iii)* the response to the Productivity Commission review of the Gas Access Regime, *iv)* the development of a wholesale gas market, and *v)* the development of a gas emergency protocol. Each reform is discussed in more detail below.

## COAG ENERGY MARKET REVIEW

In December 2003, the Ministerial Council on Energy (MCE) released its response to the COAG Energy Market Review, announcing a three-year energy market reform programme. The programme includes reforms to market governance, economic regulation, electricity transmission, gas markets, and user participation. The elements of the reform programme that relate to gas markets are as follows:

- The Australian Energy Regulator (AER) is to assume the regulation responsibilities of the Australian Competition and Consumer Commission (ACCC), including regulation of:
  - Gas transmission by no later than 30 June 2005, except in WA<sup>26</sup>.
  - Distribution and retail (following MCE agreement on a national distribution and retail framework) by no later than 31 December 2006.
- The Australian Energy Market Commission (AEMC) will be responsible for all rule-making (code changes) and market development functions:
  - Those currently performed by the National Gas Pipelines Advisory Committee (NGPAC) and the Code Registrar in respect of natural gas transmission and distribution networks by no later than 30 June 2005.
  - Those conferred by jurisdictions in respect of natural gas distribution networks and retail markets (other than retail pricing), by no later than 31 December 2006.
- The MCE agreed in principle to develop a national approach to energy access covering electricity and gas transmission and distribution, under the Trade Practices Act, subject to consideration of the outcomes of the Productivity Commission review. Streamlined ACCC approvals procedures and acceptance under Part IIIA will be developed under a Memorandum of Understanding between the AEMC, AER and ACCC to be agreed by the MCE.
- The MCE will draw up a gas market development plan (see below).

It should be noted that the creation of AER and AEMC, which was scheduled by July 2004, has been delayed by 12 months, certainly postponing the above-mentioned reforms.

## UPSTREAM ISSUES

The Ministerial Council on Mineral and Petroleum Resources (MCMPR) has policy responsibility for upstream gas issues. As a result, MCE referred to MCMPR key recommendations arising from the Parer report. Specifically, these were to:

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26. For the present, WA has elected for its Essential Services Commission to maintain gas pipeline regulatory functions in that state. The Australia Energy Market Agreement provides for WA to elect to bring gas pipeline regulation under the AER in the future.

- Preclude jurisdictions from exempting future arrangements for the joint marketing of natural gas from the competition rules of the Trade Practices Act 1974.
- Undertake a review of appropriate treatment of no production areas in the renewal of existing production licences.
- Undertake a review of the gas industry's principles for TPA to upstream facilities.

In December 2004, the MCE endorsed the decisions of the MCMPR with regard to these recommendations. In relation to the first two, the MCMPR decided that changes to the Trade Practices Act 1974 were unnecessary, and that there was no systemic problem concerning exploration efforts in production licence areas. However, MCMPR has agreed to undertake a review of the industry's upstream TPA principles and will advise MCE of the outcome<sup>27</sup>.

### **Productivity Commission Review of the Gas Access Regime**

The National Gas Access Regime establishes a uniform national regulatory framework for TPA to natural gas transmission pipelines and distribution networks. It comprises the Inter-Governmental Agreement (IGA) of November 1997, state/territory-based access legislation, the Gas Pipelines Access Law and an extrinsic code – the National Third Party Access Code for Natural Gas Pipeline Systems (the Gas Code). The Gas Code provides for the following:

- A coverage process to determine whether a pipeline/network should be regulated.
- Submission of an Access Arrangement by the pipeline owner/operator which describes the basic terms and conditions of TPA. Access arrangements are determined by the relevant regulator (ACCC or relevant state/territory regulator), usually for a five-year period, and reviewed after that time. These approved arrangements become “default” agreements.
- Reference Tariff Principles against which reference tariffs for defined services are determined.
- Provisions to facilitate negotiation between the service provider and the access seeker.
- A dispute resolution mechanism.
- Ring-fencing provisions designed to prevent cross-subsidisation and cost shifting between vertically integrated entities in the gas supply chain (*i.e.* it precludes direct activity by the service provider in related upstream and downstream gas markets).

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27. MCE Statement on Upstream Gas Issues, December 2004.

The National Gas Access Regime applies to the spare or unused capacity in gas pipelines and distribution networks, which are “covered” by the Gas Code<sup>28</sup>. Not all transmission pipelines are covered by the Gas Code. Exceptions include the Eastern Gas Pipeline (connecting Longford to Sydney), most of the Moomba to Sydney pipeline, the SEAGas Pipeline (connecting Adelaide to the Victorian transmission network) and the Tasmanian Gas Pipeline (connecting Longford in Victoria to Bell Bay and Hobart in Tasmania). While most of the significant pipelines are covered, much of the gas transported is delivered under long-term contracts and is not directly regulated.

Further reforms of the Gas Access Regime are expected, following the review by the Productivity Commission of the access regime, completed in June 2004. The commission’s report indicates that the current regime is a form of cost-based price regulation<sup>29</sup>, which has significant costs in terms of information gathering, decision-making delays, appeals, and merit reviews. More importantly, the review revealed that the regulatory risk associated with the current review is very large, and includes a potential to distort investment.

The Productivity Commission has proposed improvements that would reduce regulatory costs, while preserving the benefits from facilitating competition through TPA to pipelines. The main recommendations are:

- Including a less costly monitoring option for regulators as an alternative to cost-based price regulation. The choice between price regulation and monitoring for each covered pipeline would be based on which was assessed as generating the greater net economic benefits.
- Clarifying the regime’s objectives by including an objects clause that focuses on promoting economic efficiency.
- Changing the test for coverage, in particular raising the threshold for applying the existing cost-based price regulation approach.
- Replacing the current guidelines for approving reference tariffs with a clear set of pricing principles<sup>30</sup>.
- Including scope to use non-building block approaches to setting reference tariffs.

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28. Gas pipelines and distribution networks are not automatically regulated unless they have been “covered” in accordance with the requirements of the Gas Code. If a pipeline is covered by the Gas Code, the owner/operator is required to submit a proposed access arrangement to the relevant regulator for consideration and determination following a publicly transparent assessment process.

29. The Productivity Commission review notes: “Although the Gas Access Regime appears to be based on a negotiate-arbitrate framework, third-party access prices, in effect, are determined using cost-based price regulation. This outcome arises because of the fundamental role attached to reference tariffs in the event of a dispute over access to a reference service and the way in which tariffs for reference services must be determined under the regime. In effect, third-party access is essentially based on the regulator-approved cost-based reference tariffs.”

30. In particular, the reference tariffs should include a return on investment commensurate with the regulatory and commercial risks involved.

- Tightening guidance to regulators for approvals of access arrangements and reference tariffs.
- For new greenfield pipelines, allowing for a binding ruling of no coverage for 15 years, on a case-by-case basis. This would apply to proposed pipelines that do not meet the coverage criteria.

The MCE has still to respond to the Productivity Commission's report. The response, which is now expected by mid-2005, will take into account the new governance and institutional arrangements for the Australian energy market, the key differences between the gas and electricity sectors and gas market development issues.

## WHOLESALE GAS MARKET DEVELOPMENT

In December 2004, the MCE finalised principles to guide the future development of the Australian wholesale market(s). The principles aim to encourage transparency, new market entrants, investment in gas infrastructure, and to provide a market mechanism to assist in managing supply and demand interruptions. The principles are as follows<sup>31</sup>:

- Information on market and system operations and capabilities at all stages of the gas supply chain (subject to recognition of existing contractual confidentiality) should be publicly available and frequently updated.
- Gas market structure is to facilitate a competitive market in all sectors.
- Gas market participants should be able to freely trade between pipelines, regions and basins.
- There should be regulatory certainty and consistency across all jurisdictions.
- Market design and institutional requirements should be responsive to and reflective of the needs of the market and market participants.

The MCE must now consider the costs and benefits of possible gas market development options based on these principles.

## NATIONAL EMERGENCY RESPONSE PROTOCOL

Currently, no formal cross-jurisdictional mechanism exists for managing major unplanned gas supply disruptions and there are no specific national laws covering gas supply security. However, disruptions at Longford (1998) and Moomba (2004) highlighted the vulnerability of the gas market to supply disruptions.

In April 2004, the MCE agreed to develop a National Emergency Response Protocol for the natural gas sector to be applied in the event of major disruptions. In

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31. MCE Statement on Principles for Gas Market Development, December 2004.



developing a gas emergency response protocol, the Gas Emergency Protocol Working Group is considering existing commercial and regulatory arrangements, and is energy-focused given the growing convergence of electricity and gas markets and the high dependence of electricity generation on gas supplies in some jurisdictions. The prospective emergency response protocols will articulate the responsibilities and roles of government, market participants and end-users. In addition, to ensure that future supply interruptions are managed in a nationally consistent manner, the gas emergency response protocol will cover both cross-border and intra-jurisdictional arrangements. The arrangements will change as the market matures. As the first stage in developing a protocol, MCE ministers signed a Memorandum of Understanding in December 2004 under which a jurisdiction proposing to exercise an emergency power must consult other affected jurisdictions before exercising the emergency power. A protocol proposing the establishment of a cross-jurisdictional mechanism, including industry involvement, in managing major unplanned gas supply disruptions is to be considered by the MCE shortly.

## **GAS MARKET REFORMS IN THE STATES AND TERRITORIES**

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Gas pipeline access legislation, introduced between 1997 and 2000, required transmission and distribution pipelines covered by the Gas Code to be ring-fenced from related upstream and/or downstream retail businesses. It also required all jurisdictions to implement full retail contestability (FRC) over a number of years. This has been completed in all jurisdictions except Queensland, Tasmania and the Northern Territory. Although most jurisdictions are moving towards FRC, some retail prices are still regulated, especially for small retail customers.

**Victoria** offers the most competitive environment for gas supplies. Victoria's gas market was privatised in the 1990s. Full gas retail competition was introduced in October 2002. Suppliers issued with a licence to retail natural gas in Victoria include AGL Energy Sales & Marketing, BHP Billiton Petroleum, ENERGEX Retail, EnergyAustralia, Ergon Energy Gas, Esso Australia Resources, Gascor, Origin Energy (Victoria), Origin Energy Retail and TXU. Recently, Santos acquired a licence and is going to market gas directly to industrial customers and into the Victorian spot market. The number of customers that have switched suppliers up to December 2004 was 430 000, around 27% of the small customer market.

A spot gas market has been developed since 2003 at Longford through which gas can be traded. The VicHub Interconnector, developed by Duke Energy and now owned by Alinta, joins the Tasmanian Gas pipeline and mainland Eastern Gas pipeline to GasNet's pipeline system at Longford. VENCORP, the Victorian Energy Networks Corporation, has also developed a spot gas market which provides a commercial basis for balancing the gas transmission system. The spot market was established in 1998. However, it is not used for trading purposes. VENCORP is now reviewing the pricing and balancing arrangements of the market.

Full gas retail competition was introduced in **New South Wales** (NSW) in January 2002. Twelve suppliers have obtained a licence to retail gas in NSW, including AGL, Country Energy, Envestra, Origin Energy, ActewAGL and Allgas/ENERGEX. However, AGL is still the dominant gas supplier to Sydney and Newcastle and has benefited from the perpetuation of its long-term supply contracts. Full retail competition has allowed a significant number of customers to enter into competitive supply contracts. By September 2004, over 822 000 customers had chosen to negotiate a competitive contract with their retail (gas and electricity) supplier.

**Queensland's** gas distribution market is dominated by Envestra, which has structured legacy supply contracts in place with Origin Energy. Some distribution is also conducted by Allgas Energy/ENERGEX. A small number of large industrial customers use over half the gas consumed in Queensland. Retailers and large industrial customers purchase their gas directly from gas producers in the Bowen/Surat basin. Gas distributors operate 4 364 km of reticulation main in Queensland, providing gas to 145 000 customers. Most of this gas is sold to industrial customers. The gas retail market in Queensland was scheduled to become fully contestable in 2003, but is now subject to a cost-benefit analysis being undertaken by the Queensland government.

Natural gas is distributed in **South Australia** (SA) by Envestra and retailed by Origin Energy, Terra Gas Trader, International Power and Eastern Energy. The majority of natural gas produced in SA comes from the SA and Queensland sections of the Cooper basin, with the remainder coming from the Otway basin (at Katnook) in south-east SA. Since the beginning of 2004, a new pipeline, the SEAGas Pipeline, has linked Port Campbell (in Victoria) to Adelaide, to bring a new natural gas supply into SA from offshore Victorian gas fields. Natural gas is used in many applications in South Australia, with 53% being utilised for electricity generation in power stations and co-generation plants. The remainder is distributed through a reticulation network of 6 800 km, to customers in the metropolitan and regional areas.

With more than three-quarters of Australian gas reserves, **Western Australia** (WA) is the largest gas-consuming jurisdiction in the country and the host of the North West Shelf Gas Project – which comprises a domestic gas supply plant and the LNG export facility operated by Woodside Petroleum. Gas is distributed to over 458 000 domestic, commercial and industrial customers in and around Perth and to a small extent around Kalgoorlie. AlintaGas is the principal distribution and retail company and the operator of the DBNGP through its 20% interest acquired from Epic Energy. It is now spreading its influence to other states through its acquisition of Duke Energy assets and a controlling stake in United Energy. An industry-based regulator has been established and has the authority to regulate all transmission and distribution pipelines in WA.

The Australian Gas Light Company (AGL) began natural gas distribution and retail in the **Australian Capital Territory** (ACT) in 1982. In 2000, AGL's natural

gas network and marketing business in the ACT entered into a partnership with the ACT government-owned electricity network and marketing business, ACTEW, to form ActewAGL. The multi-utility is the first in Australia to offer gas, electricity, water and sewerage services. Full gas retail contestability was introduced in the ACT in January 2002, and new retailers may now enter the market.

Origin Energy retails natural gas in Alice Springs, and NT Gas Distribution retails in Darwin. Over 90% of natural gas used in the **Northern Territory (NT)** is for electricity generation. The remainder is used by industrial customers, and also reticulated to commercial and residential customers in Alice Springs and Darwin. All gas comes from gas fields located in the Amadeus basin. The NT has no plans to implement FRC given the very small number of business customers and the lack of a household distribution network.

**Tasmania** has now been connected to natural gas, following the completion in 2002 of an undersea pipeline across the seafloor of Bass Strait, from Victoria's Gippsland basin to Tasmania. The New Zealand-based company, Powerco Limited, had been chosen to distribute natural gas in Tasmania. The gas distribution network is still being rolled out with completion scheduled for April 2007 and will be fully contestable from the roll out.

## GAS PRICES AND TAXATION

Most gas production in Australia is still contracted on a long-term basis and pricing information is treated by the industry as commercial-in-confidence and is thus not publicly available. (The last data the IEA has received on Australian gas prices were from 1997.) The intention is to move, over time, towards greater trading volumes and more transparency. However, estimates provided by the government show that Australian industrial prices are among the lowest if not the lowest in the IEA.

Table 30

### Industrial Gas Prices (taxes included) in Selected Countries

Country	USD per 10 <sup>7</sup> kcal
Australia	140
USA	237
UK	201.9
Canada	204.01
Japan	357.04
Netherlands	227.3

Data from Q1 2004, or latest available.

Sources: IEA and Australian government.

Although the gas price is low compared with international prices, it is much higher on a heat-content basis than competing fuels for electricity generation, such as coal. The petroleum industry claims that one of the reasons for this is

the tax differential between the petroleum and the mining industries. The tax burden on gas compared to coal introduces a bias against the use of natural gas in the electricity sector, where coal is a major competitor. The following table highlights some of the differentials in current resource taxation.

Table 31  
Resource Taxation

<i>Fuel</i>	<i>Tax per GJ</i>
Brown coal VIC royalty	approx. AUD 0.03
Black coal NSW royalty	approx. AUD 0.07
Onshore natural gas SA/QLD royalty	less than AUD 0.25
Coal Seam gas NSW/QLD royalty	approx. AUD 0.25
Offshore natural gas Commonwealth PRRT	more than AUD 1.00

Source: NatGas, APPEA, December 2003.

## CRITIQUE

The Australian natural gas sector has experienced major reforms and structural change since the mid-1990s with the separation of formerly integrated companies and the introduction of TPA to transmission and distribution pipelines. These reforms have contributed to customer choice and exerted a downward pressure on prices. A degree of competition has developed, facilitated by more extensive interconnections between states and territories. Most retail gas markets in Australia have now become fully contestable. There has been significant investment, expansion and integration of the gas transmission network, particularly in south-eastern Australia, that has enabled competition and increased security of supply. New investment has been permitted by the allowance of a rate of return on new investments that is relatively competitive and attractive with other investments with a similar risk profile. In addition, the major gas-consuming regions in Australia (capital cities and south-eastern Australia) are now serviced by more than one gas supply source.

Although these and other developments have generally increased security of supply, there is not yet a national emergency protocol taking into account the development of a national energy market. As such, the Gas Emergency Response Protocol will be an important step forward in assuring security of supply. The government is encouraged to proceed with its plans in this area, paying special attention to delineating the responsibilities of the governments, the supply industry and customers themselves.

There are still some challenges to achieve real competition and support new investment. The Australian gas market is still relatively small, lacking liquidity and depth. Many areas are dominated by one producer (through a joint

marketing agreement). Upstream, the concentration of supply is a major issue: almost 94% of natural gas supplied to eastern Australia in 2001/02 was from the Esso/BHP Gippsland basin joint venture and the Santos-led Cooper-Eromanga basin joint venture. Downstream, the number of big players is also rather limited. Furthermore, some companies are vertically integrated and there is the potential for cross-subsidisation between activities.

Outside Victoria, the transmission network is best described as a "point to point" network. The location of Australia's natural gas reserves and the large distances between the consumption centres has created three main transmission networks not linked to each other; one in the eastern states and SA, and the two others serving WA and NT. The gas access regime is a form of cost-based price regulation, which needs to be improved to allow real competition to develop. There is a tendency towards greater consolidation (APT and Alinta have both bought several gas pipelines in the past few months), as well as integration of customers along the gas chain with "customer" pipelines (SEAGas). These new trends are not favouring the emergence of more competition. There is a need to improve regulatory certainty. The current regime lacks binding upfront authorisation rulings. Under the existing regime, companies considering investing in a pipeline can ask the National Competition Council for advice on whether the pipeline would be covered. However, this advice is not binding. There might be emphasis on building capacity that is essentially fully contracted prior to construction. The Productivity Commission has completed a very comprehensive review of the regime and proposed several changes to foster investment, better interconnectivity and competition. One recommendation is to move to an *ex post* regulation with a monitoring option. Although this may be envisaged in the long term, the Australian gas market is still characterised by low competition and, as recognised in the PC review, still needs a gas access regime. Experience in European countries of *ex post* regulation has not proved to be successful and has led the European Commission to move to non-discriminatory and transparent regulated access. Likewise the proposal to allow, on a case-by-case basis, an exemption of 15 years from the binding ruling has the potential to distort competition. There is a need to ensure access to pipelines on fair and reasonable terms and to make sure that pipeline owners can secure a fair return. In case of high-risk investment, a premium on the rate of return may be a better instrument than an exemption for 15 years.

Australia is well endowed with gas reserves and is a major LNG exporter through the North West Shelf project. Expansion of the North West Shelf project and several greenfield LNG projects are under consideration. In the long term, LNG is expected to be Australia's fastest growing energy export. However, although the global LNG market is booming, competition among global LNG suppliers is fierce. Australia offers several advantages compared with competitors, namely its political stability, a strong reserves base, its experience and success in developing LNG infrastructure, its LNG safety record since the beginning of exports in 1989 and its reliability as an LNG exporter.

In addition, the Australian government has been encouraging LNG projects through its LNG Agenda. However, a few hurdles remain. Maritime boundaries disputes with the East Timor government have not been resolved so far, leading Woodside to stop preparatory work on its proposed Greater Sunrise project.

Since the mid-1990s, substantial changes have occurred upstream with the removal of barriers to trade gas between jurisdictions. This has spurred substantial new investment in gas transmission pipelines. Market deregulation has stimulated exploration in south-eastern Australia, which has led to the discoveries and developments at fields such as Yolla, Minerva, Thylacine/Geographe and Casino, providing buyers with additional choice. However, there are still major barriers to the development of more competition upstream.

Depending on the geographic location in Australia, gas production can result in the need to pay either the Petroleum Resource Rent Tax (PRRT) or a royalty. It is claimed by the petroleum industry that the level of taxation imposed under these two quite different regimes results in a strong competitive bias, as gas competes for the same customers. The claimed unfavourable tax treatment for offshore gas may represent a barrier to exploration and production, and the further development of the gas market. The PRRT applies to all petroleum produced from a petroleum project. It does not differentiate between gas and oil projects (as most projects produce petroleum liquids and gas) and does not explicitly take into account their different cost and risk profiles. The recent decision by the Australian government to provide a taxation concession for exploration in “designated frontier areas” is a positive first step in encouraging further offshore exploration and production.

Access to upstream facilities has been debated heavily in the last ten years. Upstream facilities are not like pipelines and are not typically monopoly facilities, which would justify regulation. However, access to processing plants would allow more supply and upstream competition. The upstream Australian Petroleum Production and Exploration Association (APPEA) has published a set of principles, which would typically apply to such negotiations. The Ministerial Council on Mineral and Petroleum Resources (MCMR) is currently undertaking a review of the industry’s upstream TPA principles and will advise MCE of the outcome. Such a review will take into account the concentration of upstream suppliers (in particular in eastern Australia) and the difficulty for potential small producers to enter the market. Finally, although the joint production of gas is often necessary to share costs and risks, the argument is less valid for the marketing of gas. Experience in Norway with the break-up of the GFU has demonstrated that competition can successfully be introduced in the sale of gas when the market is liquid enough. Australia may consider a policy to facilitate separate marketing where and when it is feasible to do so.

Gas sector reform lags that of electricity. Nevertheless, the sector has moved more quickly to private hands, and full retail contestability (FRC) has been established in Victoria, NSW, WA, SA and the ACT. The small number of

suppliers, however, is a major barrier to both competition and greater transparency in the market. The market is still immature and characterised by a low penetration of gas in the residential and commercial sectors, except in Victoria. Competition from electricity produced from cheap coal deters increased gas consumption. ABARE expects that gas consumption will almost double from 2001/02 to 2019/20, driven by a large increase in the manufacturing sector and the use of gas for power generation. Gas has already found a niche role in peaking power in the south-eastern market. However, its penetration for baseload generation encounters a number of problems. The market price of coal is much cheaper than the market price of gas. In addition, the petroleum industry claims that differences in taxation between the mining and the petroleum industries currently discourage the increased use of gas for baseload generation and restrict its use to middle or peaking loads only. Furthermore, the way electricity tariffs are set fails to recognise the added value of gas-fired generation being able to more easily locate close to load centres. Although gas could act as a transition solution towards a less carbon-intensive economy, realising this role could be difficult without addressing this bias or without any explicit GHG policy and/or carbon price signals.

MCE is developing a gas market development plan in co-operation with the industry to agree on the fundamental principles and design concepts for a gas market and develop options, such as increased transparency, to encourage new market entrants, promote further efficient investment in gas infrastructure and provide efficient management of supply and demand interruption. In particular, the government has launched an initiative to develop wholesale gas markets. This is an important step to increase competition and transparency in the market by allowing prices to be determined by market fundamentals and not through bilateral contracts. However, these markets cannot be mandated and will not be developed by government action. They can only be developed under the impetus of market participants who see commercial opportunities and take advantage of them. This does not mean that no governmental action is required. A market will develop only if the regulatory conditions are appropriate. In this area, the most urgent task for the government is to review the gas access regime and ensure TPA on a non-discriminatory basis with clear and transparent rules of access.

## RECOMMENDATIONS

*The government of Australia should:*

- ▶ *Strengthen the development of a national energy/gas market with better interconnectivity of the grid and more consistency of rules across jurisdictions; complete the gas market development plan jointly developed*

*with the industry; actively promote the development of hubs/spot markets; and increase transparency in the market (e.g. market share information and prices).*

- ▶ *Complete the Gas Emergency Response Protocol as soon as possible, making clear the roles and responsibilities of governments, market participants and customers.*
- ▶ *Establish a clear, transparent and stable framework for a gas access regime that enables cost-effective access at the transmission level, gives enough incentives for new greenfield pipelines and ensures uniformity of approach nationally; quickly respond to the Productivity Commission Review on the Gas Access Regime.*
- ▶ *Promote further upstream competition, for example by reviewing the upstream fiscal regime for onshore and offshore fields in order to encourage exploration and production offshore and create internationally, as well as across jurisdictions, competitive conditions; by reviewing joint marketing policy and facilitating separate marketing where feasible; and by reviewing/monitoring conditions for access to upstream facilities.*
- ▶ *Continue to encourage the development of LNG exports in the face of global competition, with particular attention to resolving boundaries and royalty issues with East Timor.*
- ▶ *Review the effects of differing taxes, regulations and changes on the competitive position of gas versus coal in energy markets.*





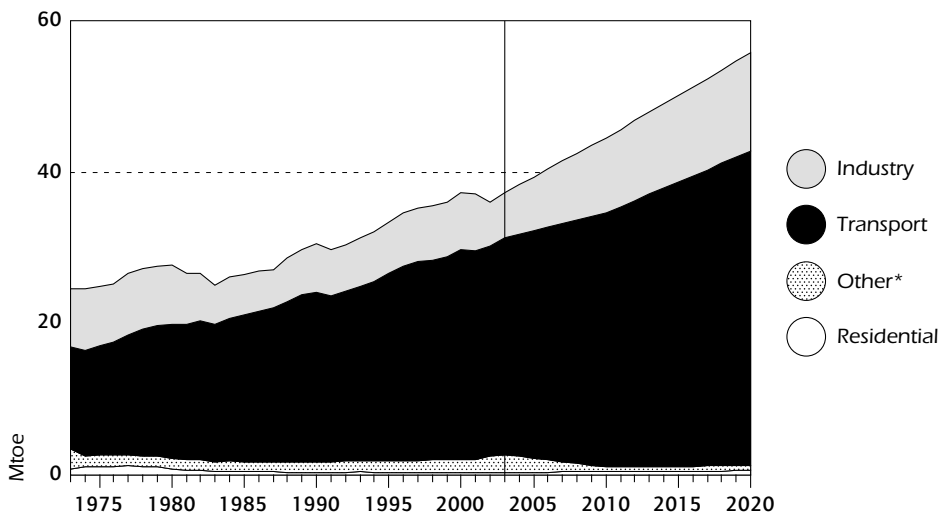
## SUPPLY AND DEMAND

In 2003, oil accounted for 32% of Australia's TPES. By way of comparison, oil's share of TPES for all IEA countries combined was 40% in 2002. In 1970, oil's share of Australian TPES was 48% and it has been falling steadily since then. The federal government forecasts that oil use in Australia will grow in absolute terms at an average annual rate of 3.0%, slightly above the supply growth for all fuels of 2.8%.

In 2003, transport accounted for 77% of oil TFC, followed by industry (10%), non-energy use (6%), commercial (6%) and residential (1%). Oil use in the transport sector has grown rapidly. From 1970 to 2003, oil TFC grew by 1.6% annually while oil use in the transport sector grew by 2.9% annually. This trend has continued in recent years and is projected to grow by 2.0% annually over the period 2001/02 to 2019/20. Oil has never been used extensively as a fuel for electricity generation, while in 1973, it accounted for 2.6% of total generation and in 2003, for 1.0%.

Figure 18

### Final Consumption of Oil by Sector, 1973 to 2020



\* includes commercial, public service and agricultural sectors.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2005; and country submission.

While Australia has been an oil producer for more than 30 years, it has only rarely been a net exporter of oil. In only two years since 1973 has Australia been a net oil exporter. In the other years, import reliance (*i.e.* net imports as a percentage of oil supply) has varied between 45% and 0%. Since 1990, domestic production in absolute terms has not shown any substantial upward or downward trends. ABARE projects that domestic oil production will remain flat in the coming years and thus increasing oil demand will cause import reliance to rise, reaching 37% in 2010 and 46% in 2020. More conservative estimates from Geoscience Australia project a downturn in Australian crude oil production.

## **INDUSTRY STRUCTURE**

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### **UPSTREAM**

The Australian upstream petroleum industry is made up of small, medium and large companies, many of which are foreign-based. Major companies include Shell, BP, Chevron, ExxonMobil, BHP Billiton, Woodside and Santos. Material obtained from public company sources indicates they have the following market shares for oil and condensate production: BHP Billiton (22%), ExxonMobil (21%), Woodside (16%), Chevron (9%), Shell (9%), and Santos (7%). The petroleum industries continue to generate a high proportion of the nation's export income. Total petroleum exports in 2003/04 amounted to around AUD 8.8 billion compared to imports of AUD 12.5 billion.

Onshore and in coastal waters (effectively the first three nautical miles from the coastline), the states and territories own and allocate petroleum rights, administer petroleum operations and collect royalties on petroleum produced. The states and Northern Territory have empowered the National Offshore Petroleum Safety Authority (NOPSA) to exercise occupational health and safety powers in coastal waters from 1 January 2005. Beyond the coastal waters to the outer limits of Australia's continental shelf, petroleum rights are held by the federal government, although day-to-day administration, with the exception of occupational health and safety, is carried out jointly with the relevant adjacent states or territories.

Through Geoscience Australia, the government provides pre-competitive geoscientific data and access to historic data from commercial exploration and development activities to encourage exploration, recognising that there are extensive areas of potential petroleum-bearing sedimentary basins, many of which remain underexplored.

During the period between 1996 and 2004, 33 production licences, 27 pipeline licences and 54 retention leases were either granted or renewed in federal waters. Over the same period, a total of 198 offshore petroleum exploration permits have also been granted or renewed under the Petroleum (*Submerged Lands*) Act 1967. There are currently 157 exploration permits in force – an all-time record.

The annual number of exploration and development wells drilled between 1998 and 2003 has been variable, as shown in Table 32. In 2003, a total of 55 offshore exploration wells were drilled, which is seven more than in 2002. A total of seven offshore discoveries were made in 2003, six in the Carnarvon basin and one in the Gippsland basin. Onshore, 36 exploration wells were drilled in 2003, which is four less than in 2002. There were six discoveries, five in the Cooper/Eromanga basin and one in the Perth basin.

Table 32  
**Summary of Exploration and Development Wells Drilled,  
 1998 to 2003**

	1998	1999	2000	2001	2002	2003
<b>Exploration wells</b>						
Offshore	73	51	62	59	48	55
Onshore	95	43	37	67	40	36
<i>Sub-total</i>	<i>168</i>	<i>94</i>	<i>99</i>	<i>126</i>	<i>88</i>	<i>91</i>
<b>Development wells</b>						
Offshore	40	41	24	19	26	29
Onshore	55	40	79	68	56	61
<i>Sub-total</i>	<i>95</i>	<i>81</i>	<i>103</i>	<i>87</i>	<i>82</i>	<i>90</i>

Source: Geoscience Australia. Exploration wells included appraisal, extension and wildcat wells.

From 1998 to 2003, there has been an overall decline in the amount of seismic surveying performed, as shown in Table 33. A total of 22 092 line km of 2D seismic and 7 820 square km of 3D seismic were recorded in offshore Australia in 2003. Onshore, there was 1 371 line km of 2D data and 424 square km of 3D data acquired during 2003.

Table 33  
**Summary of Seismic Surveys Performed, 1998 to 2003**

	1998	1999	2000	2001	2002	2003
<b>2D seismic survey (line kilometres)</b>						
Offshore	104 720	89 195	25 064	62 079	25 780	22 092
Onshore	6 190	5 181	2 291	1 298	3 387	1 371
<b>3D seismic survey (square kilometres)</b>						
Offshore	856 160	136 331	14 305	18 537	6 295	7 820
Onshore	4 989	7 068	1 581	3 250	1 237	424

Source: Geoscience Australia.

From 1998 to 2002, total expenditure on exploration and development declined by 15%; however, it should be noted that exploration expenditure provides only an imperfect measure of the level of actual activity. Declining exchange rates can dramatically increase the costs of USD denominated vessel contracts, difficulties in securing appropriate offshore equipment to Australia can add massive vessel mobilisation costs, and misadventure can dramatically increase well costs.

**Table 34**  
**Petroleum Exploration and Development Expenditure**  
(thousand AUD)

	1998	1999	2000	2002
<b>Exploration expenditure</b>				
Offshore	789 515	599 408	736 859	606 199
Onshore	218 519	99 996	137 472	183 333
<b>Development expenditure</b>				
Offshore	1 201 693	1 362 433	1 085 262	1 213 311
Onshore	724 796	882 530	727 674	512 547
<b>Total</b>	<b>2 934 523</b>	<b>2 944 367</b>	<b>2 687 267</b>	<b>2 515 390</b>

Source: Geoscience Australia. Data were unavailable for 2001 and 2003.

## DOWNSTREAM

### Refining

With a total capacity of 874 500 barrels per day<sup>32</sup>, Australia's refineries are relatively small in comparison with refineries in Asia. In 2002, average throughput of the refining industry was 689 000 barrels per day. Australian refineries use both domestic and imported crude oil as feedstock for downstream petroleum products, including LPG, petrol, diesel, jet fuel, lube oil and bitumen. Current demand for products in Australia is approximately 777 000 barrels per day. A greater reliance on product imports in the medium to long term (industry sources suggest around 25% of total demand will be met by imports) is expected.

Following the mothballing of Mobil's Port Stanvac refinery in Adelaide in mid-2003 owing to poor refining margins resulting from regional over capacity, only seven of Australia's eight refineries are currently operational. The refineries were constructed in the 1950s and 1960s, but have been extensively modified. At the end of 2003, the downstream petroleum industry had AUD 5 billion of refining assets. Australian refiners are expected to invest around AUD 2.0 billion by 2010

32. This figure includes the mothballed Port Stanvac plant of 79 000 barrels per day of capacity.

to maintain integrity, reliability and competitiveness of the refineries, as well as for upgrading to meet tightened fuel standards. The industry employs around 3 600 people in Australia.

Table 35

### Australian Refineries

<i>Refinery</i>	<i>Owner</i>	<i>Location</i>	<i>Capacity (bpd)</i>
Bulwer Island	BP	Brisbane	88 000
Lytton	Caltex	Brisbane	105 500
Clyde	Shell	Sydney	86 000
Kurnell	Caltex	Sydney	124 500
Altona	Mobil	Melbourne	135 000
Geelong	Shell	Geelong	119 000
Port Stanvac <sup>(1)</sup>	Mobil	Adelaide	78 000
Kwinana	BP	Kwinana, WA	138 500
<b>Total</b>			<b>874 500<sup>(1)</sup></b>

bpd: barrels per day.

<sup>(1)</sup> Although the Port Stanvac facility has been mothballed, its capacity is still included in the total.

Source: Australian Institute of Petroleum.

## Retail

There are approximately 6 500 service stations in Australia, operated under a variety of commercial arrangements. The overwhelming trend over the last 20 years has been the consolidation of sites. The number of service stations has fallen from 20 000 in 1975 to the current 6 500, with a corresponding increase in sales volumes at the remaining sites. This trend is continuing with fewer, larger sites increasing market exposure with reduced overhead per unit operating costs.

The petrol/diesel retail industry is made up of four vertically integrated refiner/marketers (BP, Caltex, Mobil and Shell) two of which have petrol retailing supermarket alliances (Caltex-Woolworths and Shell-Coles Myer), and of the independent retailers (including the larger independent chains and the smaller independent operators). In 2004, Caltex (including Caltex-Woolworths sites) had the largest market share with around 33%, followed by Shell-Coles Myer with 25%, and BP and Mobil, with at least a 16% share each. The independents cumulatively had a share of 10%.

The entry of supermarkets is changing the motor fuel retail landscape with discount offers on fuel for supermarket shoppers sparking greater competition. In May 2003, Shell and Coles Myer Ltd (a supermarket chain) announced an alliance where a subsidiary of Coles Myers would operate Shell's retail properties. Customers would receive a discount on fuel if a certain amount of

groceries were purchased. In September 2003, Independent Grocers of Australia (IGA) launched a fuel offer, which provides a 4 cents per litre refund on fuel with a AUD 30 purchase of groceries. In November 2003, Woolworths and Caltex opened co-branded service stations also offering a fuel discount of four cents per litre. Such fuel discounts tied to food purchases are referred to as "shopper docket discounts" in Australia.

In February 2004, the Australian Competition and Consumer Commission (ACCC) released a report on the effects of shopper dockets on competition. It found that shopper dockets increased competition and reduced prices, thereby providing substantial benefits for consumers.

## **GOVERNMENT POLICY**

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Under Australian law, petroleum rights are owned by the government but assigned to the private sector for exploration and development. The government has four main roles in relation to the petroleum sector:

- It establishes the macroeconomic environment (broad economic policy).
- It provides a regulatory framework for exploration, development, project approval processes, safety, environmental assessment and revenue collection.
- It reduces commercial risk in minerals and petroleum exploration, by collecting and disseminating geoscientific information.
- It looks for ways to remove impediments to improve the industry's competitiveness.

## **DOMESTIC PRODUCTION**

The government is interested in keeping Australia an attractive investment destination in which companies explore for and produce oil. It considers the country underexplored in terms of oil resources and would like to see greater activity to exploit domestic oil. Australia's political and economic stability is a major selling point in this regard. In 2003, Australia ranked number one in the world across a wide range of risk factors in a World Investment Risk Survey conducted by Resource Stocks. The government wants to build on such strengths to maximise sustainable development of energy resources and provide an appropriate return to investors.

In April 1999, the Australian government announced a revised Offshore Petroleum Strategy. The strategy provides a ten-year framework for the exploration of Australia's continental shelf. It creates more certainty in the acreage release process, gives industry more lead-time in considering areas for future release and ensures that Australia's regulatory and fiscal arrangements remain internationally competitive.

Two recent government initiatives are intended to increase exploration and ultimately production. The first initiative was to increase funding for government geoscience activities. Government collectively spends around AUD 90 million a year providing geoscience data that identify and assess Australia's resources. Starting with the budget for 2003/04, the government announced a further funding of AUD 61 million over four years for Geoscience Australia's core petroleum programme. Of this amount, AUD 25 million is to generate new geoscience data to further encourage exploration in offshore frontier areas.

The second initiative was announced in the June 2004 energy White Paper. Production companies in Australia face both corporate income tax (reduced from 36% to 30% in 2001) and the Petroleum Resource Rent Tax (PRRT), a profits-based tax that automatically adjusts to changes in prices and costs. (See Chapter 3 for full explanation of this and all taxes). Previously, companies were allowed to deduct 100% of their exploration costs from the PRRT liability. Starting with the 2004/05 budget, this will be increased to a 150% reduction of the exploration costs incurred in designated frontier areas. This is intended to further reward and motivate companies to explore those unexplored areas where a major new oil province could be found.

## RETAIL REGULATORY ENVIRONMENT

The downstream petroleum industry continues to be regulated by the Petroleum Retail Marketing Sites Act 1980 and the Petroleum Retail Marketing Franchise Act 1980. The Sites Act dictates how many sites the oil majors directly own and operate in the Australian market and was put in place to promote competition between the oil majors and prevent further vertical integration. The Franchise Act provides protection of tenure for franchisees, requiring disclosure of relevant information by franchisors to prospective franchisees. It also prohibits discrimination in price in the sale of fuel between the franchisor and its franchisees. The Franchise Act applies to sites trading under a supplier's brand which retail a minimum of 30 000 litres of petrol per month.

The government has sought to repeal the Sites and Franchise Acts but to date these attempts have proved unsuccessful. The motivation for this change is the majors' requirement to rely on franchises rather than direct ownership, which may not be as efficient as other models such as commission agency sites. The government is committed to removing this restriction on competition by repealing the Sites and Franchise Acts and introducing a mandatory industry code, the Oilcode, to govern relations between fuel suppliers and retailers. The Downstream Petroleum Reform Package – which provides a uniform regulatory environment for industry participants through the introduction of a mandatory industry code, the Oilcode, under section 51AE of the Trade Practices Act 1974 and repeal of the Franchise and Sites Acts – was considered



by the government in December 2003. The government decided not to proceed with the implementation of the reform package although consultation with industry was initiated again in December 2004 with the expectation that a plan for reform be put in place by the end of 2005.

## NEW ENVIRONMENTAL FUEL STANDARDS

The first national fuel quality standards were introduced on 1 January 2002. The standards are prescribed in the Fuel Standard (Petrol) Determination 2001 and the Fuel Standard (Automotive Diesel) Determination 2001, and made under the Fuel Quality Standards Act 2000. The legislation provides the framework for the harmonisation of Australian fuel quality standards with international standards. The new standards prohibit the supply of leaded petrol and reduce the level of sulphur in petrol and diesel fuel. Where a state or territory government already has fuel quality standards in place, the federal government standards operate concurrently. State or territory standards apply where they regulate a fuel characteristic not covered by the federal government standards (*e.g.* Reid Vapour Pressure) or apply more stringent standards.

The first tranche of Australian standards for petrol and diesel is being progressively introduced between 1 January 2002 and 2006. The first tranche of standards will see the sulphur content of Australian petrol drop from 500 parts per million (ppm) to 150 ppm for all grades of petrol from 1 January 2005 and the benzene content will be regulated for the first time to a maximum of 1%. The sulphur content of Australian diesel will drop from 500 ppm to 50 ppm from 1 January 2006, matching that of European (Euro 4) diesel from that date. The reduction in sulphur levels will facilitate the introduction of advanced low-emission technology such as direct injection engines and improved catalysts into the Australian market.

A second tranche of Australian standards was announced on 22 July 2004 to apply post-2006. The standards will bring national petrol and diesel standards into approximate alignment with European (Euro 5) standards for both fuels, to be introduced in Europe on 1 January 2009. The second tranche of standards will see sulphur in premium unleaded petrol limited to 50 ppm from 1 January 2008 and sulphur in diesel limited to 10 ppm from 1 January 2009.

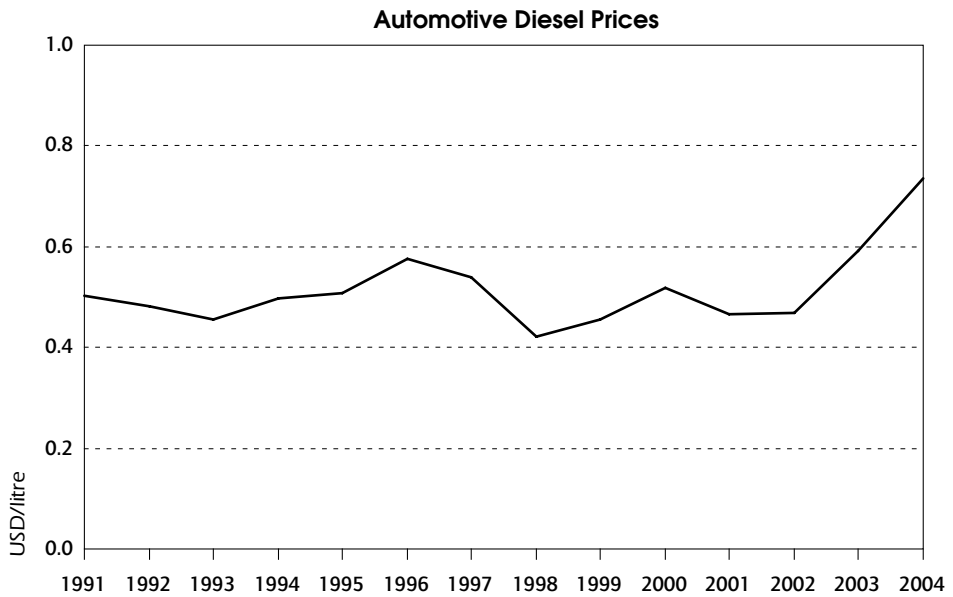
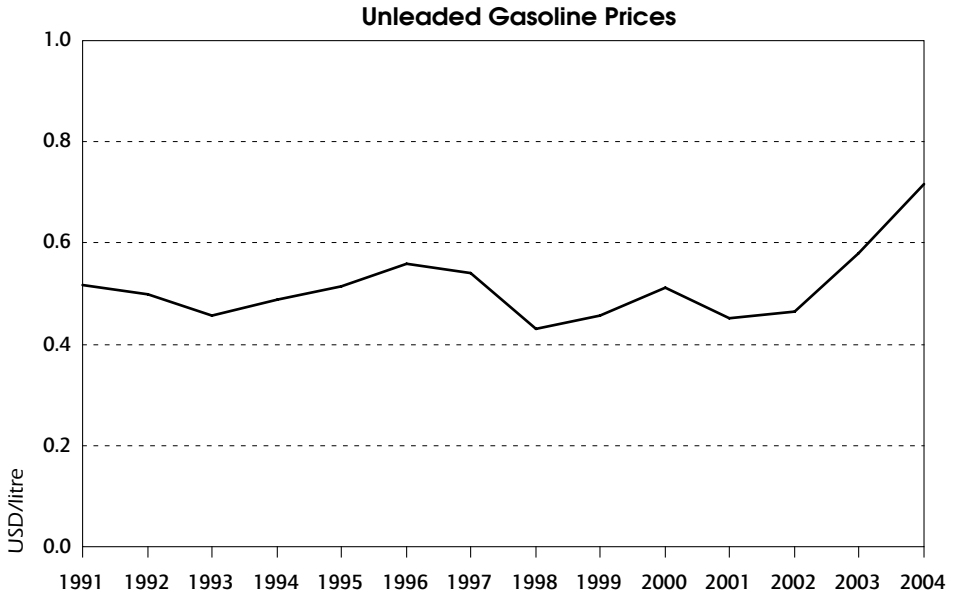
## OIL PRICING

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Australia has some of the cheapest petrol and diesel prices in the IEA. In the fourth quarter of 2004, full retail prices for both petrol and diesel fuel were the fourth-lowest among all IEA countries. Full retail prices for diesel were the fifth-lowest among all IEA countries. The energy White Paper announced a reform of the excise tax for motor fuels that would substantially decrease the burden from this tax for business use. (See Chapter 3 for a complete discussion of this reform.)

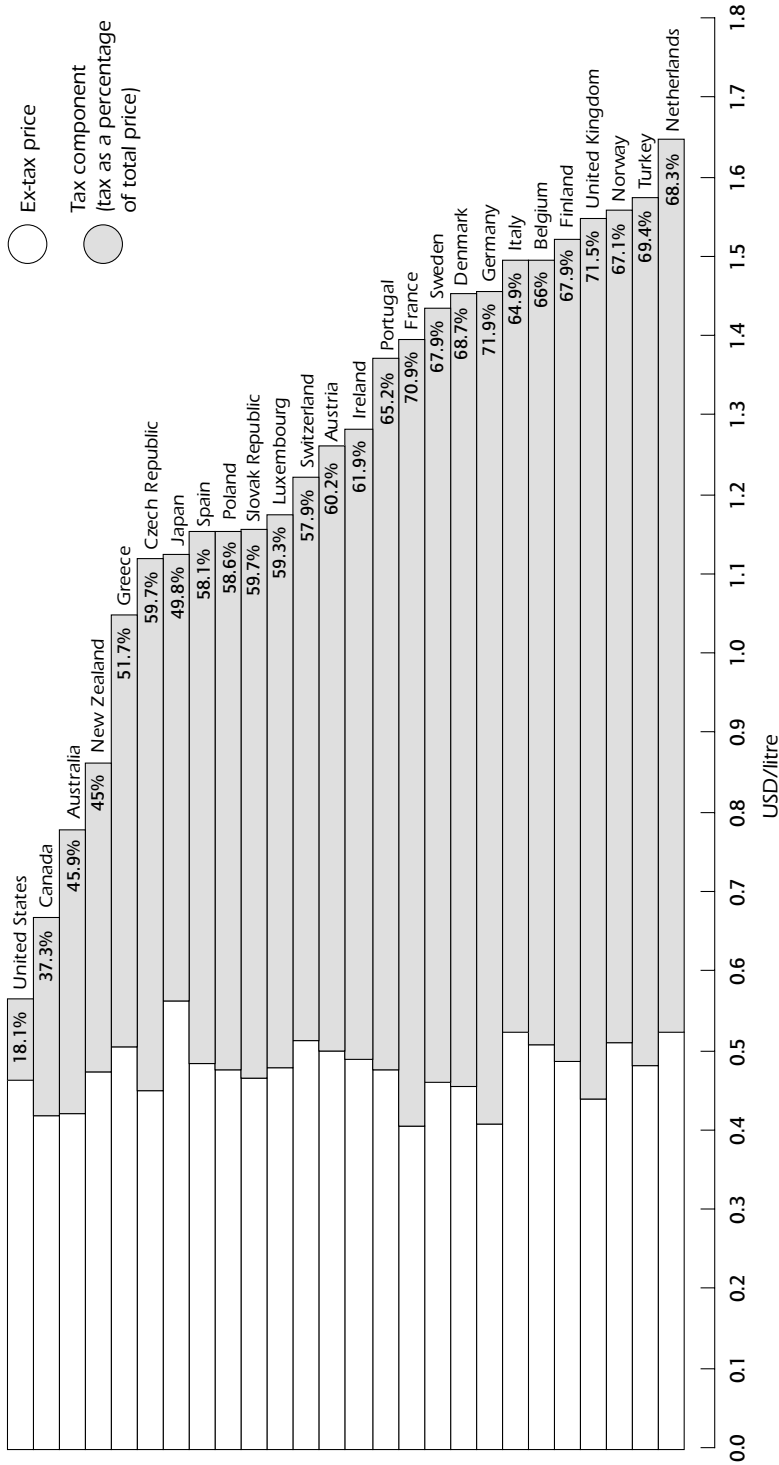
Figure 19

Unleaded Gasoline and Automotive Diesel Prices,  
1991 to 2004



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2005.

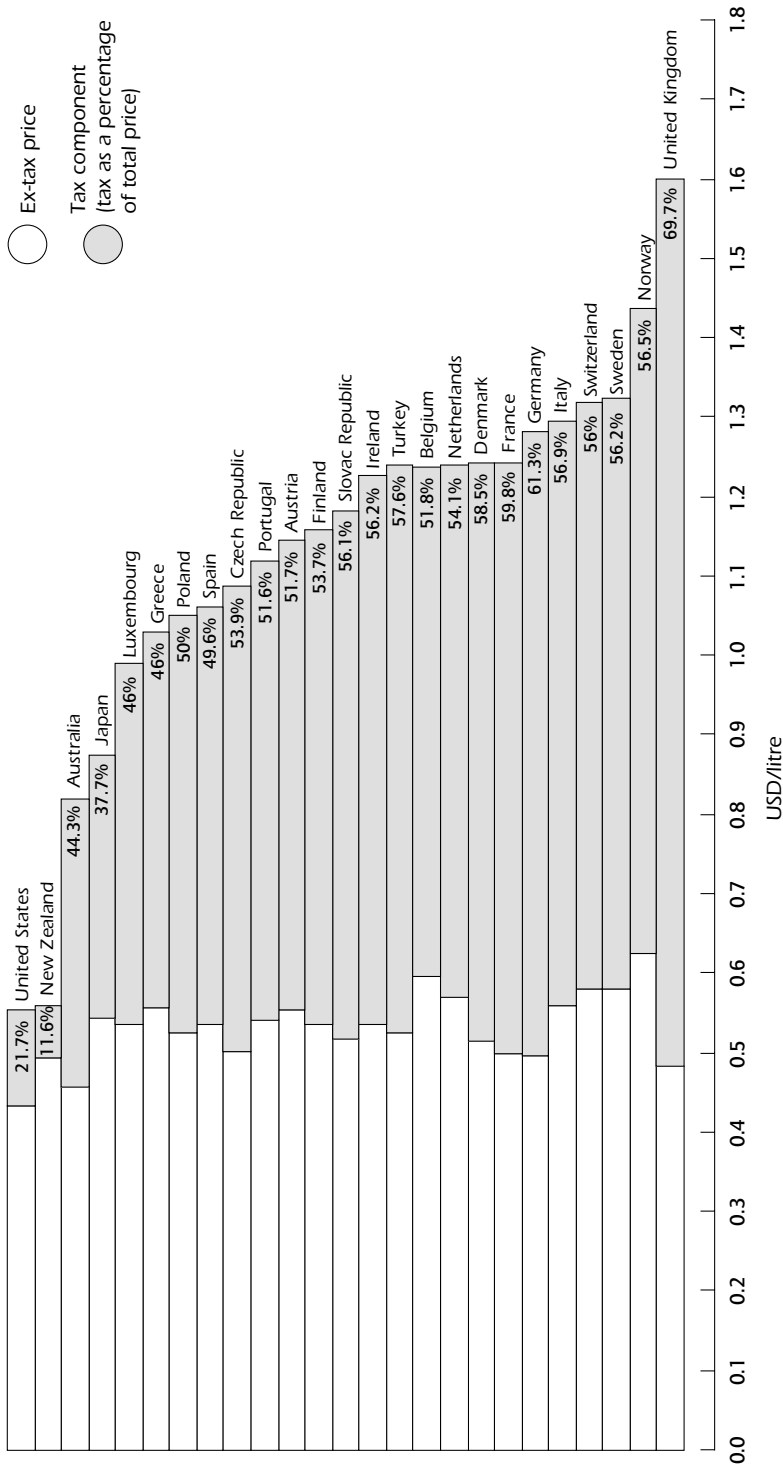
Figure 20  
**OECD Unleaded Gasoline Prices and Taxes, Fourth Quarter 2004**



Note: data not available for Hungary, Korea and Mexico.  
 Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2005.

Figure 21

OECD Automotive Diesel Prices and Taxes, Fourth Quarter 2004



Note: data not available for Canada, Hungary, Korea and Mexico.  
 Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2005.

## EMERGENCY PREPAREDNESS

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Australia has a comprehensive oil emergency legislation, the Liquid Fuel Emergency Act 1984 (LFE Act). It gives the Australian government the authority to initiate the drawdown of stocks as well as participation in an early initial co-ordinated response action. The threshold for emergency stockdraw is flexible and is at the discretion of the Minister for Industry, Tourism and Resources.

The broad objectives of the act are to ensure that:

- Essential users have access to sufficient fuel.
- Other users have adequate supplies of fuel.
- Fuels are distributed equitably across Australia.
- The effects of a fuel shortage on trade/commerce are minimised.
- Australia meets its obligations under the agreement on an International Energy Program to the International Energy Agency.

The Petroleum (Submerged Lands) Act 1967 also has a provision for the Australian government to direct producers to take all necessary and practical steps to increase or reduce the rate at which oil is being recovered within a licensed area or pool.

In 2003, Australian reserves met 86% of oil supply needs. Such substantial domestic production levels make it difficult to justify government investment in stocks or requirements for industry to maintain minimum stocks. However, import reliance has dramatically increased in the last two years, largely owing to reduced crude oil production and the mothballing of the Port Stanvac refinery.

While Australia meets its IEA obligation with 107 days of net imports as of 1 January 2005, net import stock coverage has dropped from 419 days on 1 January 2003, and 184 on 1 January 2004. Moreover, it should be noted that these stocks are held for operational purposes in view of the highly extensive supply network of Australia and would, therefore, be available only to a very limited extent for use in an emergency. The Australian government is investigating options to ensure it continues to meet its IEA obligation.

As stated in the energy White Paper *"Securing Australia's Energy Future"*, the Australian government's general approach to national fuel security is to engage with the international community to promote open oil markets and to maintain a high level of global capability in addressing global or regional oil supply disruptions.

Under the LFE Act, a national liquid fuel emergency response plan has been developed under the auspices of the National Oil Supplies Emergency Committee (NOSEC) and provides an effective set of arrangements should an emergency arise in the short term. This plan was tested during the simulation exercise, Exercise Tanker, conducted in June 2003 and has been independently reviewed by ACIL Tasman. NOSEC is currently considering comments made on the response plan.

The Australian government has also established the Critical Infrastructure Council, comprising Commonwealth, state and territory government representatives, as well as critical infrastructure owners and operators. This council is designed to assess system vulnerabilities, methods of threat mitigation and consequence management for infrastructure such as information technology, water, energy and banking systems. The Energy Group, established under this umbrella (and including industry and government representatives), is working to ensure that there are adequate levels of protective security on critical energy infrastructure, and rapid, tested recovery procedures. NOSEC is liaising closely with the Energy Group, particularly on the identification of essential liquid fuel users.

Finally, as New Zealand is a geographically close neighbour facing many of the same oil emergency response issues, the possibility exists for further discussions and co-ordination of oil emergency responses through the Ministerial Council on Energy or other mechanisms.

## EMERGENCY PLANNING

The National Oil Supplies Emergency Committee (NOSEC), a committee of the Ministerial Council on Energy, is charged with preparing contingency plans for a national liquid fuel emergency. NOSEC includes representatives from the Commonwealth and state/territory governments and from the petroleum industry.

Contingency planning measures include:

- Directing fuel industry corporations to maintain specified reserves of particular products.
- Directing fuel industry corporations to develop bulk allocation procedures.
- Directing fuel industry corporations to maintain statistical information and to make that information available to the government.

## CRITIQUE

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Australia has been a substantial oil producer for the last 30 years, producing an average of 80% of its oil needs from 1973 to 2003. This production enhances energy security, provides government revenue and promotes

economic activity. While production levels are forecast by ABARE to remain at current levels in absolute terms through 2020, the expected rise in demand means that the country will become increasingly dependent on imports, with import levels reaching nearly 50% by 2020. This does not necessarily pose any serious problems to Australia's energy security as the world and regional crude and products markets are sufficiently liquid to meet their growing demand.

At the same time, the efforts being made to encourage more exploration, and ultimately production, are sound. This is particularly the case since these efforts have been targeted on the so-called "frontier areas", which remain largely unexplored. While Australia clearly has a very attractive political and economic environment in which to make investments, it is competing for investment with countries whose geological and resource attributes are considered more attractive. The additional geoscience pre-competitive work by the government and the increase in the allowable deduction of exploration expenses from PRRT liability to 150% can be seen as government money wisely spent to overcome this disadvantage and spur more activity.

It is noted that despite fiscal measures such as the tax uplift for exploration expenditure in designated frontier areas and the reduction in the corporate tax rate, oil industry representatives continue to question whether the Australian oil tax regime is internationally competitive and whether it provides sufficient incentives for exploration and production (E&P) activities in Australia. However, the government has made it clear it intends to keep the PRRT regime under review. The success of this measure in attracting exploration to the frontier areas will only be seen some years from now. Against the background of high oil prices, which should increasingly be factored into companies' investment decisions, it seems prudent for the government to take a step-wise approach towards further taxes or other concessions.

With amendments to the Petroleum Act recently being implemented, the regulatory regime has been further improved. It is however important to continuously adapt the regime as circumstances change. It is also vital to secure industry participation when considering reforms to the regulatory framework. The government should consider how the industry, notably the oil companies and the service industry, could participate on a regular basis in relation to the upstream sub-committee or other relevant forums.

With the mothballing of the Port Stanvac refinery and steadily increasing demand for oil products, Australia has become a net importer of fuels. If new refinery investments are not undertaken, the deficit will continue to grow. However, as product supplies are readily available in the region, security of supply of liquid fuels is not threatened. The new fuel standards to be introduced in the coming years and the adjustments made by refiners are not likely to change this picture.

While Australia at present comfortably meets its IEA obligation with 107 days of net imports as at 1 January 2005, net import stock coverage has dropped from 419 days as at 1 January 2003. It should be noted that all stocks are industry stocks held for operational purposes in view of the highly extensive supply network of Australia and would, therefore, be available only to a very limited extent for use in an emergency. If new refinery investments are not undertaken, the deficit will continue to grow. Therefore, Australia needs to closely monitor its emergency stock position to ensure it continues to meet its IEA stockholding obligation and we understand the Australian government is investigating options to do so.

Competition at the retail level appears strong, particularly following the entrance of the supermarket chains. Low prices at the retail level indicate that the market is functioning well. Motor fuel prices receive substantial attention from the public and the government, especially the ACCC, which regularly reviews the competitiveness of the sector. Its 2004 review found no evidence of collusion and that the supermarkets' entry, and their alliances with the four majors, act to lower prices for consumers. The Petroleum Retail Marketing Sites Act 1980 and the Petroleum Retail Marketing Franchise Act 1980 continue to influence the sector despite reform efforts that seem to have backing from government and much of industry. The market has changed substantially since regulations were written and enacted, and it will therefore be prudent to subject the regulations to reform in light of the new realities.

## RECOMMENDATIONS

*The government of Australia should:*

- ▶ *Continue to review and adapt the upstream regulatory regime in close co-operation with the oil industry.*
- ▶ *Assess whether the announced fiscal measures and the upstream taxation provisions have the intended impact of increasing exploration and production activities and, if necessary, propose new measures.*
- ▶ *Continue to work with industry and other stakeholders to reform legislation governing retail activity in light of the substantial changes that have taken place in the motor fuels market.*
- ▶ *Monitor closely its emergency stockholding position to ensure it continues to comply with IEA obligations, especially in light of the changing domestic refinery industry and the expected growth of oil imports.*





# ENERGY RESEARCH AND DEVELOPMENT INNOVATION

## INTRODUCTION

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Unlike the energy research and development (R&D) chapters of the previous IEA in-depth reviews, the chapter title in this report is “Energy R&D Innovation” instead of “Energy R&D” because the Australian government incorporates the idea of “innovation” in its energy R&D activities. According to the White Paper, “innovation is a complex process involving concept identification, research and development (R&D), commercialisation/demonstration and uptake.” Therefore, innovation is a broader concept, which includes R&D and the discussion in this chapter reflects that approach.

## STAKEHOLDERS

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The stakeholders of energy R&D innovation include the federal and the state governments, research organisations, universities and industry. Within the federal government, the stakeholders include the Council of Australian Governments (COAG), the Prime Minister’s Science Engineering and Innovation Council (PMSEIC), the Australian Research Council (ARC), the Department of Industry, Tourism and Resources (DITR), which includes Invest Australia and AusIndustry, and the Department of Environment and Heritage (DEH), which includes the Australian Greenhouse Office (AGO). (See Chapter 3). Research organisations such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Cooperative Research Centres (CRCs), and the Australian Bureau of Agricultural and Resource Economics (ABARE) play a very important role in R&D innovation programmes. Industrial stakeholders include numerous private-sector firms and various industry associations.

## THE COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION (CSIRO)

The CSIRO is Australia’s national science agency. There are more than 6 500 staff in 21 research divisions classified into four areas: *i)* Agribusiness and Health, *ii)* Environment and Natural Resources, *iii)* Information Technology, Manufacturing and Services, and *iv)* Sustainable Minerals and Energy. Activities take place in 57 sites throughout Australia and overseas. CSIRO’s purpose is to provide the R&D to help develop innovative solutions for industry, society and the environment. Over the past eight to ten years, this

has evolved to include an increased focus on social and economic aspects of R&D and innovation. The organisation's strategy includes developing strong partnerships with universities, other science agencies and industry. The CSIRO is the largest participant in the Cooperative Research Centre (CRC) programme (core participants in 50 of the 71 centres). The CSIRO also plays an important role linking basic science and energy technologies, which includes nanotechnology.

The Energy Transformed Flagship is one of the most important contributors to the CSIRO's R&D in the area of energy technology. It is one of six Flagships of the National Research Flagship (NRF) programme. The NRF programme is one of the largest scientific initiatives ever mounted in Australia. The mission of the Energy Transformed Flagship is to develop low-emission energy technologies and systems. There are four themes to its activities, namely:

**Theme 1: Energy Futures.** Supply the tools, data and modelling capability to develop a range of techno-economic scenarios for electricity and transport sectors to 2020 and beyond through a process guided by the Energy Futures Forum, which includes representatives from industry, government, research organisations (*e.g.* CSIRO, ABARE), and environmental and community groups.

**Theme 2: Low Emission Electricity.** Seek cost-effective, progressive reductions in GHG emissions from large-scale (greater than 30 MW) stationary fossil fuel energy generating plants such as coal gasification and the capture and storage of CO<sub>2</sub> (including by geological sequestration), and develop cost-effective options to progressively increase to 15% the proportion of renewable energy by 2040 and develop the necessary linkages to a future hydrogen economy. The overall goal is emissions reductions of 5% by 2020, 15% by 2030 and 25% by 2050.

**Theme 3: Low Emission Transport.** Pursue innovations in vehicle technologies (*e.g.* hybrid electric vehicles) and road traffic management systems (*e.g.* intelligent transport systems) to decrease traffic congestion that will reduce GHG emissions from the transport sector by 37% by 2020, 60% by 2030 and 80% by 2040.

**Theme 4: Low Emission Distributed Generation.** Develop small-scale power generation technology (less than 30 MW) with waste heat utilisation and system solutions (*e.g.* intelligent control of distributed energy capacity) to enable cost-effective large-scale deployment of distributed generation to reduce GHG emissions by 5% by 2020, 14% by 2030 and 22% by 2050.

## The CSIRO Energy Centre

The CSIRO Energy Centre in Newcastle, NSW, features a unique combination of energy-efficient building and small-scale generation capable of delivering most of its electricity needs. Preliminary performance figures indicate that the

Energy Centre is one of the most energy-efficient research facilities in the southern hemisphere. Estimated outcome is about 2 000 tonnes of CO<sub>2</sub> reduction per year, equivalent to taking 700 cars off the road all year. Energy conservation measures include: *i)* an under floor air distribution system, *ii)* a demand-side management system which operates, controls and monitors energy consumption, *iii)* maximum usage of natural light, *iv)* use of outside air for cooling, and *v)* window glass selection to minimise heat and maintain natural light. On-site energy generation initiatives include building integrated photovoltaic arrays and gas-fired micro turbines. Any excess electricity produced is sold to the national grid.

## COOPERATIVE RESEARCH CENTRES (CRC)

The CRC programme links researchers and research users in the public and private sectors. It supports both R&D and commercialisation/demonstration. Sectors where CRCs operate include: *i)* manufacturing technology, *ii)* information and communication technology, *iii)* mining and energy, *iv)* agriculture and rural based manufacturing, *v)* environment, and *vi)* medical science and technology. There are currently 71 CRCs.

## **ENERGY R&D INNOVATION POLICY OBJECTIVES**

Australia's energy R&D innovation policy objectives are outlined in the White Paper. They are *i)* maintaining the productivity and competitiveness of the energy sector, *ii)* supporting strong economic development, and *iii)* reducing GHG emissions at a more competitive cost. These policy objectives are in line with Australia's national energy policy objectives, namely: encouraging efficient provision of reliable, competitively-priced energy services; encouraging responsible development of Australia's energy resources, technology and expertise; and mitigating local and global environmental impacts, notably greenhouse impacts. The national energy policy objectives also explicitly refer to technology.

Australia's national research policy objectives are *i)* environmentally sustainable Australia, *ii)* promoting and maintaining good health, *iii)* frontier technologies for building and transforming Australian industries, and *iv)* safeguarding Australia. Again, energy R&D innovation policy objectives are consistent with national research policy objectives.

The Energy Technology Assessment in the White Paper takes a strategic approach and provides a guide to energy R&D innovation priority setting, recognising that Australia's relatively small size means that it cannot be a leader in all fields of technology, but must carefully consider its unique needs and capacities. The government assessed a broad range of energy-

related technologies in this context. Accordingly, the White Paper has categorised energy technology into three broad fields as shown in Table 36 and outlined below.

**Table 36**  
**Technology Assessments**

<i>Market leader</i>	<i>Fast follower</i>	<i>Reserve</i>
Play a leading role in international R&D efforts	Strongly position Australia to follow international developments quickly	Position Australia to monitor international developments and follow as needed
<i>Energy supply technologies</i>		
Advanced brown coal Geosequestration Hot dry rocks Photovoltaic Remote area power systems Coal mining and extraction	Advanced black coal Natural gas Wind Biomass Wave Solar thermal	Hydrogen Tidal Large-scale hydro Nuclear
<i>Energy demand technologies</i>		
Solid oxide fuel cells	Intelligent transport systems Energy efficiency Advanced conventional vehicles Hybrid electric vehicles	Other fuel cells

Source: Securing Australia's Energy Future (The White Paper), 2004.

## MARKET LEADER TECHNOLOGIES

Market leader technologies where Australia should play a leading role in international developments are of strategic importance to Australia. They are areas where Australia cannot rely on international activities and/or where Australia has a clear technological advantage. These technologies deserve high priority in government support.

Examples of the rationales<sup>33</sup> for the relevant technologies are as follows:

- *Advanced brown coal*: International R&D activities are limited, as this type of coal is utilised in only a small number of countries.
- *Geosequestration*: Local geology (e.g. identifying and evaluating domestic storage locations) is vital for developing this technology.

33. The rationales for the Energy Technology Assessments are stated in the Annex of Chapter 10 of the White Paper.

- *Hot dry rocks* (i.e. a form of geothermal energy – heat stored in rocks – which might be a renewable electricity generation option): *i)* Domestic geology is very important for evaluating accessibility and potential; *ii)* Australia has excellent hot dry rock resources.
- *Photovoltaics*: Australia conducts world-leading research in certain aspects of this technology.
- *Remote area power systems*: *i)* Few industrialised countries have significant remote settlements; *ii)* Australia is one of the technology leaders concerning integrated systems.
- *Coal mining and extraction*: *i)* These technologies are central to the continued competitiveness of Australia; *ii)* Other industrialised countries cannot be relied on, at least partly because Australia's coal resources tend to have special features.
- *Solid oxide fuel cells*: Australia is one of the world leaders in this technology.

## FAST FOLLOWER TECHNOLOGIES

Fast follower technologies, which strongly position Australia to follow international developments quickly, are of strategic interest. However, domestic efforts should supplement international developments, because there are significant international development activities of direct relevance to Australia's needs. The fast follower approach requires active engagement in international forums (bilateral and multilateral), and a domestic R&D effort sufficient for Australia to effectively participate in international collaborations.

Examples of the rationales for the relevant technologies are as follows

- *Advanced black coal*: Substantial international R&D efforts are being made in this area which could be adaptable to Australia.
- *Natural gas*: Adaptation of gas technologies could easily be done internationally.
- *Wind*: Australia imports most wind technologies. Little or no local adaptation is required.
- *Biomass*: Established technologies exist and can easily be transferred.
- *Wave*: Some international R&D does exist and Australia has a large wave potential.
- *Solar thermal*: Technology is developing relatively rapidly and Australia has expertise in important niche areas.

- *Intelligent transport system*: Technologies are developed internationally, but local adaptation will be required.
- *Energy efficiency, advanced conventional vehicles and hybrid electric vehicles*: The importance of these technologies indicates a need to take up these technologies when available, while Australia does not have technological leadership in these technologies.

## RESERVE TECHNOLOGIES

Reserve technologies that position Australia to monitor international developments and follow as needed are technologies where Australia has a lesser strategic interest at this time. In the reserve approach, Australia needs to stay abreast of international developments, since reserve technology may develop a high priority in the future. Examples of the rationales for the relevant technologies include:

- *Hydrogen*: Air quality and fuel security concerns driving hydrogen development are less prominent in Australia.
- *Tidal*: Very few practical sites exist globally, and most of the tidal resources in Australia are located far from major energy users.
- *Large-scale hydro*: Potential for further large-scale hydro is limited in Australia.
- *Nuclear*: The use of nuclear energy in Australia is not being contemplated by the government.
- *Fuel cells (other than solid oxide fuel cells)*: There are significant international R&D efforts, and adaptation to local conditions is not required.

## ENERGY R&D FUNDING

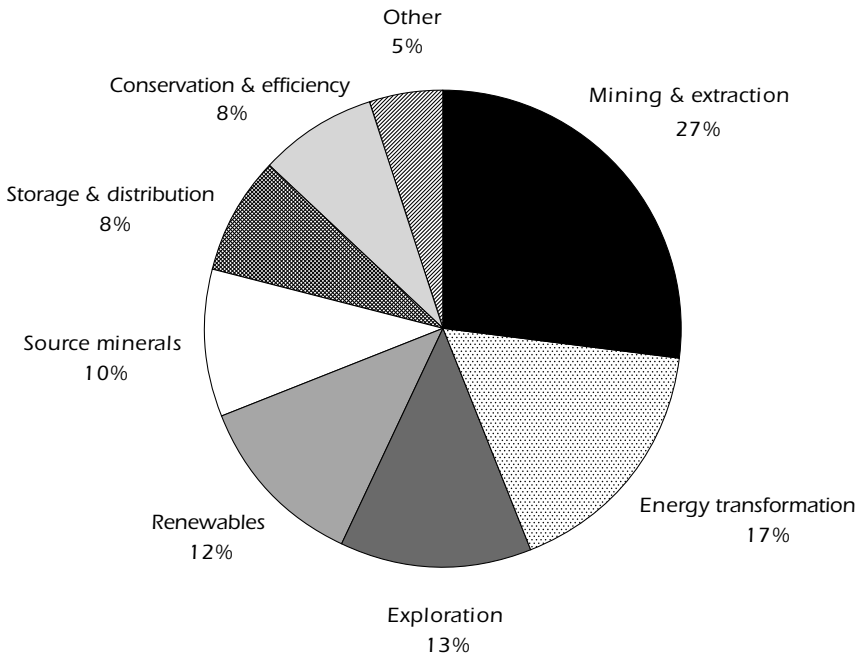
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In 2000/01 AUD 365 million was spent on energy R&D in Australia. When the recently introduced categories relating to the "prevention and treatment of pollution" associated with energy are included, this figure becomes AUD 387 million. Of this amount, 59% of energy R&D was funded by the business sector, 31% by the federal government and 10% by the state governments.

Just over half (52%) of this total funding was spent on energy resources, while just under half (48%) was spent on energy supply. Regarding energy resources, about 27% was spent on mining and extraction, 13% on exploration and 10% on source minerals. As for energy supply, 17% was spent

on energy transformation, 12% on renewables, with smaller contributions from conservation and efficiency (8%) and energy storage and distribution (8%) as shown in Figure 22.

Figure 22  
**Share by Sector of Total R&D Expenditure  
(Business, Federal Government and State Governments)  
on Energy in Australia, 2000 to 2001**



Source: Australian government submission to IEA questionnaire, 2004.

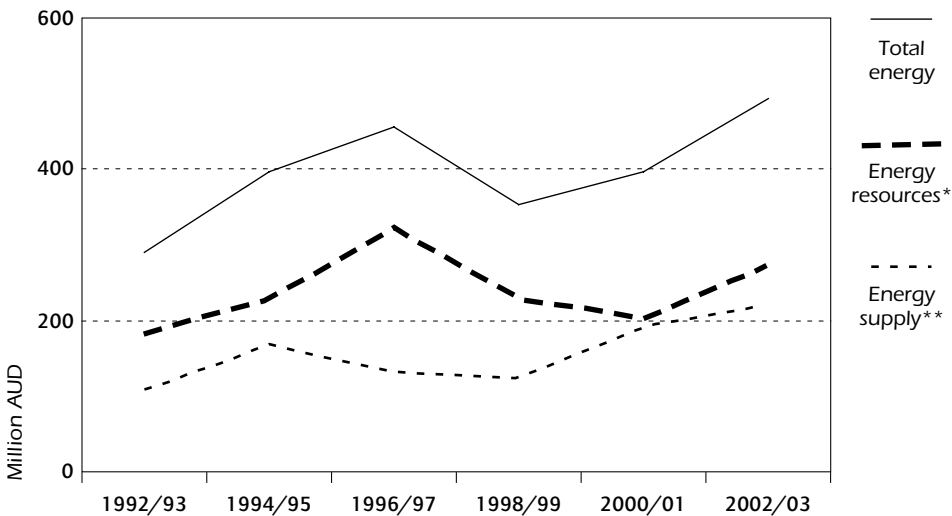
Energy R&D spending in Australia has a strong cyclical component corresponding to cycles in exploration investment as indicated in Figure 23. The main trend that stands out against the cyclical spending patterns in Australia is the increasing importance of energy R&D on renewables.

Although there have been difficulties in gathering adequate information on government spending on energy R&D since 1998, efforts have been made recently to develop statistics or data in the energy sector for the purpose of *i)* developing a picture of energy R&D innovation, including roles of various technologies; *ii)* realising trends of energy R&D funding and performance in Australia since the mid-1990s by fuel type; and *iii)* comparing Australia's funding and performance of energy R&D with other IEA countries.



Figure 23

**Total R&D Expenditure  
(Business, Federal Government and State Governments)  
on Energy in Australia, 1992/93 to 2002/03**



\* energy resources include *i)* mining and extraction, *ii)* exploration *iii)* energy source minerals.

\*\* energy supply includes *i)* energy transformation, *ii)* renewables, *iii)* conservation and efficiency, *iv)* energy storage and distribution .

Source: Science and Innovation Analysis Section, DEST, based on ABAS R&D data.

## GOVERNMENT SUPPORT FOR ENERGY R&D

Table 37 summarises the major programmes of government support for energy R&D innovation. The classification into different stages of the R&D innovation is not definite, since many programmes cover more than one stage of the R&D innovation process. CRCs, for example, support R&D as well as commercialisation/demonstration activities.

Government programmes target different needs at different stages of innovation. For example, for a current project developing “hot dry rock” technologies in SA, the R&D Start Programme has provided assistance at the R&D stage, while the Renewable Energy Commercialisation Program has provided assistance at the commercialisation/demonstration stage. If the project proves successful, the resulting electricity generation could receive further assistance through the Mandatory Renewable Energy Target (MRET) which is at the uptake stage. In this way, the Australian energy R&D innovation support has been responsive to the project at different stages from initial concept identification to practical uptake.

## Major Programmes of Government Support for Energy R&amp;D

<i>Research and development</i>	<i>Commercialisation/demonstration</i>	<i>Uptake</i>
<i>General Innovation Programmes</i>		
<ul style="list-style-type: none"> <li>• University Funding</li> <li>• R&amp;D Tax Concession</li> <li>• Australian Research Council</li> <li>• Grants</li> <li>• R&amp;D Start/Commercial Ready</li> <li>• Cooperative Research Centres</li> <li>• CSIRO</li> </ul>	<ul style="list-style-type: none"> <li>• Pooled Development Funds</li> <li>• Innovation Investment Funds</li> <li>• Cooperative Research Centres</li> <li>• COMET</li> <li>• R&amp;D Start Commercial Ready</li> </ul>	<ul style="list-style-type: none"> <li>• Greenhouse Gas Abatement Program</li> </ul>
<i>Energy specific programmes</i>		
<ul style="list-style-type: none"> <li>• Elements of GeoScience Australia</li> </ul>	<ul style="list-style-type: none"> <li>• Renewable Energy Commercialisation Program</li> <li>• Renewable Energy Equity Fund</li> </ul>	<ul style="list-style-type: none"> <li>• Fuel Excise Concessions (LPG, biofuels, shale oil)</li> <li>• Remote Renewable Power Generation Program</li> <li>• Photovoltaic Rebate Program</li> <li>• Mandatory Renewable Energy Target (MRET)</li> <li>• Minimum Energy Performance Standards</li> </ul>

Source: Securing Australia's Energy Future (The White Paper), 2004.

Examples of ongoing major programmes of government support for energy R&D innovation are as follows.

### Energy Efficiency

- The Rail Cooperative Research Centre (CRC) supports more cost-effective rail transport, for example by developing a system that will help the driver achieve the required schedule with minimum energy consumption.
- Several manufacturing CRCs have programmes to improve the efficiency of manufacturing processes. For example, the CRC for Intelligent Manufacturing Systems & Technologies has a programme whose objectives include reducing the environmental impacts from by-products of manufacturing processes.

### Coal

Australia's policy focus on coal includes maintaining, strengthening and developing partnerships (*e.g.* the federal and state governments; research organisations such as CRCs; university and private sectors, including foreign companies) in Australia and internationally; and facilitating R&D for clean coal technologies. Technologies being explored include the following:

- Oxygen combustion
- Fluidised beds
- Supercritical conventional coal plants
- Integrated gasification combined cycle
- Ultra clean coal as a gas turbine fuel
- CO<sub>2</sub> capture and storage
- Coal bed methane

Specific programmes include the following:

- The COAL21 programme is a collaborative partnership between the federal and the state governments, the coal and electricity generating industries and the research community (*e.g.* CSIRO), initiated by the Australian coal industry. Its objectives include creating a national plan to scope, develop, demonstrate and implement near-zero emissions coal-based electricity generation, cost-effectively.
- A number of R&D Start grants have been awarded to coal-related projects. These projects cover coal gasification technology and mining exploration technology.
- The CSIRO has the following four research streams on coal R&D:
  - Coal exploration and mining (*e.g.* geological assessment of reserves) concerning technologies for the effective design and efficient and safe operation of open-cut and underground mines.
  - Environmental impacts of mining concerning rehabilitation of land affected by coal mining.
  - Coal preparation and handling (*e.g.* chemical cleaning).
  - Clean utilisation technologies (*e.g.* on-line measurement and control).
- The CRC's involvement includes:
  - CRC for Mining Technology and Equipment (CMTE) develops a range of new technologies that would bring about a step change in the mining operations (*e.g.* the development of technologies on underground vehicles).
  - CRC for Clean Power from Lignite develops technologies that cost-effectively reduce GHG emissions from lignite-based power plants by improving process efficiency (*e.g.* continuous dewatering of coal using mechanical thermal expression (MTE)).
  - Cooperative Research Centre for greenhouse gas technologies (CO<sub>2</sub> CRC) plays a very important role on CO<sub>2</sub> capture and storage. This CRC

has co-ordinated a carbon capture and storage technology road mapping exercise.

- CRC for Coal In Sustainable Development (CCSD) focuses on improving the environmental and greenhouse performance of black coal. This CRC manages the Entrained Coal Gasification Research Facility and works closely with CSIRO, the Queensland government and Queensland power generators in the Centre for Low Emissions Technology Research.
- Black coal producers provide funding for generic coal industry research through the Australian Coal Association Research Program (ACARP), which has been running since 1992. Under this programme, producers impose a voluntary levy on themselves of 5 cents per tonne of coal produced, which is used to lever additional funding and support in-kind from researchers to undertake research covering all aspects of coal production and utilisation in Australia. All Australian black coal producers participate in this programme.

## **Oil and Gas**

- One of CSIRO's recent major achievements is improving the performance of oil and gas reservoirs. This research has resulted not only in more efficient production from existing oil and gas fields but also in improved risk analysis in exploration and field developments.
- The activities of the Australian Petroleum CRC (APCRC) include the following:
  - Finding new oil and gas fields through better understanding of seals.
  - Improving oil production by developing reservoir characterisation.
  - Decreasing drilling risks where abnormally high formation pressures exist.
  - Finding more liquid hydrocarbons.
  - Decreasing the cost of exploration and production by utilising computer science.
  - Defining the technical, environmental and economic feasibility of geological sequestration, particularly CO<sub>2</sub>, in major gas fields.

## **Renewable Energy**

- There are Australian Research Council (ARC) grants for a Key Centre for Photovoltaic Engineering at the University of New South Wales (UNSW) and the Centre for Sustainable Energy Systems at the Australian National University (ANU).
- Support for commercialisation/demonstration is delivered through the Renewable Energy Commercialisation Program (RECP) and the Renewable Energy Equity Fund (REEF).

- Programmes that facilitate the uptake of energy R&D innovation include the Remote Renewable Power Generation Program, the Photovoltaic Rebate Program, the Mandatory Renewable Energy Target (MRET) and the Minimum Energy Performance Standards.

## Cross-cutting

- **Backing Australia's Ability (BAA) and Backing Australia's Ability – Building our future through science and innovation (BAA2).** The Australian government is encouraging businesses and households to develop and take up innovative approaches and technologies. This is reflected in the BAA in May 2004 and the BAA2 in 2004. Together, these policies will invest AUD 8.3 billion in support for science and innovation over ten years, the largest amount ever in Australian innovation.
- **AusIndustry.** AusIndustry is a part of the federal government. It has about 10 000 customers and 30 programmes. It delivers nearly AUD 2 billion in grants and business services.
- **Business Energy Innovation Initiatives (Sustainable Energy Authority in Victoria (SEAV)).** SEAV provides funding and support to reduce the risks and uncertainty associated with business.

## FUTURE R&D PROJECTS

Realising the importance of technology from a long-term perspective, the federal government will also establish new programmes including the following:

- **Low Emissions Technology Demonstration Fund (LETDF).** The government will establish a AUD 500 million LETDF to support industry-led projects for large-scale demonstration of low-emissions technologies that could reduce the cost of technologies and contribute to reduce GHG emissions significantly in the longer term.
- **Solar Cities.** The government will provide AUD 75 million to implement Solar Cities trials to demonstrate the economic and environmental benefits of applications of solar and efficient technologies combined. This trial will deliver a working model of how sustainable energy systems can work in the future.
- **Renewable Energy Development Initiative (REDI).** The government will provide AUD 100 million to support the technological development of smaller-scale renewables.
- **Address specific barriers impeding the uptake of renewable energy.** The government will spend AUD 34 million to identify specific barriers concerning the uptake of renewables. This includes wind forecasting and advances in energy storage.

## INTERNATIONAL R&D COLLABORATION

The key activities of international R&D collaboration include IEA Implementing Agreements, the International Partnership for the Hydrogen Economy (IPHE), Energy Working Group of Asia-Pacific Economic Co-operation (APEC), and the Carbon Sequestration Leadership Forum (CSLF). As of 31 March 2005, Australia participates in the following 15 Implementing Agreements: Demand-Side Management, Energy Conservation in Buildings and Community Systems Programme (ECBCS), Advanced Fuel Cells, Greenhouse Gas Programme, Clean Coal Sciences, Enhanced Oil Recovery, Multiphase Flow Sciences, Photovoltaic Power Systems, Solar Heating and Cooling, SolarPACES, Wind Energy Systems, Bioenergy, Geothermal, Hydrogen and the Stellarator Concept.

A review of international energy technology collaboration was completed in December 2004. The review did not identify any significant problems with Australia's current approach to international energy technology collaboration agreements. The key findings were as follows:

- The current whole-of-government approach to international energy technology collaboration agreements should be continued. Its value is to be increased by a checklist of questions to be addressed. The responses to the questions would guide an implementation plan and subsequent reviews.
- Relevant professionals from the business and research communities should be involved in the development of new agreements.
- Agreements should be periodically reviewed to ensure that they remain focused on priority issues, and that they continue to support the appropriate range of collaborative activities.
- All relevant agencies and representatives of the business and research communities should be involved in those periodic reviews.
- The appropriate funding mechanism(s) for an agreement should be decided on a case-by-case basis, either when an existing agreement is reviewed or a new agreement is under consideration.
- Additional data should be collected to inform future decisions on international energy technology collaboration over the next 12 months, and as part of an ongoing process.

## CRITIQUE

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The approach taken in the White Paper to look at the overall innovation process, including not only R&D but also concept identification, commercialisation/demonstration and uptake, is commendable. Such

a comprehensive picture can be very helpful in bringing technologies out of the laboratories and into the market. This approach may be particularly fruitful in an Australian context because CSIRO focuses on science and R&D, and the CRCs focus on R&D and commercialisation/demonstration, and therefore encouraging co-operation between the two will be necessary.

Although there are many stakeholders, including the federal and state governments, universities, research organisations and industry, there seems to be many examples of effective collaboration among stakeholders including public-private partnerships such as CRCs. This partnership approach is sound and should be strengthened where possible.

Energy R&D innovation policy objectives are consistent with both national energy policy objectives and national research policy objectives. This should improve the effectiveness of any technologies arising from the R&D programme if the focus of the original strategy is maintained. It is also commendable that national energy policy objectives explicitly refer to technology. Although energy R&D innovation policy objectives do not appear to explicitly include energy security perspectives, given Australia's rich natural resources, this is understandable. It is more likely that Australia's role as a stable supplier that augments global energy security, particularly in the Asia-Pacific region, could be a focus of R&D efforts.

The Energy Technology Assessments in the White Paper are an important means of improving the R&D programme. The inclusion of the rationales for the Energy Technology Assessments in the White Paper is intended to link energy R&D policy with overall energy policy. It is encouraging that these assessments will be incorporated into existing innovation mechanisms because this should contribute to consistency between the assessments and current government support. To ensure the continued linkage between overall energy policy and energy R&D, a regular review system will have to be followed. Such reviews should also take into account any international and domestic developments.

It will be important to re-evaluate the role of end-use technologies. Australia has not appeared to place much emphasis on end-use technologies, which will grow increasingly important as the country tries to improve energy efficiency. The push for improved efficiency in the White Paper is sound policy whose implementation will be more effective with new energy-saving technologies coming onto the market.

There have been difficulties in gathering adequate information on Australian government spending on energy R&D since 1998. Recent efforts to develop statistics or data in the energy sector, including profiles of various technologies, will assist Australia to develop a picture of energy R&D

innovation, to realise trends of energy R&D funding by sector since the mid-1990s and to compare Australia's funding with that of other IEA countries. These efforts are encouraging and should be strengthened.

It is laudable that the government significantly supports energy R&D innovation, and that government programmes target different needs at different stages of innovation so that support can be responsive to the project from initial concept identification to practical uptake. This support should continue to be consistent with the goals of the White Paper in particular and with other national research priorities.

Assessing the programme performance will also be important. Like many countries, Australia faces challenges in reviewing the effectiveness of R&D programmes. Such review is very important to maximise the cost-effectiveness of the overall energy R&D programme. A set of indicators or benchmarks could be developed for existing and new R&D programmes and their performance should be periodically reviewed using these criteria. As recommended in the review of international energy technology collaboration, all relevant stakeholders from government, business and research communities should be involved in the evaluation.

A review of international energy technology collaboration was completed in December 2004. The review did not identify any significant problems, but identified areas of possible small improvements, which include ensuring stakeholder involvement and periodic reviews in the future. Australia should use its international agreements to build alliances in energy technologies where it has aspirations to take a leading position in technology development, as well as those where it is looking to become a fast follower of technologies developed by others.

## **RECOMMENDATIONS**

*The government of Australia should:*

- ▶ *Maintain and refine the approach taken in the White Paper to look at the innovation process overall.*
- ▶ *Maintain and further develop effective collaboration among stakeholders, including public-private partnerships.*
- ▶ *Ensure regular reviews of the technology assessments and consistency between government support for energy R&D innovation, the technology assessments and the goals of general energy policy.*



- ▶ *Develop improved mechanisms for data collection of overall energy R&D funding, the allocation of that funding and communication of this information to international partners.*
- ▶ *Continue to provide energy R&D innovation support, which is both substantial and responsive at different stages of the projects, and is consistent with the goals of the White Paper in particular and other national research priorities.*
- ▶ *Develop improved mechanisms for assessing the performance of R&D projects conducted by the government and public-private partnership.*
- ▶ *Ensure actions or measures under international technology agreements to help Australia achieve its aspirations as a leader and “fast follower” in technology development.*

## ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

<b>SUPPLY</b>		1973	1990	2002	2003	2010	2020	2030
<b>TOTAL PRODUCTION</b>		<b>68.0</b>	<b>157.7</b>	<b>254.5</b>	<b>253.5</b>	<b>350.0</b>	<b>396.2</b>	..
Coal <sup>1</sup>		40.3	106.3	184.3	185.0	245.0	264.9	..
Oil		19.8	29.0	33.0	30.7	30.6	32.7	..
Gas		3.4	17.1	30.3	31.3	65.0	89.0	..
Comb. Renewables & Waste <sup>2</sup>		3.5	4.0	5.4	5.0	7.5	7.6	..
Nuclear		-	-	-	-	-	-	..
Hydro		1.0	1.2	1.4	1.4	1.5	1.5	..
Geothermal		-	-	-	-	-	-	..
Solar/Wind/Other		-	0.1	0.1	0.2	0.4	0.5	..
<b>TOTAL NET IMPORTS<sup>3</sup></b>		<b>-10.3</b>	<b>-65.7</b>	<b>-139.4</b>	<b>-139.5</b>	<b>-203.9</b>	<b>-216.8</b>	..
Coal <sup>1</sup>	Exports	17.6	67.7	131.6	135.5	188.8	198.1	..
	Imports	-	-	-	-	-	-	..
	Net Imports	-17.6	-67.7	-131.6	-135.5	-188.8	-198.1	..
Oil	Exports	3.4	9.3	26.2	22.1	19.7	13.7	..
	Imports	12.5	14.2	28.0	28.0	37.4	41.2	..
	Bunkers	1.8	0.6	0.7	0.7	0.8	0.8	..
	Net Imports	7.4	4.3	1.1	5.1	16.8	26.7	..
Gas	Exports	-	2.3	8.9	9.1	32.0	45.3	..
	Imports	-	-	-	-	-	-	..
	Net Imports	-	-2.3	-8.9	-9.1	-32.0	-45.3	..
Electricity	Exports	-	-	-	-	-	-	..
	Imports	-	-	-	-	-	-	..
	Net Imports	-	-	-	-	-	-	..
<b>TOTAL STOCK CHANGES</b>		<b>-0.1</b>	<b>-4.5</b>	<b>-3.2</b>	<b>-1.4</b>	<b>0.4</b>	<b>-</b>	..
<b>TOTAL SUPPLY (TPES)</b>		<b>57.6</b>	<b>87.5</b>	<b>111.9</b>	<b>112.6</b>	<b>146.5</b>	<b>179.5</b>	..
Coal <sup>1</sup>		22.6	35.0	49.0	48.0	56.2	66.8	..
Oil		27.1	32.5	34.6	35.9	47.9	59.3	..
Gas		3.4	14.8	21.4	22.2	33.0	43.7	..
Comb. Renewables & Waste <sup>2</sup>		3.5	4.0	5.4	5.0	7.5	7.6	..
Nuclear		-	-	-	-	-	-	..
Hydro		1.0	1.2	1.4	1.4	1.5	1.5	..
Geothermal		-	-	-	-	-	-	..
Solar/Wind/Other		-	0.1	0.1	0.2	0.4	0.5	..
Electricity Trade		-	-	-	-	-	-	..
<b>Shares (%)</b>								..
Coal		39.2	39.9	43.8	42.6	38.4	37.2	..
Oil		47.1	37.2	30.9	31.9	32.7	33.1	..
Gas		5.9	16.9	19.2	19.7	22.5	24.3	..
Comb. Renewables & Waste		6.1	4.5	4.8	4.4	5.1	4.3	..
Nuclear		-	-	-	-	-	-	..
Hydro		1.7	1.4	1.2	1.2	1.1	0.9	..
Geothermal		-	-	-	-	-	-	..
Solar/Wind/Other		-	0.1	0.1	0.1	0.2	0.3	..
Electricity Trade		-	-	-	-	-	-	..

0 is negligible, - is nil, .. is not available.

Please note: All data except GDP and population refer to the fiscal year July to June.

**DEMAND****FINAL CONSUMPTION BY SECTOR**

	1973	1990	2002	2003	2010	2020	2030
<b>TFC</b>	<b>40.0</b>	<b>58.1</b>	<b>70.9</b>	<b>72.3</b>	<b>89.2</b>	<b>111.1</b>	..
Coal <sup>1</sup>	4.9	4.3	2.9	2.7	2.6	2.7	..
Oil	24.7	30.5	36.1	37.3	44.5	55.7	..
Gas	2.4	8.8	11.0	11.5	17.8	22.8	..
Comb. Renewables & Waste <sup>2</sup>	3.5	3.3	4.6	4.3	3.8	4.4	..
Geothermal	-	-	-	-	-	-	..
Solar/Wind/Other	-	0.1	0.1	0.1	0.1	0.1	..
Electricity	4.5	11.1	16.3	16.4	20.3	25.4	..
Heat	-	-	-	-	-	-	..
<b>Shares (%)</b>							
Coal	12.3	7.4	4.0	3.8	2.9	2.4	..
Oil	61.7	52.6	50.9	51.7	49.9	50.2	..
Gas	5.9	15.2	15.5	15.9	20.0	20.5	..
Comb. Renewables & Waste	8.7	5.6	6.4	5.9	4.3	3.9	..
Geothermal	-	-	-	-	-	-	..
Solar/Wind/Other	-	0.1	0.1	0.1	0.1	0.1	..
Electricity	11.3	19.1	23.0	22.6	22.8	22.9	..
Heat	-	-	-	-	-	-	..
<b>TOTAL INDUSTRY<sup>4</sup></b>	<b>17.6</b>	<b>23.1</b>	<b>25.7</b>	<b>25.8</b>	<b>36.6</b>	<b>45.4</b>	..
Coal <sup>1</sup>	4.6	4.1	2.7	2.6	2.5	2.5	..
Oil	7.7	6.3	5.9	6.0	9.9	13.0	..
Gas	1.8	6.1	7.1	7.5	12.1	15.5	..
Comb. Renewables & Waste <sup>2</sup>	1.5	1.5	2.5	2.4	2.3	2.8	..
Geothermal	-	-	-	-	-	-	..
Solar/Wind/Other	-	-	-	-	-	-	..
Electricity	2.0	5.1	7.4	7.3	9.8	11.7	..
Heat	-	-	-	-	-	-	..
<b>Shares (%)</b>							
Coal	26.4	17.6	10.7	10.1	6.9	5.6	..
Oil	43.8	27.4	22.8	23.2	27.1	28.5	..
Gas	10.0	26.5	27.5	29.2	33.1	34.0	..
Comb. Renewables & Waste	8.5	6.4	9.9	9.2	6.2	6.1	..
Geothermal	-	-	-	-	-	-	..
Solar/Wind/Other	-	-	-	-	-	-	..
Electricity	11.3	22.0	29.0	28.3	26.7	25.8	..
Heat	-	-	-	-	-	-	..
<b>TRANSPORT<sup>5</sup></b>	<b>13.5</b>	<b>22.7</b>	<b>28.3</b>	<b>29.2</b>	<b>34.7</b>	<b>42.9</b>	..
<b>TOTAL OTHER SECTORS<sup>6</sup></b>	<b>8.9</b>	<b>12.3</b>	<b>17.0</b>	<b>17.3</b>	<b>17.9</b>	<b>22.7</b>	..
Coal <sup>1</sup>	0.3	0.1	0.1	0.1	0.0	0.0	..
Oil	3.5	1.8	2.5	2.7	1.0	1.2	..
Gas	0.6	2.7	3.6	3.7	4.9	6.3	..
Comb. Renewables & Waste <sup>2</sup>	2.0	1.8	2.0	1.9	1.6	1.6	..
Geothermal	-	-	-	-	-	-	..
Solar/Wind/Other	-	0.1	0.1	0.1	0.1	0.1	..
Electricity	2.5	5.9	8.7	8.9	10.3	13.5	..
Heat	-	-	-	-	-	-	..
<b>Shares (%)</b>							
Coal	3.2	1.1	0.4	0.3	0.1	0.1	..
Oil	39.7	14.2	14.6	15.8	5.7	5.5	..
Gas	7.0	21.8	21.3	21.2	27.5	27.6	..
Comb. Renewables & Waste	22.5	14.4	11.8	10.8	8.7	7.0	..
Geothermal	-	-	-	-	-	-	..
Solar/Wind/Other	-	0.7	0.5	0.5	0.4	0.5	..
Electricity	27.7	47.7	51.3	51.3	57.6	59.4	..
Heat	-	-	-	-	-	-	..

<b>DEMAND</b>							
<b>ENERGY TRANSFORMATION AND LOSSES</b>							
	1973	1990	2002	2003	2010	2020	2030
<b>ELECTRICITY GENERATION<sup>7</sup></b>							
INPUT (Mtoe)	16.0	35.1	55.3	54.3	65.8	79.1	..
OUTPUT (Mtoe)	5.5	13.3	19.5	19.6	23.6	29.6	..
(TWh gross)	64.4	154.3	226.2	227.9	274.6	343.9	..
<b>Output Shares (%)</b>							
Coal	74.9	77.1	76.9	77.2	71.9	71.1	..
Oil	2.6	2.7	1.7	1.0	0.9	0.7	..
Gas	4.3	10.6	13.6	13.8	17.5	20.2	..
Comb. Renewables & Waste	0.5	0.4	0.7	0.6	2.1	1.6	..
Nuclear	-	-	-	-	-	-	..
Hydro	17.7	9.2	7.0	7.0	6.5	5.2	..
Geothermal	-	-	-	-	-	-	..
Solar/Wind/Other	-	-	0.2	0.3	1.2	1.2	..
<b>TOTAL LOSSES</b>	<b>17.8</b>	<b>29.3</b>	<b>46.5</b>	<b>46.1</b>	<b>57.2</b>	<b>68.4</b>	<b>..</b>
<i>of which:</i>							
Electricity and Heat Generation <sup>8</sup>	10.5	21.7	35.9	34.7	42.2	49.5	..
Other Transformation	5.5	0.6	2.3	2.7	5.2	6.2	..
Own Use and Losses <sup>9</sup>	1.7	7.0	8.3	8.6	9.9	12.7	..
<b>Statistical Differences</b>	<b>-0.1</b>	<b>0.2</b>	<b>-5.6</b>	<b>-5.7</b>	<b>-</b>	<b>-</b>	<b>..</b>
<b>INDICATORS</b>							
	1973	1990	2002	2003	2010	2020	2030
GDP (billion 2000 USD)	168.30	273.23	415.49	431.16	546.56	753.67	..
Population (millions)	13.61	17.18	19.76	20.01	21.33	23.19	..
TPES/GDP <sup>10</sup>	0.34	0.32	0.27	0.26	0.27	0.24	..
Energy Production/TPES	1.18	1.80	2.27	2.25	2.39	2.21	..
Per Capita TPES <sup>11</sup>	4.23	5.10	5.66	5.63	6.87	7.74	..
Oil Supply/GDP <sup>10</sup>	0.16	0.12	0.08	0.08	0.09	0.08	..
TFC/GDP <sup>10</sup>	0.24	0.21	0.17	0.17	0.16	0.15	..
Per Capita TFC <sup>11</sup>	2.94	3.38	3.59	3.61	4.18	4.79	..
Energy-related CO <sub>2</sub> Emissions (Mt CO <sub>2</sub> ) <sup>12</sup>	157.9	259.7	346.6	347.1	414.3	510.1	..
CO <sub>2</sub> Emissions from Bunkers (Mt CO <sub>2</sub> )	7.3	6.3	8.6	9.2	9.4	9.5	..
<b>GROWTH RATES (% per year)</b>							
	73-79	79-90	90-02	02-03	03-10	10-20	20-30
TPES	3.0	2.2	2.1	0.7	3.8	2.1	..
Coal	1.5	3.2	2.9	-2.0	2.3	1.7	..
Oil	2.9	0.1	0.5	3.9	4.2	2.2	..
Gas	12.7	7.1	3.1	3.3	5.9	2.8	..
Comb. Renewables & Waste	0.1	1.0	2.6	-6.6	5.9	0.2	..
Nuclear	-	-	-	-	-	-	..
Hydro	5.1	-0.7	1.0	1.2	1.6	-0.1	..
Geothermal	-	-	-	-	-	-	..
Solar/Wind/Other	-	17.3	3.3	26.1	13.1	2.4	..
TFC	2.5	2.1	1.7	1.9	3.1	2.2	..
Electricity Consumption	6.3	5.0	3.3	0.2	3.1	2.3	..
Energy Production	3.9	5.7	4.1	-0.4	4.7	1.2	..
Net Oil Imports	4.2	-6.9	-10.9	379.1	18.5	4.7	..
GDP	2.6	3.0	3.6	3.8	3.4	3.3	..
Growth in the TPES/GDP Ratio	0.4	-0.8	-1.4	-3.0	0.4	-1.2	..
Growth in the TFC/GDP Ratio	-0.1	-0.9	-1.8	-1.8	-0.4	-1.0	..

Please note: Rounding may cause totals to differ from the sum of the elements.

## FOOTNOTES TO ENERGY BALANCES AND KEY STATISTICAL DATA

1. Includes lignite.
2. Comprises solid biomass, biogas, and industrial waste. Data are often based on partial surveys and may not be comparable between countries.
3. Total net imports include combustible renewables and waste.
4. Includes non-energy use.
5. Includes less than 1% non-oil fuels.
6. Includes residential, commercial, public service and agricultural sectors.
7. Inputs to electricity generation include inputs to electricity and CHP. Output refers only to electricity generation.
8. Losses arising in the production of electricity and heat at main activity producer utilities (formerly known as public) and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of 100% for hydro.
9. Data on "losses" for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.
10. Toe per thousand US dollars at 2000 prices and exchange rates.
11. Toe per person.
12. "Energy-related CO<sub>2</sub> emissions" have been estimated using the IPCC Tier I Sectoral Approach. In accordance with the IPCC methodology, emissions from international marine and aviation bunkers are not included in national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 2003 and applying this factor to forecast energy supply. Future coal emissions are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

## INTERNATIONAL ENERGY AGENCY “SHARED GOALS”

Member countries\* of the IEA seek to create the conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants.

In order to secure their objectives they therefore aim to create a policy framework consistent with the following goals:

- 1. Diversity, efficiency and flexibility within the energy sector** are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.
- 2. Energy systems should have the ability to respond promptly and flexibly to energy emergencies.** In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.
- 3. The environmentally sustainable provision and use of energy** is central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should where practicable have regard to the Polluter Pays Principle.
- 4. More environmentally acceptable energy sources** need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA members wish to retain and improve the nuclear

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\* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

**5. Improved energy efficiency** can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

**6. Continued research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries, should be encouraged.

**7. Undistorted energy prices** enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

**8. Free and open trade** and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

**9. Co-operation among all energy market participants** helps to improve information and understanding, and encourage the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at their 4 June 1993 meeting in Paris.)

## **GLOSSARY AND LIST OF ABBREVIATIONS**

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In this report, abbreviations are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention and subsequently abbreviated, this glossary provides a quick and central reference for many of the abbreviations used.

ACCC	Australian Competition and Consumer Commission
ACT	Australian Capital Territory
AER	Australian Energy Regulator.
AEMC	Australian Energy Market Commission.
ANTS	Annual National Transmission Statement.
AUD	Australian dollars.
bcm	billion cubic metres.
bpd	barrels per day.
CCGT	combined-cycle gas turbine.
CHP	combined production of heat and power.
COAG	Council of Australian Governments.
CO2CRC	Cooperative Research Centre for Greenhouse Gas Technologies.
CRD	co-operative research centre.
CSIRO	Commonwealth Scientific and Industrial Research Organisation.
CSM	coal seam methane.
EIS	Environmental Impact Statement.
ETEF	Electricity Tariff Equalisation Fund.
EU	European Union.
FRC	full retail contestability.



GDP	gross domestic product.
GHG	greenhouse gases.
GGAP	Greenhouse Gas Abatement Program.
GW	gigawatt, or $1 \text{ watt} \times 10^9$ .
GWh	gigawatt-hour = $1 \text{ gigawatt} \times 1 \text{ hour}$ .
HHV	higher heating value.
IEA	International Energy Agency.
IPCC	Intergovernmental Panel on Climate Change
kcal	kilocalorie, or $1 \text{ cal} \times 10^3$ .
km <sup>2</sup>	square kilometre.
kW	kilowatt, or $1 \text{ watt} \times 10^3$ .
kWh	kilowatt-hour = $1 \text{ kilowatt} \times 1 \text{ hour}$ .
LNG	liquefied natural gas.
LPG	liquefied petroleum gas.
LRC	Low Reserve Conditions.
MCE	Ministerial Council on Energy.
mcm	million cubic metres.
MCMPR	Ministerial Council on Mineral and Petroleum Resources.
Mt	million tonnes.
Mtoe	million tonnes of oil equivalent; see toe.
MRET	Mandatory Renewable Energy Target.
MW	megawatt, or $1 \text{ watt} \times 10^6$ .
MWh	megawatt-hour = $1 \text{ megawatt} \times 1 \text{ hour}$ .
NEM	National Electricity Market.
NEMMCO	National Electricity Market Management Company.
NGPAC	National Gas Pipelines Advisory Committee.
NO <sub>x</sub>	nitrogen oxide.
NOSEC	National Oil Supplies Emergency Committee.

NSW	New South Wales.
NT	Northern Territory.
OECD	Organisation for Economic Co-operation and Development.
PJ	petajoule, or $1 \text{ joule} \times 10^{15}$ .
PJM	Pennsylvania-New Jersey-Maryland Interconnection.
PPP	purchasing power parity: the rate of currency conversion that equalises the purchasing power of different currencies, <i>i.e.</i> estimates the differences in price levels between different countries.
PRRT	Commonwealth Petroleum Resource Rent Tax.
PWCS	Port Waratah Coal Services.
PV	photovoltaic.
PVRP	Photovoltaic Rebate Program.
QLD	Queensland.
REC	renewable energy certificate.
RECP	Renewable Energy Commercialisation Program.
R&D	research and development, especially in energy technology; may include the demonstration and dissemination phases as well.
RIP	Renewables Investment Program.
SA	South Australia.
SO <sub>x</sub>	sulphur oxide.
SOO	Statement of Opportunities.
TFC	total final consumption of energy.
toe	tonnes of oil equivalent, defined as $10^7 \text{ kcal}$ .
TPA	third-party access.
TPES	total primary energy supply.
TWh	terawatt-hour = $1 \text{ terawatt} \times 1 \text{ hour}$ .
UNFCCC	United Nations Framework Convention on Climate Change.
VOCs	volatile organic compounds.
WA	Western Australia.



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