



International
Energy Agency

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Energy Policies of IEA Countries

Australia

2012 Review

Australia

Australia enjoys the benefit of abundant and diverse energy resources; it is the world's ninth-largest energy producer and is one of only three net energy exporters in the OECD. Its substantial conventional energy resource base includes coal, natural gas, oil and uranium. The country also enjoys extensive wind, solar and geothermal resources as well as large biomass and ocean energy potential.

The energy sector is a significant contributor to the Australian economy. Exports have more than tripled over the past decade and surging economic and social expansion in relatively nearby emerging economies such as China and India has driven significant demand for Australian energy and mineral resources. This boom is widely forecast to continue in the coming decades.

Late in 2011, the Australian government released a draft energy white paper, which sets out a comprehensive strategic policy framework to guide the development of the energy sector. Also in 2011, the Australian government announced a climate change plan including a wide-ranging package of clean-energy proposals and the introduction of a carbon price mechanism accompanied by significant levels of financial support for innovation in clean-energy technologies.

The scale of Australia's energy policy ambitions is enormous and very costly even for a resource-rich nation. Significant investments will be needed for the clean-energy transition and building the infrastructure necessary to expand the domestic resource base. This review analyses the energy-policy challenges facing Australia and provides critiques and recommendations for further policy improvements. It is intended to help guide the country towards a more secure and sustainable energy future.



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INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its primary mandate was – and is – two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply, and provide authoritative research and analysis on ways to ensure reliable, affordable and clean energy for its 28 member countries and beyond. The IEA carries out a comprehensive programme of energy co-operation among its member countries, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency's aims include the following objectives:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

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Germany
Greece
Hungary
Ireland
Italy
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Luxembourg
Netherlands
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United States



**International
Energy Agency**

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1. EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS

EXECUTIVE SUMMARY

Australia enjoys the benefit of abundant and diverse energy resources; it is the world's ninth-largest energy producer and is one of only three net energy exporters in the OECD. Its substantial conventional energy resource base includes coal, natural gas, oil, uranium and potentially thorium. In addition, Australia has extensive untapped wind, solar and geothermal resources and large potential sources of wave, tidal and biomass energy. The energy sector is a major contributor to the economy, contributing between 16% and 17% of current GDP and employs approximately 100 000 people.

SUBSTANTIAL PROGRESS IN TWO PHASES

Since the previous in-depth review (2005), the Australian energy-policy framework has experienced two phases of considerable change; the first in the period to early 2011 and the second after that date. These changes have been happening at a time when Australia has become a major player in global coal markets and liquefied natural gas (LNG) markets.

During the earlier period, new federal ministries were established, including the Department of Resources, Energy and Tourism (RET) and the Department of Climate Change and Energy Efficiency (DCCEE), and other federal government agencies were created or streamlined. These include the Australian Centre for Renewable Energy and the Australian Solar Institute. Establishment of the Global Carbon Capture and Storage Institute was also an Australian initiative.

Following the ratification of the Kyoto Protocol in 2007, a national greenhouse and energy reporting system was established and proposals for a national emissions trading scheme, the Carbon Pollution Reduction Scheme, were published. A Multi-Party Climate Change Committee was set up and legislation was introduced to implement an expanded Renewable Energy Target such that 20% of Australia's electricity is sourced from renewables by 2020.

The Prime Minister established a Task Group on Energy Efficiency; a National Strategy on Energy Efficiency was published; and an innovative energy saving programme, the Energy Efficiency Opportunities Program, was implemented in the industrial sector.

The government confirmed its commitment to efficient energy markets by maintaining its programme of reform, including the establishment of the Australian Energy Market Commission, the Australian Energy Regulator and the Australian Energy Market Operator. These institutions were complemented by the development of a National Energy Customer Framework, the implementation of a range of initiatives to improve transparency and increase competition, the institutionalisation of regular reviews of energy security and reform of the minerals taxation regime.

The second phase commenced in July 2011, when the Australian government published a comprehensive package of clean energy proposals that included the introduction of a

revised carbon price mechanism and the provision of significant levels of financial support for innovation in clean energy technologies. The purpose of *Securing a Clean Energy Future – The Australian Government’s Climate Change Plan*¹ was to bring all previously existing policies together and strengthen them by introducing new initiatives. The plan contains four key pillars: the introduction of a carbon price; the update of renewable energy; the improvement in energy efficiency; and action on the land.

The plan is accompanied by proposals to provide significant levels of financial support for innovation in clean energy technologies, including renewable energy, a new AUD 10 billion commercially oriented Clean Energy Finance Corporation, which will invest in renewable energy, low-emission and energy-efficient technologies as well as a new institution, the Australian Renewable Energy Agency, which will separately administer AUD 3.2 billion in government support for existing research and development, demonstration and commercialisation of renewable energy. Many of these measures were transposed into Commonwealth law in November 2011.

The IEA welcomes the broad sweep of measures proposed by the Australian government in relation to clean energy, notably its strong financial commitment and the establishment of the commercially oriented Clean Energy Finance Corporation, which will invest in renewable energy, low-emission and energy-efficient technologies.

The Australian government, in partnership with stakeholders from the research community and the private sector, has implemented a development strategy for the carbon capture and storage (CCS) innovation chain. The strategy includes substantial (AUD 2 billion) support of large-scale and small- to medium-scale projects via a number of national programmes.

The IEA views carbon pricing as a critical component of climate policy and welcomes the introduction of a carbon price and hopes the move will put an end to uncertainty in the energy sector. IEA argues, however, that, even with a carbon price, supplementary policies are still needed: energy efficiency policies to unlock low-cost abatement and technology policies to help lower the cost of renewable energy, carbon capture and storage, and other technologies for the long term. Australia has developed a relatively balanced package with strong elements of each policy. Furthermore, the IEA has published a review of existing emissions trading scheme designs, based on international experience, and found some key emerging design lessons: the new Australian carbon mechanism fits well with these lessons.

More significantly, a comprehensive Draft Energy White Paper (EWP)² was published in November 2011, seven years after the release in 2004 of the previous EWP. The draft energy policy provides a review of Australia’s future energy needs to 2030 and sets out a policy framework to guide the further development of the sector. The Draft EWP policy framework is based on three clear objectives: the provision of accessible, reliable and competitively priced energy for all Australians; enhancement of Australia’s domestic and export growth potential; and the delivery of clean and sustainable energy. It also identifies four priority areas for future action and outlines a set of initiatives to progress this agenda. This clarity is helpful for stakeholders. Accordingly, the IEA welcomes the publication of the Draft EWP and commends the open, inclusive manner of its preparation. The final EWP will be published in late 2012 and the Australian government should endeavour to ensure that this happens.

1. *Securing a Clean Energy Future – The Australian Government’s Climate Change Plan*, Department of Climate Change and Energy Efficiency, 2011.

2. Draft Energy White Paper 2011: Strengthening the Foundation for Australia’s Energy Future, Commonwealth of Australia, 2011.

Despite the large number of progressive energy policy developments, there is some scope for strengthening the energy policy framework. In particular, mechanisms for monitoring and evaluating the implementation of energy policy could be developed. Public engagement and outreach efforts for CCS can be broadened and a more proactive approach to addressing workforce shortages and infrastructure bottlenecks in the energy sector needs to be developed. Finally, urgent action should be taken to comply with the IEA 90-day oil stockholding obligation complemented by improvements in both oil and natural gas data quality.

MONITORING AND EVALUATION OF POLICY

The scale of Australia's energy policy ambitions is enormous and very costly even for a resource-rich nation. Significant investments will be needed for the transition to clean energy and building the infrastructure necessary to expand the domestic resource base. Wisely, the government has restructured many of the institutions overseeing this transition and supported its policy decisions with the publication of a wealth of modelling data, which has informed policy design and public discussion about carbon pricing. The output of this analysis supports policy development, validation and implementation processes. The IEA commends this level of transparency to the carbon pricing mechanism and other policy proposals.

Although Australia already has a strong system of checks and balances in place, it could be strengthened by the establishment of a formal mechanism to monitor and evaluate progress of the medium-term implementation of the proposals contained in the Draft EWP in order to assist the timely and cost-effective delivery of policy. The outcomes of the reviews should be published on a regular basis. Similar mechanisms have been developed in other IEA member countries such as Denmark and Germany. Reviews should take into account the costs to the Australian economy, energy security implications and include all technologically and economically feasible policy options. Accordingly, we welcome proposals contained in the Draft EWP to institutionalise a regular four-yearly review of the national energy policy strategy, beginning in 2016.

CARBON CAPTURE AND STORAGE

Carbon capture and storage has a unique and vital role to play in the global transition to a sustainable low-carbon economy, in both power generation and industry. IEA analysis suggests that CCS will play a vital role in worldwide, least-cost efforts to limit global warming, contributing around one-fifth of the required emissions reductions in 2050. Accordingly, the government of Australia has identified it as a key technology for reconciling its own economic and environmental objectives.

The federal government, alongside the governments of the relevant states, is taking welcome steps to promote CCS technology. Australia is among the most advanced IEA member countries with regard to having developed CCS legal and regulatory frameworks. CCS legislation is currently in place at federal level (for injection and storage in Commonwealth waters) and also for CCS activities onshore in a number of states. The Australian Treasury forecasts that fossil fuel-fired plants with carbon capture and storage could provide between 26% and 32% of total electricity generation as part of a low-carbon portfolio in 2050.

The IEA commends Australia's commitment to the development of CCS but notes a risk that delivery of integrated commercial large-scale CCS by 2030 is not guaranteed at this stage. A number of challenges lie ahead; among them improving the efficiency and

reducing the cost of large-scale CO₂ capture technologies, provision of suitable commercially viable CO₂ storage sites and building integrated transport networks to agreed pipeline standards.

While the Australian government is taking many steps to develop the CCS chain, some concerns remain as a result of a low, or lack of, public awareness of CCS. To address these possible concerns, the government already requires project developers, those which receive government funding, to develop and implement community engagement plans. The IEA supports these obligations and encourages the government to ensure these plans are fully executed. The IEA also suggests the deployment of broader public awareness and engagement plans to enhance the support for CCS.

ENERGY AND THE ECONOMY

In the past decade Australia's economy has performed consistently well; annual GDP growth has remained between 1.5% and 4.5% and is expected to grow by about 3% over 2012 and 2013, and by a little more over the year to mid-2014.³ Surging economic and social expansion in relatively nearby emerging economies such as China and India has driven significant demand for Australian energy and mineral resources. The importance of these growing economies is considerable and Australia has become an Asia-focused nation in terms of trade and foreign policy.

The energy industry is a significant contributor to the Australian economy; the coal and petroleum industries contributed around AUD 47 billion to industry value added in 2009/10, representing 3.5% of the Australian total. The electricity and gas supply industries contributed another AUD 22 billion to industry gross value added. Industry also provides significant employment and infrastructure.⁴ Resources exports have more than tripled over the past decade; from AUD 57.8 billion in 2001 to AUD 177.4 billion in 2011, accounting for 59% of Australia's total exports compared to 37% in 2001. Coal and iron ore accounted for 58% of total resources exports in 2011, with a combined value of AUD 102.1 billion.⁵

This boom is widely forecast to continue in the coming decades. Strong demand for energy and minerals and high market prices for these commodities are bringing significant economic rewards to Australia and changing the structure of the domestic economy. The scale of investment required to maintain output and continue to develop the Australian energy resource base is large and will exceed the potential of the domestic market.

One concern of policy makers is the manner in which energy production has begun to dominate the Australian economy. The commodity boom is also having a negative impact on the economy by driving the Australian dollar upward, squeezing trade-exposed industries such as manufacturing and tourism and boosting inflation. The Australian Treasury expects that conditions in other parts of the economy will continue to be weighed down by the high exchange rate, cautious household spending behaviour and tightened macroeconomic policy settings. Furthermore, a shortage of workers for projects needing big resources has led to high wages and deprived less buoyant sectors of manpower.

There is a perceived risk of bottlenecks in infrastructure, workforce shortages, as well as a risk for Australia to create a patchwork economy. Australia must continue to have

3. *Statement on Monetary Policy*, Reserve Bank of Australia, May 2012.

4. *Energy in Australia 2012*, Bureau of Resources and Energy Economics, Canberra, February 2012.

5. *Composition of Trade 2011*, Australian Government Department of Foreign Affairs and Trade, 2012.

access to a large pool of highly qualified labour and maintain experienced research communities if it is to sustain progress on both conventional resource production and the development of new technologies. Federal and state governments should take a proactive approach in order to address workforce shortages in terms of education, training and attracting a suitably qualified overseas workforce.

OIL STOCKS AND DATA QUALITY

At present, Australia is the only IEA country that fully relies on commercial stockholding of industry to meet its minimum 90-day stockholding obligation. Australia does not have public stock holdings and does not place a minimum stockholding obligation on its domestic oil industry. Previously, when Australia was a net exporter or only a marginal net importer of oil, this reliance on commercial stocks was considered sufficient to meet its IEA requirements. This is no longer the case, however, as Australia becomes an ever larger net importing country, like many other IEA countries.

Accordingly, the IEA strongly recommends that the Australian government take action to become fully and systematically compliant with its International Energy Program (IEP) stockholding commitment. The establishment of emergency stockholding to meet the minimum IEP commitment would also create the means for Australia to contribute to an IEA collective action with the use of emergency stocks.

Furthermore, high-quality energy data and statistics are the cornerstone of energy policy and an essential element of informed decision making. While some of the data produced by Australia are of the highest quality, there is room for improvement, particularly with regard to oil and natural gas data. While the establishment of the Bureau of Resources and Energy Economics in 2011 is a positive development, further progress is needed. The Draft EWP correctly identifies that an improved and more transparent information base on energy resources, technologies and fuels, including their comparative costs and commercial maturity, is an important complement and input into the policy process. The Draft EWP also proposes a number of measures, notably steps, in consultation with industry, to improve the quality of the Australian petroleum statistics. The IEA welcomes these proposals and urges the government to implement the measures as soon as possible.

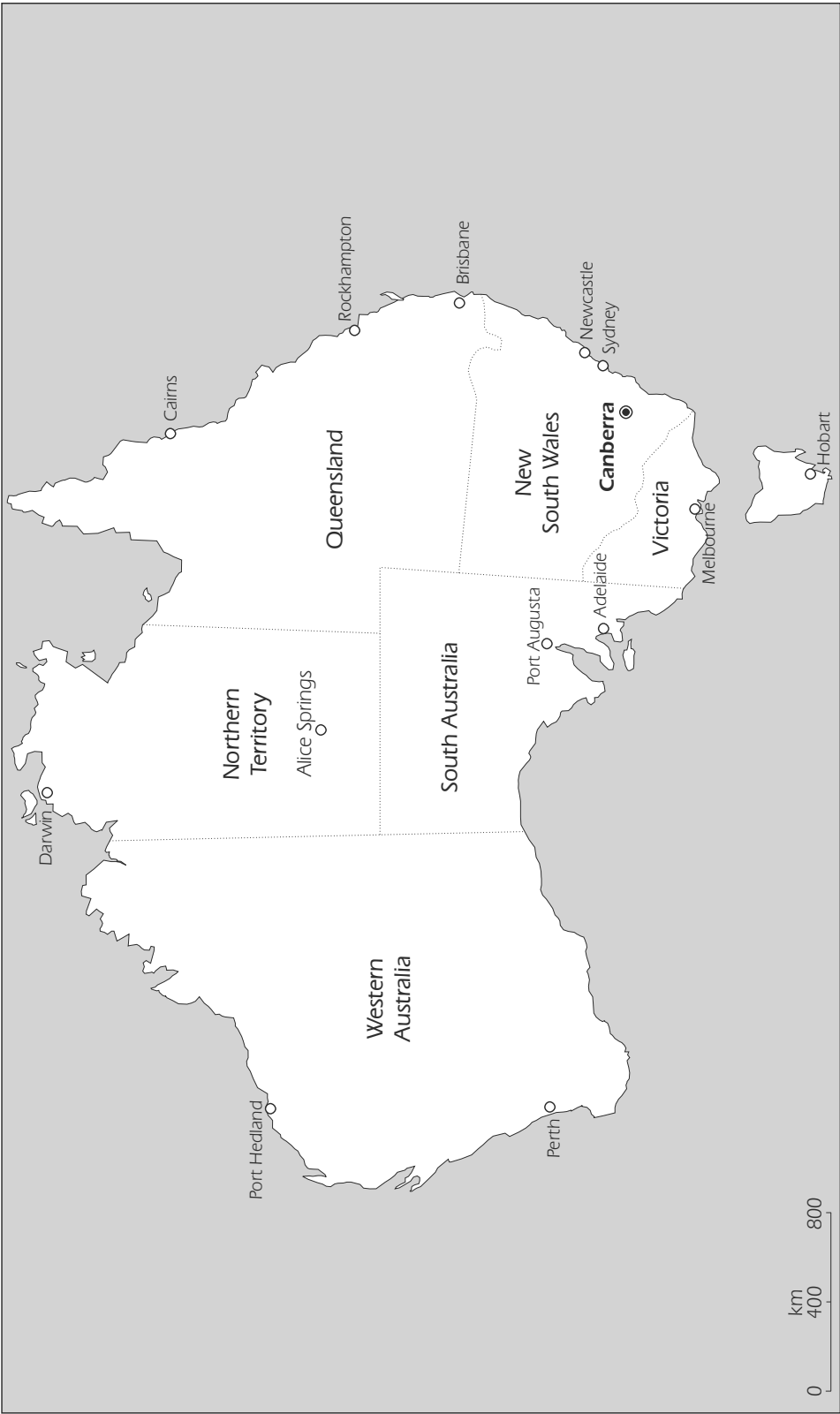
KEY RECOMMENDATIONS

The government of Australia should:

- ☐ *Finalise the EWP in 2012 and fully utilise the new clean energy policies and institutions to position Australia among the global leaders in the transition to a low-carbon economy.*
- ☐ *Continue public engagement and outreach efforts in relation to carbon capture and storage and maintain efforts to broaden awareness and engagement at community level.*
- ☐ *Take action to address its 90-day oil stockholding obligation and examine available options to meet this commitment.*
- ☐ *Take all necessary steps to improve the quality of oil and gas data reporting. This may include placing a data-reporting obligation on all industry participants.*
- ☐ *Actively monitor infrastructure capacity and manpower needs to facilitate timely and sufficient access to highly qualified labour and research communities.*

PART I
POLICY ANALYSIS

Figure 1. Map of Australia



2. GENERAL ENERGY POLICY

Key data (2010)

TPES: 125 Mtoe (coal 41%, oil 32%, natural gas 21%, renewables 6%), +15% since 2000

TPES per capita: 5.5 toe (IEA average: 4.7 toe)

TPES per GDP: 0.15 toe per 1 000 USD GDP (IEA average: 0.15 toe per 1 000 USD GDP)

Electricity generation: 242 TWh (coal 75%, natural gas 15%, renewables 9%, oil 1%)

Electricity consumption per capita: 11.4 MWh (IEA average: 9.5 MWh)

Inland energy production: 311 Mtoe, or 249% of TPES

COUNTRY OVERVIEW

Australia is a large, sparsely populated country, rich in mineral resources. It is the world's sixth-largest country; mainland Australia covers an area of 7.69 million square kilometres (km²). Australia is the Earth's largest island but smallest continent. It stretches about 3 700 kilometres (km) from north to south and 4 000 km from east to west. It is 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 22.5 million people with a population density of 2.6 persons per km², the lowest in the OECD and one of the lowest in the world. Much of the population is concentrated along the eastern and south-eastern coast with a smaller number on the west coast and very few people in the country's arid centre. It has no land boundaries with other countries.

ECONOMY

Economic activity is focused on Australia's eastern seaboard, where most of the population lives. New South Wales generates around 32% of Australia's GDP, while Victoria generates 24% and Queensland 19%. There is a sharp divide in economic performance between the states: typically, growth in South Australia and Tasmania is well below the overall national rate, while Western Australia, and to a lesser extent Queensland, are heavily dependent on the mining industry.

The Australian economy, fuelled by the mining boom, is expected to grow in 2012 and 2013 at rates of between approximately 3.1% and 3.7%.⁶ Strong growth, driven by terms of trade gains and dynamic investment, will reduce unemployment.

The Reserve Bank of Australia forecasts that domestic demand will grow at a slightly stronger pace than its long-run average, with rapid growth in mining investment not

6. *Australia – Economic forecast summary*, Organisation for Economic Co-operation and Development, Paris, May 2012.

completely offset by weak building activity and soft government spending.⁷ Export growth has been revised lower, although it is still expected to be at an above-trend pace as a result of high current and future investment in mine and transport infrastructure.

GOVERNMENT

Australia is a fully independent parliamentary democracy. Queen Elizabeth II of the United Kingdom is also formally the Queen of Australia. Nonetheless, the country enjoys a federal system of government with a national parliament and legislative assemblies and councils (parliaments) in each state and territory (there is no Legislative Council in Queensland, the Northern Territory, the Australian Capital Territory (ACT) or Norfolk Island). Under the Constitution the federal government has responsibility for foreign relations, trade, defence and immigration. State government responsibilities include justice, consumer affairs, health, education, forestry, public transport and main roads. A variety of electoral systems are used for these parliaments.

The supreme law-making institution – the federal Parliament – has two houses: the House of Representatives and the Senate. The House of Representatives currently has 150 members elected by preferential voting. Proportional representation is used in the Senate.

The Australian Constitution sets out the powers of government in three separate chapters – the legislature, the executive and the judiciary – but insists that members of the executive must also be members of the legislature. In practice, Parliament delegates wide regulatory powers to the executive.

Government is formed in the House of Representatives by the party able to command a majority in that chamber. The present first-time minority government, a Labor government headed by Prime Minister Julia Gillard and supported by the Greens and Independents has been in power for nearly two years.

SUPPLY AND DEMAND

PRODUCTION AND SUPPLY

Australia is one of only three OECD countries that are net energy exporters; the country has become a major player in global coal markets and liquefied natural gas (LNG) markets. Australia is the fourth-largest coal-producing country in the world after China, the United States and India, and the world's largest coal exporter.

In 2010/11 Australia exported 20 million tonnes (Mt) of liquefied natural gas (LNG) to a value of AUD 10.4 billion, making it the third-largest LNG exporter in the Asia-Pacific region and the fourth-largest in the world.

In 2010, total coal production amounted to around 240 million tonnes of oil equivalent (Mtoe), equivalent to three-quarters of domestic energy production. The remaining contributions to domestic energy production come from natural gas with 14%, oil with 8% and renewables with 2%.

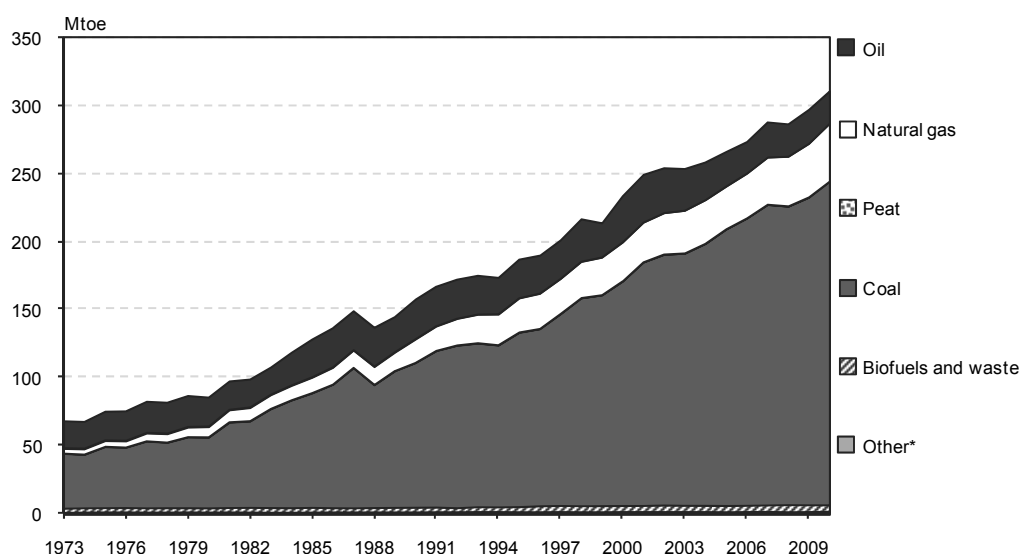
7. *Statement on Monetary Policy*, Reserve Bank of Australia, Canberra, May 2012.

Between 2000 and 2010, the increase in Australian energy production was the largest among all IEA member countries in terms of absolute amounts and the third-largest in terms of growth rate. Total energy production amounted to 311 Mtoe in 2010, 33% more than in 2000; the government expects it to increase by 78% over the next decade and reach more than 550 Mtoe. The government forecasts a strong increase in coal production (59%), and an even stronger increase in natural gas and renewables, each expected to increase its amounts fourfold up to 2020.

Australia exports most of its coal production (80%), and half of its natural gas production. Conversely, 40% of total oil supply is imported.

Total primary energy supply (TPES) was 125 Mtoe in 2010, which is 1% lower than the all-time high reached in 2009 but 15% higher than in 2000. Australia's energy mix is dominated by fossil fuels, coal, oil and gas representing 41%, 32% and 21% of TPES in 2010. In addition, biofuels represent 4% and hydro energy 1% of TPES.

Figure 2. Energy production by source, 1973-2010



* Other includes wind solar and hydro (negligible).

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011.

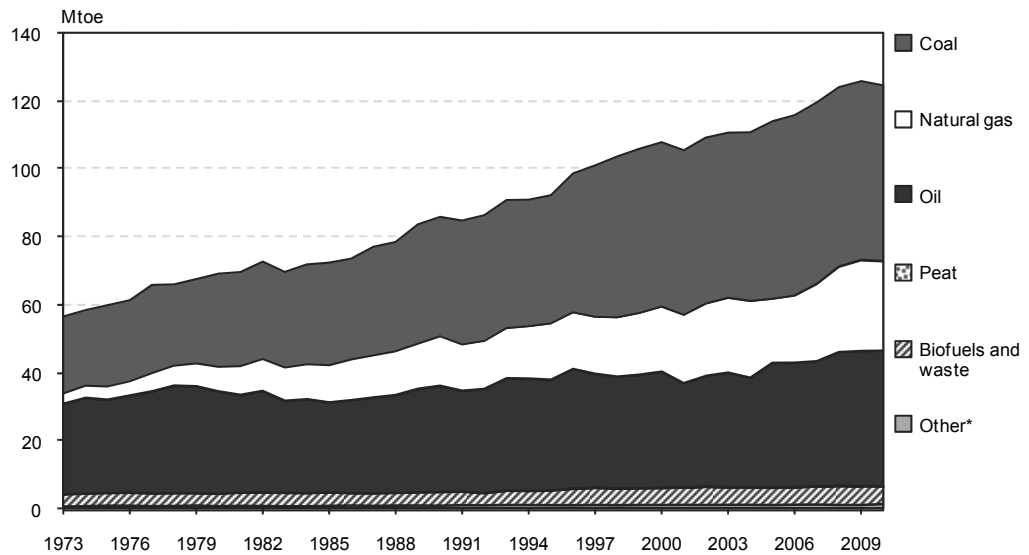
DEMAND

Australia's total final consumption of energy (TFC) was 75 Mtoe in 2010, similar to 2009 but 8% higher than in 2000 and 33% higher than in 1990. The final energy mix has remained stable over the last years, oil being the main energy carrier, representing around half of energy consumption. Electricity is the second-largest energy carrier, with 23% of final consumption. Natural gas, coal and biofuels represented 17%, 4% and 5% of TFC in 2010.

Transport is the largest final energy consuming sector, representing 29 Mtoe or 38% of total final consumption (TFC) in 2010. This share has remained constant over recent decades, but in terms of volume, consumption in the transport sector has grown; it doubled between 1995 and 2010. Industry is the second-largest consuming sector with 36% of TFC, while the residential and the commercial-services sectors only represent 13% and 12% respectively. Compared to other IEA member countries (the average is 36%), Australia has a very low share of consumption in households and services.

In terms of energy consumption per capita, Australia is one of the first among IEA countries; with 5.5 tonnes of oil equivalent (toe) per capita in 2010, it is 17% higher than the IEA average of 4.5 toe per capita. However it should be noted that Australia's energy-intensive economy is largely the result of low energy costs and the production of export activities by energy intensive industries.

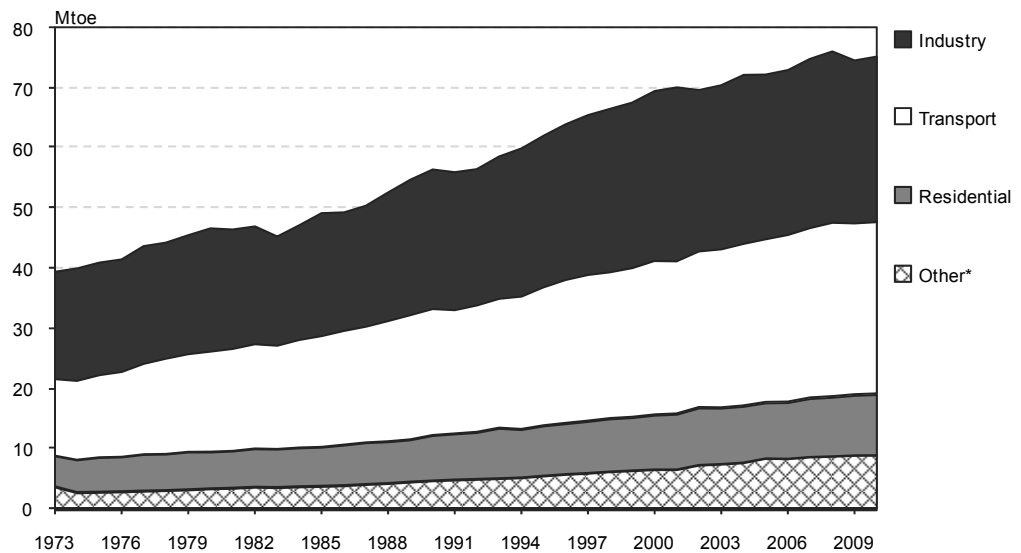
Figure 3. Total primary energy supply, 1973-2010



* Other includes wind, solar and hydro (negligible).

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011.

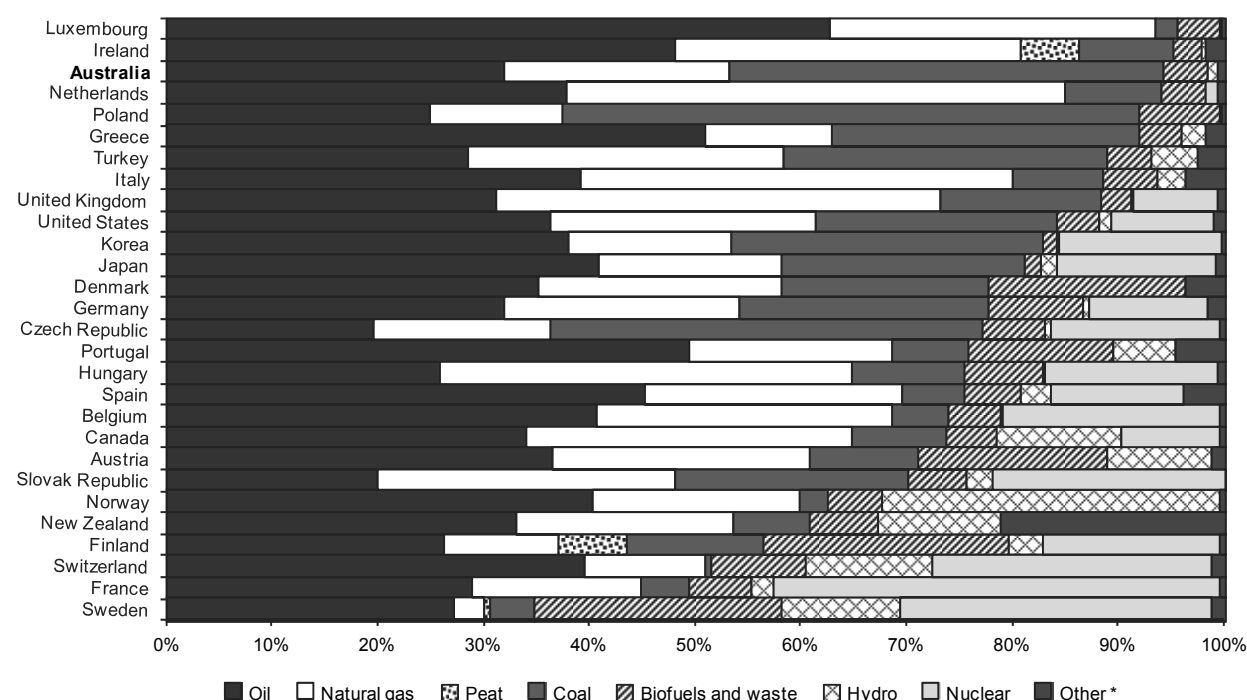
Figure 4. Total final consumption by sector, 1973-2010



* Other includes commercial, public service, agricultural, fishing and other non-specified sectors.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011.

Figure 5. Breakdown of total primary energy supply in IEA member countries, 2010



* Other includes geothermal, solar, wind, and ambient heat production.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011.

INSTITUTIONS

AUSTRALIAN GOVERNMENT DEPARTMENTS

The **Department of Resources, Energy and Tourism (RET)** was established following the 2007 federal election. It is the government department responsible for providing advice and policy support to the government regarding Australia's resources, energy and tourism sectors. Key objectives of the department include: achieving strong economic growth; resilient and secure energy systems; equitable distribution of the benefits of Australia's energy, resources and tourism industries; and actively participating in the government's approach to domestic and international environmental policy.

The Department of Climate Change was established on 3 December 2007. On 8 March 2010, as a result of government changes, a new **Department of Climate Change and Energy Efficiency (DCCEE)** was established. The role of the department is to support government by leading and co-ordinating the mitigation of greenhouse gas (GHG) emissions, promotion of energy efficiency, and adaptation to climate change and shaping of global solutions.

The **Department of the Prime Minister and Cabinet (PM&C)** provides policy advice to the Prime Minister and the Cabinet on matters that are at the forefront of public and government administration, including domestic and international affairs and, in particular, the implications of proposals for Australian government-state/territory relations.

The **Council of Australian Governments (COAG)** is the principal intergovernmental forum in Australia, comprising the Prime Minister, State Premiers, Territory Chief Ministers and the President of the Australian Local Government Association. The role of

COAG is to initiate, develop and monitor the implementation of policy reforms that are of national significance and that require co-operative action by Australian governments, including reforms relating to climate change and energy policy.

The **Standing Council on Energy and Resources** (SCER) is the national policy and governance body for the Australian energy market, responsible for delivering the economic and environmental benefits for Australia resulting from implementation of the COAG national energy policy framework. SCER was established in December 2011, replacing its predecessors the **Ministerial Council on Energy** (MCE) and the **Ministerial Council on Mineral and Petroleum Resources** (MCMPR)

The **Department of Infrastructure and Transport** (DIT) provides policy advice to the Minister for Infrastructure and Transport and delivers a variety of programmes on behalf of the Australian government. Relevant energy-related policies include transport infrastructure, green transport and vehicle standards.

The **Department of Industry, Innovation, Science, Research and Tertiary Education**, established in December 2011, delivers a number of industry, innovation and research programmes relevant to the energy sector, most notably the AUD 1.2 million Clean Technology Program.

STATE AND TERRITORIAL INSTITUTIONS

Australia is a federal country with a Commonwealth government comprising six states and two territories. Accordingly, there are relevant state and territorial government departments in each of Australia's jurisdictions. The states have primary responsibility for energy production, transport, land-use, mineral rights and environmental assessments, except for resources located offshore in Commonwealth waters. 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. Table 1 is a guide to some of the relevant departments in the states and territories.

Table 1. Australian state and territorial institutions concerning the energy sector (as at 1 July 2012)

State/territory government	Institution
Australian Capital Territory (ACT)	Department of the Environment, Climate Change, Energy and Water
New South Wales (NSW)	Office of Environment and Heritage
	Department of Trade and Investment, Regional Infrastructure and Services
Northern Territory (NT)	Department of Natural Resources, Environment, the Arts and Sport (NRETA)
	Department of Resources (DoR)
	Environment Protection Authority
Queensland (QLD)	Department of Environment and Heritage Protection
	Department of Natural Resources and Mines
	Department of Energy and Water Supply
	Office of Climate Change
	Office of Clean Energy

South Australia (SA)	Department for Environment and Natural Resources (DENR)
	Department of Primary Industries and Resources SA (PIRSA)
	Department of Transport, Energy and Infrastructure
	Department for Water
	Environment Protection Authority SA (EPA)
	Premier's Climate Change Council
	Renewables SA Board
	Sustainability and Climate Change Division, Department of the Premier and Cabinet
Tasmania (TAS)	Department of Infrastructure, Energy and Resources (DIER)
	Department of Primary Industries, Parks, Water and Environment (DPIPWE)
	Tasmanian Climate Action Office (TCCO), Department of Premier and Cabinet
	Environment Protection Authority Tasmania
Victoria (VIC)	Department of Primary Industries (DPI)
	Department of Sustainability and Environment (DSE)
	Sustainability Victoria
	Environment Protection Authority (EPA) Victoria
Western Australia (WA)	Department of Environment and Conservation (DEC)
	Department of Mines and Petroleum (DMP)
	Department of Water
	Environmental Protection Authority of Western Australia

Source: Department of Resources, Energy and Tourism.

OTHER AUSTRALIAN GOVERNMENT AGENCIES AND REGULATORY INSTITUTIONS

The **Australian Energy Market Commission (AEMC)** is the rule maker and developer for Australia's energy markets. A national, independent body, it develops and amends rules governing the National Electricity Market (NEM) and elements of natural gas markets. AEMC also provides strategic and operational advice to the Council of Australian Governments' Ministerial Council on Energy.

The **Australian Energy Regulator (AER)** regulates the wholesale electricity market and is responsible for the economic regulation of the electricity transmission and distribution networks in the NEM. The AER is also responsible for the economic regulation of gas transmission and distribution networks and for enforcing the national gas law and national gas rules in all jurisdictions except Western Australia.

The **Australian Competition and Consumer Commission (ACCC)** is an independent statutory authority, which promotes competition and fair trade, and regulates national infrastructure industries. Its primary responsibility is to ensure that individuals and businesses comply with the Australian government's laws on competition, fair trading and consumer protection.

The Clean Energy Legislative Package was transposed into national law in November 2011, which resulted in some restructuring of regulatory institutions. The Climate

Change Authority Act 2011 established the **Climate Change Authority**, which will advise the government on the setting of carbon pollution caps and periodic reviews of the carbon pricing mechanism and other climate change laws. The Clean Energy Regulator Act 2011 established the **Clean Energy Regulator**, which will administer and enforce the carbon price mechanism, the National Greenhouse and Energy Reporting System, the Renewable Energy Target and the Carbon Farming Initiative.

The Australian government will establish an AUD 10 billion commercially oriented Clean Energy Finance Corporation (CEFC) as part of its Clean Energy Future Plan. The objective of the CEFC is to overcome capital market barriers that hinder the financing, commercialisation and deployment of renewable energy, energy efficiency and low-emission technologies. The CEFC will invest in firms and projects utilising these technologies as well as manufacturing businesses that focus on producing the inputs required. It will not invest in carbon capture and storage technologies. The CEFC will not provide grants. It is intended to be commercially oriented and to make a positive return on its investments.

The Australian Renewable Energy Agency Act 2011 created the **Australian Renewable Energy Agency (ARENA)**. ARENA was established on 1 July 2012, with the objectives of improving the competitiveness of renewable energy technologies and increasing the supply of renewable energy. ARENA will consolidate administration of AUD 3.2 billion in government support for renewable energy technology innovation currently administered by the Australian Centre for Renewable Energy, the Australian Solar Institute (ASI) and the Department of Resources, Energy and Tourism.

ENERGY POLICIES

DRAFT ENERGY WHITE PAPER 2011

A Draft Energy White Paper 2011: Strengthening the Foundation for Australia's Energy Future was published for public consultation in December 2011. The paper fulfils the Australian government's commitment to publish a Draft Energy White Paper (EWP) by the end of 2011. Following the completion of the consultation process, the government anticipates that a final EWP will be released late in 2012.

The Draft EWP presents an overview of Australia's future energy needs to 2030 and sets out a comprehensive strategic policy framework to guide the further development of Australia's energy sector. The Draft EWP acknowledges the good progress Australia has made over the past twenty years in developing its energy markets and systems. It identifies a series of challenges that lie ahead and notes the transformation needed to meet climate change objectives. It proposes four priority action areas where targeted measures can enhance the country's energy potential:

- strengthening the resilience of Australia's energy policy framework;
- reinvigorating the energy market reform agenda;
- developing Australia's critical energy resources – particularly Australia's gas resources; and
- accelerating clean energy outcomes.

Among the challenges the Draft EWP identifies is the need for significant investment, estimated at AUD 240 billion, in Australia's electricity and gas production, transmission and distribution sectors between today and 2030. Liquid fuels infrastructure will also require further investment.

Strengthening the resilience of Australia's energy policy framework

The government proposes to strengthen the national energy policy framework by streamlining existing measures and introducing a series of new measures, including regular four-yearly reviews of national energy policy strategies beginning in 2016 and undertaking biennial National Energy Security Assessments (NESA) from 2014.

Australia's stock of energy information will also be strengthened by the biennial publication, starting in 2014, of the Australian Energy Resource Assessment (AERA) and the Australian Energy Technology Assessment (AETA), and expanding the scope of the AETA to specifically cover liquid fuel technologies.

Public information on Australia's conventional and unconventional gas reserves and projected market developments will also be enhanced.

Reinvigorating the energy market reform agenda

The Australian government proposes to strengthen its work with the states and territories, through the established COAG ministerial councils, to pursue greater market liberalisation and transparency measures, stronger customer protection measures and increased demand-side management reforms.

Developing Australia's critical energy resources

The Australian government continues to encourage investment in energy resource development, by pursuing an active approach to the development of its offshore gas resources and continuing to work with states and territories through the Standing Council on Energy and Resources to co-operatively progress a more harmonised approach to the regulation of the coal-seam gas industry.

Accelerating clean energy outcomes

The Clean Energy Future plan is a demand-led policy. By adding a "demand pull" dimension to policies and programmes, the government hopes to generate maximum impact from its initiatives while creating an environment in which industry competes to develop innovative solutions to meet social demands associated with challenges such as energy management and climate change. Rather than relying on government decisions to regulate or subsidise activities, a carbon price encourages industry and households to find the most effective ways of reducing carbon pollution.

The Australian government proposes to accelerate clean energy outcomes by: continuing the implementation of its clean energy programmes to ensure continued support for innovation and commercialisation. It also proposes to seek opportunities to develop collaborations with state and territory governments, businesses and the research community, and to engage in international clean energy processes.

CLEAN ENERGY FUTURE

In July 2011, the Australian government announced a comprehensive plan for a low-carbon energy future: *Securing a Clean Energy Future – The Australian Government's Climate Change Plan*. The purpose of the plan was to bring existing policies together and to strengthen them by introducing new initiatives. The plan contained four key pillars: the introduction of a carbon price; renewable energy; energy efficiency; and action on the land.

The government proposed to provide significant levels of financial support for innovation in clean energy technologies, including renewable energy, plus a new AUD 10 billion commercially oriented Clean Energy Finance Corporation (CEFC), which will invest in renewable energy, low-emission and energy-efficient technologies and a new Australian Renewable Energy Agency (ARENA), which will administer AUD 3.2 billion in government support for research and development, demonstration and commercialisation of renewable energy. In addition, the government projects that the Renewable Energy Target, combined with other elements of the plan, including the carbon price, will drive AUD 20 billion of investment in large-scale renewable energy by 2020.⁸

Clean Energy Finance Corporation

An AUD 10 billion new commercially oriented, independent Clean Energy Finance Corporation will invest in businesses seeking funds to move innovative clean energy proposals and technologies off the ground. The Clean Energy Finance Corporation will invest in the commercialisation and deployment of renewable energy, energy efficiency and low-emission technologies. It will also invest in manufacturing businesses that provide inputs for these sectors, for example manufacturing wind turbine blades.

The Australian Renewable Energy Agency

The government currently provides grant-based support for renewable energy across a series of programmes. It proposes to reform the management of these programmes by creating a new independent statutory body called the Australian Renewable Energy Agency (ARENA). The purpose of this new agency is to provide more independent, efficient and streamlined administration of existing funding.

Clean energy legislation and carbon-pricing mechanism

A Clean Energy Legislative Package, passed by the Senate on 8 November 2011, sets out the way in which the carbon-pricing mechanism was implemented from 1 July 2012. It also includes measures to support industry and jobs in emissions-intensive, trade-exposed industries, provisions to maintain energy security, governance mechanisms, and a series of related clean energy programmes.

The carbon-pricing mechanism is expected to directly apply to less than 500 of Australia's largest emitters or liable entities. Liable entities either operate facilities that exceed a covered scope on emissions threshold of 25 000 tonnes CO₂-eq, or supply or use natural gas. The mechanism covers approximately 60% of Australia's carbon emissions and includes emissions from electricity generation, stationary energy, landfills, waste water, industrial processes and fugitive emissions.

Liable entities are required to report under the National Greenhouse and Energy Reporting Scheme (NGER Scheme) on the extent of their emissions and satisfy their liability for each tonne of covered emissions that they are liable for, either by surrendering emission units or paying a unit shortfall charge.

The mechanism commenced on 1 July 2012. In the first three years, the carbon price will be fixed (fixed price period). From 1 July 2015, it will be set by the market (flexible price period). For the 2012/13 financial year, the price has been set at AUD 23 per tonne. In 2013/14, it will increase to AUD 24.15 per tonne and to AUD 25.40 per tonne in the following year.

8. A proposal that 20% of Australia's electricity supply will come from renewable sources by 2020.

From 1 July 2015 onward, the number of units issued by the government each year will be capped by a pollution cap set by regulations. Most carbon units will be auctioned by the Clean Energy Regulator and the price will be set by the market.

Carbon capture and storage

The Australian government, in partnership with stakeholders from the research community and the private sector, has implemented a development strategy covering the CCS innovation chain:

- The strategy includes substantial (AUD 2 billion) support of large-scale and small-to medium-scale projects via a number of national programmes such as CCS Flagships, National Low-Emissions Coal Initiative projects and Low-Emissions Technology Demonstration Fund projects.
- The government also supports research and development and pilot testing of low-emission coal and CCS technologies through the Cooperative Research Centre for Greenhouse Gas Technologies (CO₂CRC) and AUD 75 million for Australian National Low-Emissions Coal Research and Development Limited (ANLECR&D) which is matched by funding from the coal industry.
- AUD 61 million has been made available to accelerate the identification and development of suitable CO₂ geological storage sites through the National CO₂ Infrastructure Plan and the government is developing legislation and regulations to enable CCS activities in Commonwealth offshore waters.
- The government also supports international research and development and collaboration through the Global Carbon Capture and Storage Institute (GCCSI), the Australia-China Joint Coordination Group on Clean Coal Technology, the Carbon Capture Use and Storage Action Group, and the Carbon Sequestration Leadership Forum.
- The government has established the National Carbon Capture and Storage Council comprising industry, researchers and state and territory governments to advise on the accelerated development and deployment of CCS. The Australian government is represented by the Department of Resources, Energy and Tourism.

ENERGY AND RESOURCE TAXATION

The government of Australia and state and territory governments generally own, on behalf of the community, mineral and petroleum resources and impose charges on minerals extraction and petroleum production. Accordingly, resource extraction activities in Australia are liable to specific Australian and state and territory government taxes.

On 1 July 2012, new resource taxation arrangements were introduced. These arrangements include a minerals resource rent tax, which applies to the mining of iron ore and coal; and a petroleum resource rent tax, which extends to all onshore and offshore oil and gas projects, including activities in North West Shelf and coal seam gas projects.

Minerals resource rent tax (MRRT)

The MRRT applies from 1 July 2012 to the mining of iron ore and coal. It is a profits-based tax and only companies with profits above AUD 75 million will incur an MRRT liability at a rate of 30% allowing for the application of an extraction allowance

of 25% before the MRRT is applied. The Australian Treasury's 2012 Budget Overview estimates that net receipts from the MRRT will be AUD 3.0 billion in 2012/13.⁹

Petroleum resource rent tax (PRRT)

The PRRT was originally introduced by the Australian government in 1987 to replace royalties and crude oil excise in most areas of Commonwealth waters. From 1 July 2012 the PRRT is levied at 40% of net revenues (sales receipts less eligible expenditures) from a project. The Mid-Year Economic and Fiscal Outlook 2011/12 estimated that PRRT collections, under the existing mechanism, will be AUD 1.93 billion for 2011/12.¹⁰

ENERGY FORECASTING AND MODELLING

The Bureau of Resources and Energy Economics (BREE) was established on 1 July 2011, when responsibility for resources and energy data and research was transferred from the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) to the BREE. It is an economic research unit within the Department of Resources, Energy and Tourism. Its mandate is to provide high-quality data, forecasts and research on resources and energy for Australia from an economic perspective, a role previously carried out by ABARES.

BREE prepares *Energy in Australia*, an annual publication, which provides a detailed overview of energy in Australia, including resources, production, consumption, trade and prices.¹¹ It also prepares and publishes a number of other publications, including the *Australian Energy Projections* series, which contains long-term projections of Australian energy consumption, production and trade. The last analysis, published in December 2011, covers the period from 2008/09 to 2034/35 and was prepared using BREE's E4cast model.¹²

The Australian government Treasury also undertook extensive modelling work to inform policy design and public discussion about the effects of carbon pricing.¹³ The Treasury modelled a range of scenarios which explored different environmental targets and design features in a carbon-pricing scheme. The first modelling report was published in July 2011 and an updated version was released on 21 September 2011.

ENERGY SECURITY

The Department of Resources, Energy and Tourism is engaged in several initiatives to ensure that disruptions to energy production and distribution are addressed promptly and effectively. Emergency response plans are in place for the liquid fuels, gas and electricity sectors. These plans identify supply options, facilitate communication and ensure that effective approaches are in place in the event of a major disruption.

Furthermore, security of energy supply in Australia has been enhanced by a series of energy market reforms implemented by the Standing Council on Energy and Resources to ensure the secure delivery of energy at least cost. These reforms have resulted in price transparency promoting appropriate investment into energy infrastructure, diversification of energy supply, and improved network reliability and flexibility.

9. *2012 Budget Overview*, the Treasury, Commonwealth of Australia, May 2012.

10. *Ibid.*

11. *Energy in Australia 2012*, Bureau of Resources and Energy Economics, 2012.

12. *Australian energy projections to 2034/35*, Bureau of Resources and Energy Economics, 2011.

13. *Strong Growth, Low Pollution: Modelling a Carbon Price*, the Treasury, Commonwealth of Australia, 2011.

NATIONAL ENERGY SECURITY ASSESSMENT

The Australian government periodically updates and publishes the *National Energy Security Assessment* (NESA) to consider the key strategic energy security risks facing Australia at present and over the short, medium and long term. The analysis contained in the NESA considers the main factors challenging the adequate, reliable and competitive delivery of energy in each of the liquid fuels, natural gas and electricity sectors.

The key finding of *NESA 2011* was that Australia's overall level of energy security has remained largely consistent with the assessment undertaken in 2009, and that the energy security situation is meeting the country's economic and social needs, albeit with some emerging market and policy uncertainties that could have implications for maintaining Australia's current level of energy security.¹⁴ The *NESA* has provided a key input into the development of energy policies, including the Draft EWP.

ENERGY SECURITY MEASURES

Liquid fuels

The Liquid Fuel Emergency Act 1984 (LFE Act) provides the Australian government with the authority needed to prepare for, and manage, a national liquid fuel emergency. Supporting the LFE Act 1984 are the *Liquid Fuel Emergency Guidelines* that provide the decision maker, the Minister for Resources and Energy and/or his delegate, guidance on making a direction under the particular sections of the LFE Act. The National Oil Supplies Emergency Committee (NOSEC) is the main channel through which the federal and state governments formulate their overall management response to a national liquid fuel emergency. NOSEC manages the National Liquid Fuel Emergency Response Plan (NLFERP) which details how Australian governments would respond to a fuel disruption with national implications.

Liquid fuel vulnerability assessment

The 2011 Liquid Fuels Vulnerability Assessment (LFVA) examined Australia's energy security resilience by modelling a set of physical infrastructure and supply chain "shocks" for the liquid fuels. The scenario examined Australia's energy security resilience by modelling an interruption to shipping of crude oil and petroleum products into and out of Singapore and the shut-down of Singapore's three major refineries.

The interruption was modelled to last for around 30 days, and impacts were assessed under current conditions and then under the tighter global market conditions forecast for 2015/16. The scenario demonstrated that the global market and international supply chain could provide Australia with adequate and reliable supplies, albeit at higher prices. Adequacy and reliability over the scenario period would be maintained through alternative supplies becoming available from other regional refineries, access to stocks in Australia and those already on water, and the ability to acquire petroleum products from the Asia-Pacific region that would normally be sold to other regions.

14. *National Energy Security Assessment 2011*, Department of Resources, Energy and Tourism, Commonwealth of Australia, December 2011.

Electricity

The Australian Energy Market Operator (AEMO) is an independent organisation operating the energy markets and systems and also delivering planning advice in eastern and south-eastern Australia. AEMO also has responsibility to ensure the reliability and security of the power system, including interfacing with jurisdictions (South Australia, Victoria, New South Wales, Queensland and the Australian Capital Territory) with regard to emergency response protocols. AEMO provides leadership and decision making during a power system emergency to ensure co-operation between industry participants and co-ordination with jurisdictional authorities. The National Electricity Market Emergency Protocol co-ordinates actions to be taken under individual State Emergencies Services Legislation to manage power system security emergencies.

Natural gas

The National Gas Emergency Response Advisory Committee (NGERAC) advises the Standing Council on Energy and Resources on efficient and effective responses to major multi-jurisdictional natural gas supply shortages to maintain the integrity of the gas supply system and overall public health and safety.

Critical infrastructure protection and resilience

The responsibility for protecting critical infrastructure is shared between critical infrastructure owners and operators, and between the federal, state and territory governments. The Energy Sector Group, established under the Trusted Information Sharing Network (TISN), meets regularly to work together and share information on security issues affecting critical infrastructure.

CRITIQUE

Australia enjoys the benefit of abundant and diverse energy resources and is the world's ninth-largest energy producer. Given its large resources, it is well positioned to continue its role as an important supplier of regional energy needs, while maintaining domestic energy supply. Conventional energy resources include coal, natural gas and oil, uranium and potentially thorium. Australia has substantial untapped wind, solar and geothermal resources and large potential sources of wave, tidal and biomass energy.

POLICY EVOLUTION

Since the last in-depth review was published in 2005, the Australian energy policy framework has experienced considerable change. Substantial new policies have been developed and implemented and a Draft EWP has been published. New policy-making federal ministries and institutions have been established including the Department of Resources, Energy and Tourism (RET) and the Department of Climate Change and Energy Efficiency (DCCEE), and other Commonwealth government agencies have been created or streamlined. Ambitious new policies for climate change and energy efficiency have been developed and regular reviews of energy security are under way.

Targets for renewable energy have been widened, long-term policies for clean energy have been developed and enabling legislation has been transposed into Commonwealth law. These changes have been happening at a time when Australia has become a major player in global hard coal markets and liquefied natural gas markets.

In July 2011, the government published a comprehensive package of clean energy proposals that included the introduction of a carbon price and provision of significant levels of financial support for innovation in clean energy technologies, including renewable energy. Many of these measures were transposed into national law before the year ended.

The IEA sees carbon pricing as a critical component of climate policy and welcomes the introduction of a carbon price and hopes that the move will put an end to uncertainty in the energy sector. The IEA argues that, even with a carbon price, supplementary policies are still needed: energy efficiency policies to unlock low-cost abatement and technology policies to lower the cost of renewable energy, carbon capture and storage, and other technologies for the long term. Australia has developed a relatively balanced package with strong elements of each. Furthermore, the IEA has published a review of existing emissions trading schemes (ETS) designs, based on international experience, and found some key emerging design lessons; the Australian carbon mechanism fits well with these lessons.¹⁵

The IEA welcomes the broad sweep of measures proposed by the government in relation to clean energy; notably the strong financial commitment from government and the establishment of the commercially oriented Clean Energy Finance Corporation, which will invest in renewable energy, low-emission and energy-efficient technologies.

A comprehensive Draft EWP, published seven years after the previous one, will be finalised during 2012. This draft energy policy provides a review of Australia's future energy needs to 2030 and sets out a policy framework to guide the further development of the sector. The Draft EWP policy framework is based on a clear objective: to build a secure, resilient and efficient energy system that: provides accessible, reliable and competitively priced energy for all Australians; enhances Australia's domestic and export growth potential; and delivers clean and sustainable energy. It also identifies four priority areas for future action and outlines a set of initiatives to progress this agenda. This clarity is helpful for stakeholders; the scale of the investment needed in Australia over the coming decades will require a stable long-term policy framework. Accordingly, the IEA welcomes the publication of the Draft EWP and commends the open, inclusive manner of its preparation. We understand that the final EWP will be published in late 2012 and the Australian government should endeavour to ensure that this happens.

The scale of Australia's energy policy ambitions is enormous and very costly, even for a resource-rich nation. Vast sums of money will be invested in the transition to clean energy. Wisely the government has restructured many of the institutions overseeing this transition and supported their decisions with the publication of detailed modelling data, which allows stakeholders to come to their own positions. The output of this analysis supports policy development, validation and implementation processes. The IEA commends this level of transparency to the carbon-pricing mechanism and other policy proposals.

Although Australia already has a strong system of checks and balances in place, it could be helpful if the government considered establishing a formal mechanism to monitor and evaluate progress of the medium-term implementation of the proposals contained in the Draft EWP in order to assist the timely and cost-effective delivery of policy. The outcomes of the reviews should be published on a regular basis. Similar mechanisms have been developed in other IEA member countries such as Denmark and Germany. Reviews should take into account the costs to the Australian economy, energy security implications and

15. *Summing up the Parts, Combining Policy Instruments for Least-Cost Climate Mitigation Strategies*, IEA, Paris, 2011.

include all technologically and economically feasible policy options. Accordingly, the IEA welcomes the proposals contained in the Draft EWP to institutionalise a regular four-yearly review of the national energy policy strategy beginning in 2016.

CARBON CAPTURE AND STORAGE

The government of Australia has identified carbon capture and storage (CCS) as a key technology for reconciling its economic and environmental objectives and, alongside the relevant states, is taking welcome steps to promote CCS technology. The Australian Treasury's modelling forecasts that by 2050 fossil fuel-fired plants with CCS could provide between 26% and 32% of total electricity generation (between 90 TWh and 125 TWh per year). Meeting this target will require substantial investment, somewhere between AUD 45 billion and AUD 65 billion in coal, nearly all of which is for CCS plants.¹⁶ A precondition to such deployment is the availability of long-term capture and geological storage of CO₂ streams. To ensure timely commercial investment in CCS in the future, the Australian government, in partnership with the research community and the private sector, has in place a development strategy covering many aspects of the CCS innovation chain. It has invested in most parts of this chain, including pre-commercial exploration, research and development in small- to medium-scale CCS projects, and support for large-scale CCS demonstration projects. The Australian government is also the founder of the Global CCS Institute, which was established to accelerate the adoption of carbon capture and storage.

Australia is among the most advanced of the IEA member countries with regard to having developed CCS legal and regulatory frameworks. CCS legislation is currently in place at federal level (for injection and storage in Commonwealth waters) and also for CCS activities onshore in a number of states (Queensland, South Australia and Victoria) although some trans-boundary concerns remain outstanding. Legislation is near finalised in New South Wales and Western Australia.

The IEA commends the commitment of Australia to the development of CCS but notes a risk that delivery of integrated commercial large-scale CCS by 2030 is not guaranteed at this stage. The Draft EWP explores alternative long-term possibilities that the Australian government may consequently need to consider to ensure energy security and sustainable development at affordable prices, including nuclear energy. At present, nuclear energy is prohibited under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.¹⁷

The Draft EWP acknowledges that the only reason to consider the introduction of nuclear power would be the failure to commercialise new low-emissions baseload energy (renewables and CCS) technologies on the scale required by 2050.

DATA QUALITY

High-quality energy data and statistics are the cornerstone of energy policy and an essential element of informed decision making. While most data produced by Australia are of the highest quality, there is room for improvement, particularly with regard to oil and natural gas data. Accordingly, the establishment of the Bureau of Resources and Energy Economics is a positive development.

16. *Carbon pricing and Australia's electricity markets*, the Treasury, Commonwealth of Australia, Canberra, 2011.

17. *Draft Energy White Paper: Strengthening the Foundation for Australia's Energy Future*.

The Draft EWP correctly identifies that an improved and more transparent information base on energy resources, technologies and fuels, including their comparative costs and commercial maturity, is an important complement and input into the policy process. The Draft EWP also proposes a number of measures, notably steps, in consultation with industry, to improve the quality of the Australian petroleum statistics. The IEA welcomes these proposals and urges the government to implement the measures as soon as possible.

OIL STOCKS

The Agreement on an International Energy Program, the treaty upon which the IEA was founded in 1974, includes the commitment of IEA member countries to hold oil stocks equivalent to no fewer than 90 days of the previous year's net imports.

At present, Australia is the only IEA country that fully relies on commercial stockholding of industry to meet its minimum 90-day stockholding obligation. Australia does not have public stock holdings and does not place a minimum stockholding obligation on its domestic oil industry. Previously, when Australia was a net exporter or only a marginal net importer of oil, this reliance on commercial stocks was considered sufficient to meet its IEA requirements. However, this is no longer the case, as Australia becomes an ever larger net importing country, like many other IEA countries.

The IEA strongly recommends that the Australian government take action to become fully and systematically compliant with its IEP stockholding commitment. The establishment of emergency stockholding to meet the minimum IEP commitment would also create the means for Australia to contribute to an IEA collective action in a situation of emergency.

RECOMMENDATIONS

The government of Australia should:

- ☐ *Establish a formal mechanism to monitor and evaluate progress of the medium-term implementation of the proposals contained in the Draft EWP in order to assist the timely and cost-effective delivery of policy.*
- ☐ *Implement measures to improve the quality of energy data.*
- ☐ *Take action to address its 90-day oil stockholding obligation and examine available options to meet this commitment.*

3. CLIMATE CHANGE

Key data (2009)

Total GHG emissions (excl. LULUCF): 546 Mt CO₂-eq, +30.4% since 1990 (base year)

2008-2012 target: +8% from base year

CO₂ emissions from fuel combustion: 384 Mt (+13% since 2000)

Emissions by fuel: coal 53%, oil 30%, natural gas 17%

Emissions by sector: electricity and heat generation 54%, transport 21%, industry 12%, households 2%, services and agriculture 3%, other 8%

OVERVIEW

BACKGROUND

Australia is one of the highest emitters on a per-capita basis in the OECD. In February 2011, the Department of Climate Change and Energy Efficiency (DCCEE) predicted that Australia's emissions will increase by as much as 24% by 2020 compared to 2000 levels, 4% more than the previous year's projections.

The energy sector is responsible for 76% of Australia's greenhouse gas emissions (GHGs). Electricity generation is dominated by coal and emissions from the sector have risen by 75% since 1990. Although emissions have increased, Australia remains on track to meet its Kyoto targets, largely thanks to a commensurate reduction in the rate of deforestation since 1990.

GREENHOUSE GAS TARGETS

Australia is a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and to the Kyoto Protocol. It ratified the Kyoto Protocol in 2007, under which it is committed to a GHG emissions target over the first commitment period (2008-12) of 108% of its 1990 emissions.

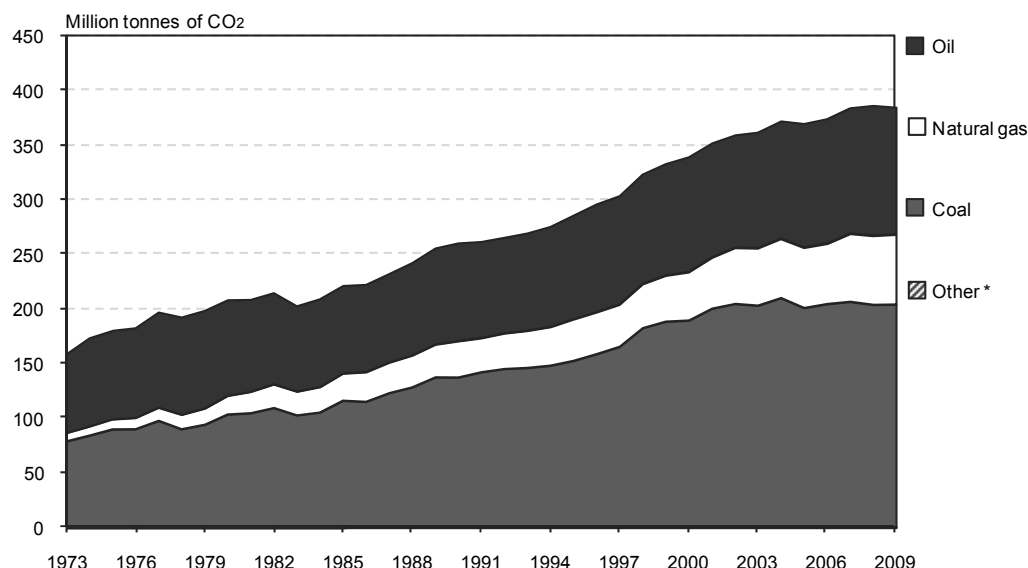
Under the UNFCCC, the Copenhagen Accord and subsequent Cancún Agreements, Australia has pledged emissions cuts of 5% below 2000 levels by 2020 on an unconditional basis, and cuts of between 5% and 15% or 25% compared with 2000 levels by 2020 depending on the actions of other nations. Australia has also committed to reducing emissions to 80% below 2000 levels by 2050. Meeting this range of targets will require a reduction in the current trend in emissions growth.

GREENHOUSE GAS EMISSIONS

Australia remains on track to meet its Kyoto Protocol target of limiting emissions to 108% of 1990 levels without the use of flexibility mechanisms or imported emission permits. Australia's emissions on a Kyoto Protocol accounting basis are projected to reach an average of 581 Mt CO₂-eq per year over the first commitment period (2008-12), which is 106% of 1990 levels.

In the absence of further policy action, emissions in Australia are projected to increase. In 2020, baseline emissions are projected to be 669 Mt CO₂-eq on a Kyoto accounting basis, equivalent to 121% of 2000 levels. The “abatement challenge” provides a measure of the amount of additional abatement or avoided emissions that are required to achieve Australia’s 2020 emissions reduction targets, given the policies and measures that are already in place. To meet the 5% reduction target, the abatement challenge is estimated to be 144 Mt CO₂-eq in 2020. Under the 15% reduction scenario, the abatement challenge is estimated to be 199 Mt CO₂-eq, while under the 25% reduction scenario it is estimated to be 255 Mt CO₂-eq. In 2009, total emissions were 384Mt CO₂; Table 2 shows a breakdown by source.

Figure 6. CO₂ emissions by fuel*, 1973-2009



* Other includes industrial waste and non-renewable municipal waste (negligible).

Source: CO₂ Emissions from Fuel Combustion, IEA/OECD Paris, 2011.

Table 2. Emissions by source, 2009

Coal	Oil	Natural gas	Other
53%	30%	17%	0%

Source: IEA.

PROJECTED EMISSIONS

Australia’s baseline emissions projection is a scenario “with measures” that incorporates all currently implemented and adopted policies and measures. This takes into account a projected 147 Mt CO₂-eq of abatement from existing policies and measures in 2020, including at least 73 Mt CO₂-eq from energy efficiency and renewable energy policies, and 18 Mt CO₂-eq of abatement from policies restricting land-use change.

In the absence of any policies and measures to reduce emissions since 1990 (*i.e.* “business as usual”), it is estimated that emissions would have risen from 631 Mt CO₂-eq in 2007 to 816 Mt CO₂-eq in 2020. A summary of Australia’s emissions projections in Mt CO₂-eq for the “with measures” and “business as usual” scenarios are set out in Table 3, calculated on a Kyoto accounting basis.

Table 3. **Summary of Australia's emissions projections to 2020** (Mt CO₂-eq)

	2007	2015	2020
Business as usual	631	739	816
Baseline ("with measures")	573	617	669

Source: Australia's Fifth National Communication to the UNFCCC.

EMISSIONS FROM FUEL COMBUSTION

In 2009, CO₂ emissions from fuel combustion amounted to 384 Mt, a slight decrease compared to the previous year (385 Mt). From 1990 to 2009, emissions increased by 47% or by an average of 2.1% per year. This increase between 2006 and 2007 came exclusively from the electricity sector.

The electricity and heat sector was the largest emitter, accounting for 54% of total CO₂ emissions in 2009 (other energy industries accounted for a further 6%). Transport accounted for 21% and manufacturing, industry and construction for 12%. In absolute terms, over the past two decades, emissions have grown most in the energy industry (by 96 Mt CO₂), followed by transport (by 21 Mt CO₂). By subsector, road transport is the largest emitter and has also seen the biggest increase in emissions since 1990.

Coal consumption accounted for 53% of total CO₂ emissions in 2009. Oil consumption was the second-largest source of emissions, with 30% of the total, followed by natural gas with 17%. Between 1990 and 2009, 54% of the growth in total CO₂ emissions came from coal, as a consequence of increased production for export. Compared to other IEA member countries, Australia has a very high CO₂ intensity in the electricity sector, with 852 g CO₂ per kilowatt-hour (kWh) in 2009; it is nearly twice the IEA average of 431 g CO₂ per kWh.

In per-capita terms, energy-related CO₂ emissions in Australia are also much higher than the IEA average. With 17.3 tonnes of energy-related CO₂ per capita in 2009, Australia is the second-highest among IEA member countries, after Luxembourg. High per-capita CO₂ levels partly result from emissions in the energy industry.

INSTITUTIONS

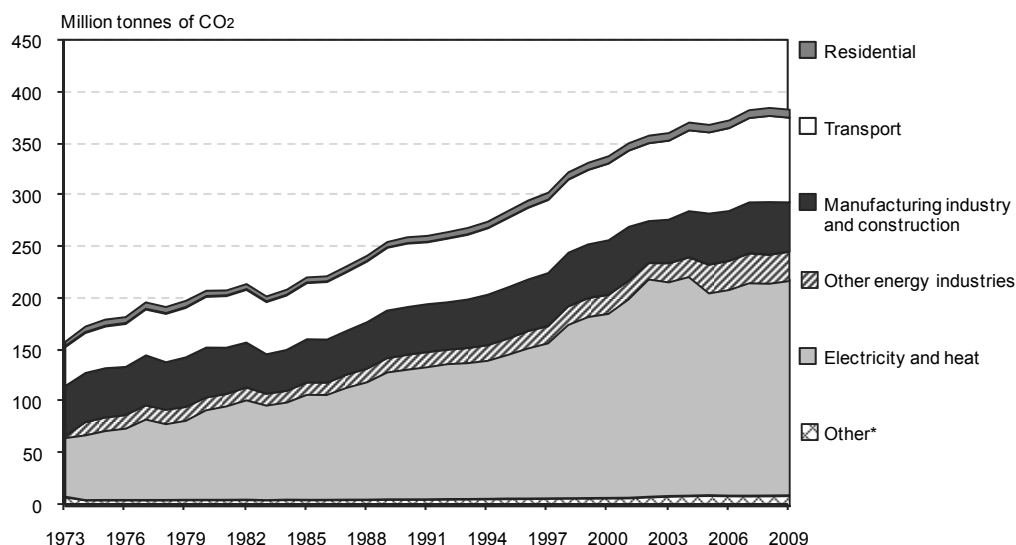
The Department of Climate Change was established in December 2007 and was replaced by the **Department of Climate Change and Energy Efficiency** (DCCEE) in March 2010. The DCCEE has primary responsibility for policy advice, policy implementation, programme delivery and regulatory oversight in four areas:

- reducing Australia's greenhouse gas emissions;
- improving Australia's energy efficiency;
- adapting to climate change; and
- helping to shape a global climate change solution.

The **Department of Resources, Energy and Tourism** (RET) also contributes to the development and implementation of sustainable energy and climate change policies. The department tries to ensure that the policies designed to deliver Australia's emissions reductions do so at least economic cost, while maintaining adequate, reliable and affordable energy supplies, and the international competitiveness of Australian industries.

In 2007, the government announced the establishment of a **Multi-Party Climate Change Committee**. The purpose of the committee was to explore options for implementing a carbon price and building consensus on how Australia will approach the challenge of climate change. Subsequently, in July 2011, the committee released a Clean Energy Agreement, which aims to reduce carbon pollution, provide opportunities for innovation and investment in clean technologies, and reward improved land-use management.

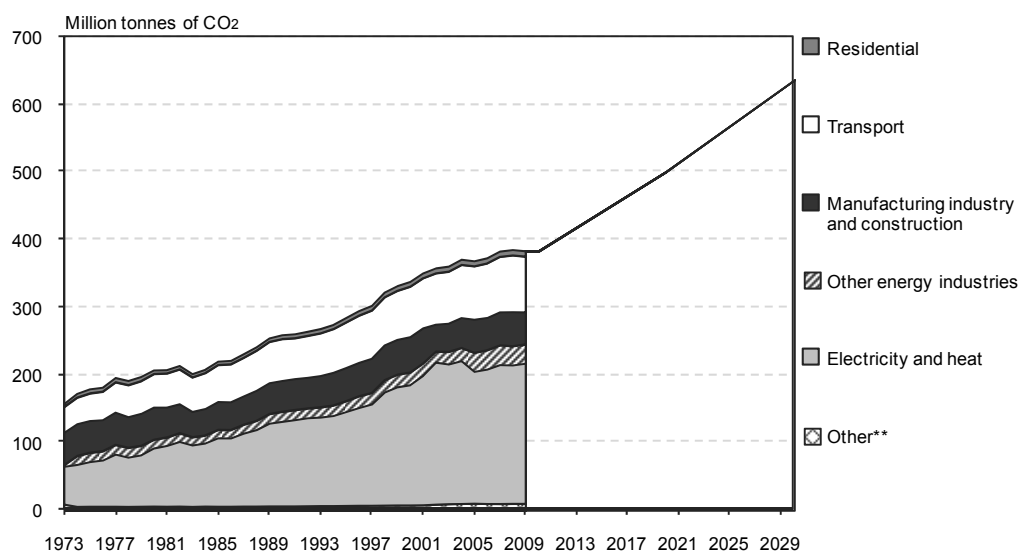
Figure 7. CO₂ emissions by sector, 1973-2009



* Other includes emissions from commercial and public services, agriculture/forestry and fishing.

Source: CO₂ Emissions from Fuel Combustion, IEA/OECD Paris, 2011.

Figure 8. CO₂ emissions by sector*, 1973-2030



* Estimated using the IPCC Sectoral Approach.

** Other includes emissions from commercial and public services, agriculture/forestry and fishing.

Note: this graph shows historical data until 2008 and the government's projections from 2009 to 2030 (no breakdown by sector available).

Source: CO₂ Emissions from Fuel Combustion, IEA/OECD Paris, 2011.

The **Clean Energy Regulator** was established as part of the Clean Energy package and started work on 2 April 2012. It will be the statutory authority responsible for administering the carbon-pricing mechanism, the National Greenhouse and Energy Reporting Scheme, the Renewable Energy Target and the Carbon Farming Initiative.

The **Climate Change Authority** was also established as part of the Clean Energy package to provide advice on pollution caps and progress towards meeting climate targets and undertake reviews of the new carbon-pricing mechanism. It commenced work on 1 July 2012. Other Australian government departments are also involved in the development of climate change policy, and state and territory governments have, in some cases, also implemented their own policies.

POLICIES AND MEASURES

OVERVIEW

Climate change has long formed part of a heated public and political debate in Australia, most recently over the government's plans to introduce an emissions trading scheme, which would be a fixed-price carbon tax for its early years. To date, policy makers have tried to balance a number of interests; the concerns of business and union interests who want more generous assistance for industry, a growing public concern about cost-of-living impacts, and the need to have an ambitious scheme to win the support of the Green Party (whose votes are needed to pass the legislation).

The present Australian government has strongly supported the argument that putting a price on carbon is the most effective way of tackling climate change and maintains a commitment to bipartisan emissions reduction targets.

Following the rejection of the previous proposal, the Carbon Pollution Reduction Scheme legislative package, by the Senate in 2010, the government established the Multi-Party Climate Change Committee. The purpose of the committee was to consult, negotiate and report to the Cabinet, through the Minister for Climate Change and Energy Efficiency, on options for the implementation of a carbon price in Australia; and to provide advice on, and participate in, building community consensus for action on climate change.

In July 2011, *Securing a Clean Energy Future – The Australian Government's Climate Change Plan* was published. It contains the government's comprehensive programme for tackling climate change and securing a clean energy future, including the carbon-pricing mechanism and a range of complementary measures. It outlines the already existing policies to address climate change and cut carbon pollution and introduces several critical new initiatives.

DRAFT ENERGY WHITE PAPER

A *Draft Energy White Paper 2011/ Strengthening the Foundation for Australia's Energy Future* was published for public consultation in December 2011. The paper fulfils the government's commitment to publish a Draft Energy White Paper (EWP) by the end of 2011. Following the completion of the consultation process, the government anticipates that a final EWP will be released late in 2012.

While the Draft EWP does not revisit existing government positions on climate change, it recognises that climate change and other policy areas interact strongly with energy policy. The Draft EWP goes on to recognise that approximately 60% of Australia's greenhouse

gas reductions in 2020 could come from purchasing international abatement. These reductions will be supplemented by the electricity sector, which is expected to provide the second-largest abatement source, some 25% of overall net emissions reductions. The Draft EWP also recognises that the nature and timeframe of any international response to climate change can present a key strategic risk for the energy sector. Australia's ability to manage its long-term climate change goals crucially depends on its ability to attract required investment and to successfully deploy a suite of low-emissions technologies. Notably, the Draft EWP acknowledges that the federal government will seek agreement from all Australian governments to a review of existing climate policy measures.

NATIONAL GREENHOUSE AND ENERGY REPORTING

The National Greenhouse and Energy Reporting (NGER) Act 2007 established a system for constitutional corporations to report their greenhouse gas emissions alongside consumption and production of energy to the Australian government.

If a corporate group meets a reporting threshold, the controlling corporation must report on all facilities under the operational control of members of the group; this includes facilities that meet their threshold (25 kt CO₂-eq emissions or 100 terajoules of energy consumption/production). The Clean Energy Regulator publishes totals for registered corporations by 28 February following each reporting period, which runs from 1 July to 30 June each year.

To date, two years of NGER reporting have been completed and 772 controlling corporations were registered in 2010/11, up from 692 in 2008/09. Approximately 70% of greenhouse gas emissions in covered sectors is reported under NGER.

CARBON POLLUTION REDUCTION SCHEME

In 2009, the government presented the Carbon Pollution Reduction Scheme (CPRS) legislative package to Parliament. The legislation was passed by Australia's lower house of Parliament in 2009, but agreement was not reached in the Senate.

The CPRS was intended to help meet Australia's commitment to a 5% cut in greenhouse gas emissions on 2000 levels by 2020 (or 25% in the event of a comprehensive global agreement) and was to commence in 2011. It covered all six Kyoto Protocol gases (carbon dioxide, methane, nitrous oxide, hydrofluorocarbon, perfluorocarbon and sulphur hexafluoride), in around 1 000 installations in the energy, industrial and transport sectors. Agricultural emissions were excluded, although the original scheme design had allowed for their inclusion. Emissions from deforestation were exempt, but afforestation activities could opt in to the scheme.

CLIMATE CHANGE PLAN: SECURING A CLEAN ENERGY FUTURE

In July 2011, the Australian government released and updated significant climate, energy and resources policies in one document: *Securing a Clean Energy Future*. The plan brought together a number of existing policies and introduces several new initiatives. It contains four main elements:

- the introduction of a carbon price;
- a renewable energy expansion;
- energy efficiency improvements; and
- action on the land.

The subsequent Clean Energy Legislative Package, which was passed by the Senate on 8 November 2011, sets out the way in which the carbon-pricing mechanism was implemented from 1 July 2012. It also includes measures to support industry and jobs in emissions-intensive trade-exposed industries, provisions to maintain energy security, governance mechanisms, and a series of related clean energy programmes.

Box 1. The Garnaut Climate Change Review

The Garnaut Climate Change Review, led by Professor Ross Garnaut, was commissioned by Australia's Commonwealth, State and Territory Governments in 2007. The purpose of the review was to conduct an independent study of the impacts of climate change on the Australian economy. The Review's Final Report was released on 30 September 2008. It recommended policy frameworks to improve the prospects for sustainable prosperity. In November 2010, the Australian government requested Professor Ross Garnaut to provide an update of the review.

The outcome of this review, the Garnaut Climate Change Review – Update 2011, was released in the form of a series of papers in early 2011. These papers examined developments across a range of subjects including climate change science and impacts, emissions trends, carbon pricing, technology, land and the electricity sector. The final report was presented to the government in May 2011.

Among its many recommendations, the final report proposed a fixed price emissions trading scheme for three years, starting in the range of AUD 20 to AUD 30 per tonne of carbon dioxide-equivalent, rising at 4% in real terms and then moving to a flexible price scheme that was an internationally linked scheme. The final report also recommended some sale by auction of permits for use after the first three years with revenue from the emissions trading scheme directed to three groups of recipients: Australian households; businesses; and innovation technology.

Source: *The Garnaut Climate Change Review Update 2011*.

Carbon price

Under the carbon-pricing mechanism, Australia's largest emitters will need to acquire and either surrender to the government a permit for every tonne of carbon pollution they produce or pay a charge. For the first three years, the carbon price will be fixed, at AUD 23 a tonne rising by 2.5% a year in real terms, before moving to an emissions trading scheme in 2015.

Earlier in 2011, the Multi-Party Climate Change Committee (MPCCC) published a document, which contained a proposed carbon-pricing mechanism. The proposal had been agreed by the government and Greens, and independent members of the committee. The proposal contained the following elements, many of which were incorporated into the final mechanism:

- A fixed carbon-price mechanism could commence as early as July 2012. The mechanism could be converted to a cap-and-trade emissions trading scheme. The timing of the mechanism is subject to the ability to negotiate agreement with a majority in both houses of Parliament and pass the relevant legislation.
- The fixed price phase could be between three and five years, with the price increasing annually at a predetermined rate. The purpose of the initial fixed price is to begin to

drive economic transformation and investment in low-emission technologies, and ensure greenhouse gas emissions reductions. At the end of the fixed-price phase, the clear intent would be that the scheme will convert to a flexible price cap-and-trade emissions trading scheme.

Clean Energy Legislative Package

The Clean Energy Legislative Package was passed by the Australian Senate on 8 November 2011 and was signed into law soon after. The complete package contains a series of laws to support the implementation of the Clean Energy Future Package including laws providing for the establishment of the Climate Change Authority and the Clean Energy Regulator.

The Clean Energy Act 2011 is the cornerstone of the package; it establishes the carbon-pricing mechanism and deals with assistance for emissions-intensive trade-exposed industries (the Jobs and Competitiveness Program) and the coal-fired electricity generation sector.

It also contains rules for who is covered, the Opt-in Scheme for liquid fuel-users, what sources of carbon pollution are included, the surrender of emission units and shortfall charges, caps on the amount of carbon pollution from 1 July 2015, international linking, monitoring, enforcement, appeal and review provisions.

It sets out the way in which the carbon-pricing mechanism which started on 1 July 2012 will be applied. The package legislated for a two-stage approach to carbon pricing:

- A fixed-price period: The carbon-pricing mechanism commenced on 1 July 2012, with a price that will be fixed for the first three years. The price started at AUD 23 per tonne and will rise by 2.5% each year in real terms.
- An emissions trading scheme: On 1 July 2015, the carbon price will change to a fully flexible price under an emissions trading scheme, with the price determined by the market.

The scheme will have broad coverage from the outset and include the stationary energy sector, transport, industrial processes, non-legacy waste, and fugitive emissions. The carbon price will not apply to household transport fuels, light-vehicle business transport and off-road fuel use by the agriculture, forestry and fishing industries. An effective carbon price will be applied to domestic aviation, domestic shipping, rail transport, and non-transport use of fuels. Users of these fuels can opt-in to the mechanism under the Opt-in Scheme.

The Australian scheme will be linked to credible international carbon markets and emissions trading schemes from the commencement of the flexible-price period. At least half of a liable party's compliance obligation must be met through the use of domestic permits or credits.

A price ceiling and floor will apply for the first three years of the flexible carbon-price period. The price ceiling was set at AUD 20 above the expected international price and will rise by 5% in real terms each year. Originally, a price floor set at AUD 15 rising by 4% each year was proposed but this is being replaced by a quantitative limit on the use of international emissions units (CDM credits) and a link with the EU emissions trading scheme.

A Jobs and Competitiveness Program will provide significant support for jobs and protects the competitiveness of these emissions-intensive trade-exposed industries. This ongoing programme will provide around AUD 8.6 billion of support over the first three

years of operation. An Energy Security Fund will be established to ensure there is a smooth transition in order to preserve energy security. This scheme will include an allocation of free carbon units and cash payments to strongly affected coal-fired electricity generators and is seeking to negotiate closure of up to 2 000 megawatts (MW) of highly polluting coal-fired generating capacity by 2020.

Renewable energy expansion

Australia has put in place a number of policies to support the development and expansion of renewable energy. As part of the package, the government is also providing significant financial support for innovation in clean energy technologies. A new AUD 10 billion commercially oriented Clean Energy Finance Corporation will invest in renewable energy, low-pollution and energy-efficient technologies.

A new Australian Renewable Energy Agency will administer AUD 3.2 billion in government support for research and development, demonstration and commercialisation of renewable energy. Australia also has a target of 20% of its electricity to come from renewable sources by 2020.

Energy efficiency improvements

The government recognises that there is considerable scope to improve energy efficiency throughout the economy. In October 2010, the government published the report of the Prime Minister's Task Group on Energy Efficiency. The Task Group was charged with examining the most economically and environmentally effective ways of delivering a step change in energy efficiency performance. The Task Group made six recommendations among which was the recommendation to agree an aspirational national energy efficiency target of improving Australia's primary energy intensity by 30% between 2010 and 2020.

The government supported all but one recommendation, that for the aspirational target, agreeing instead, among other things, to investigate the possibility of a national energy savings initiative and to undertake further work on national energy efficiency governance arrangements, for consideration by the end of 2012. This subject is covered in greater detail in Chapter 4.

Action on the land

The government decided to exclude the agricultural and land sectors from the new carbon-price mechanism. Instead, it is looking at ways to ensure that farmers and land managers who use their skills, experience and knowledge of the land to lower carbon pollution are rewarded for their efforts. The plan contains the following measures:

The Carbon Farming Initiative

The Carbon Farming Initiative is a carbon offsets scheme that will allow farmers and land managers to generate carbon credits that can then be traded. Legislation for the Carbon Farming Initiative was introduced to Parliament in March 2011 to provide long-term certainty to participants and to protect the environmental integrity and market value of carbon credits.

Credits generated under the Carbon Farming Initiative that are recognised for Australia's obligations under the Kyoto Protocol on climate change can be sold to companies with

liabilities under the carbon-pricing mechanism. The scheme includes credits earned from reforestation, savanna fire management and reductions in pollution from livestock and fertiliser.

Biodiversity Fund

The government will provide funding of AUD 946 million over the first six years for landholders to undertake projects that establish, restore, protect or manage biodiverse carbon stores.

Box 2. The Australian Treasury modelling of a carbon price

The Deputy Prime Minister and Treasurer, and the Minister for Climate Change and Energy Efficiency commissioned the Australian Treasury to model the impact of any carbon price on the economy and to inform policy design and public discussion about carbon pricing.¹⁸

The outcome of this analysis, the *Strong Growth Low Pollution: Modelling a Carbon Price* (SGLP) report, was published on 10 July 2011. An update to the report was released on 21 September 2011. The revised version takes into account two additional scenarios: one that reflects the Clean Energy Future Package endorsed by the Multi-Party Committee on Climate Change (MPCCC), with a starting carbon price of AUD 23 per tonne of CO₂-eq instead of the AUD 20 per tonne of CO₂-eq modelled in the earlier report; and one that also includes additional government policy measures.

The first report presented economy-wide modelling scenarios with starting carbon prices in 2012/13 of AUD 20 and AUD 30 per tonne of CO₂-eq, growing at 5% per year plus inflation before moving to a flexible price. The AUD 20 core policy scenario has a slightly lower carbon price path over the first three years than agreed by the MPCCC, which is for a starting price of AUD 23 per tonne of CO₂-eq, growing by 2.5% per year plus inflation.

The updated modelling projects that the Australian economy will continue to grow strongly while emissions are reduced under the new higher carbon-price scenario. The modelling update also found that the higher starting price reduces domestic emissions by an additional 5 Mt CO₂-eq in total over the first three years of the scheme and confirmed the estimated 10% increase in electricity prices in 2012/13 from the carbon pricing presented in the original report.

Carbon Farming Futures

Under the Carbon Farming Futures initiative, the government plans to invest an additional AUD 201 million (over the first six years of the programme) for research into new ways of storing carbon and reducing pollution in the land sector. Funding will target emerging technologies and innovative management practices by engaging more scientists and independent experts to improve soil carbon, reduce pollution from livestock and crops, and enhance sustainable agricultural practices.

Indigenous Australians

The government will provide support to assist Aboriginal and Torres Strait Islanders to participate in the Carbon Farming Initiative. Indigenous Australians are responsible for the management of approximately 20% of the Australian land mass, drawing on traditional knowledge of the landscape and its responses to fire, flooding and drought.

18. *Strong Growth Low Pollution: Modelling a Carbon Price*, the Treasury, Government of Australia, July 2011.

The Indigenous Carbon Farming Fund (AUD 22 million over its first five years) will assist Indigenous communities to benefit from the Carbon Farming Initiative.

The Regional Natural Resource Management Planning for Climate Change Fund

The government will provide AUD 44 million over five years for natural resource management for regional organisations to plan climate change impacts. It will also support research and analysis to develop scenarios on regional climate change impacts which can be used for natural resource management and land use planning.

INTERNATIONAL MEASURES

The internationally agreed rules for the clean development mechanism (CDM) and joint implementation (JI), under the Kyoto Protocol, establish that Parties participating in the CDM and JI must establish a designated national authority (DNA) and a designated focal point (DFP) to approve private entities' participation in CDM and JI projects respectively. Australia's DNA and DFP are grouped into a single body within the Department of Climate Change and Energy Efficiency (DCCEE) called Australia's National Authority for the CDM and JI. Up to now, there have been no JI projects hosted in Australia; the National Authority has only approved JI projects and participation in JI projects in other Annex I countries.

However, with the advent of the Carbon Farming Initiative, the government has decided that projects under this initiative which generate Kyoto-compatible abatement during the first commitment period of the Kyoto Protocol (2008-12) may apply to be recognised as JI projects as well. This will enable the project proponents to exchange their credits from the Carbon Farming Initiative for internationally recognised Kyoto credits which can be readily traded in global carbon markets.

CRITIQUE

The government of Australia has recently concluded a sometimes contentious national debate and legislative process on the appropriate instrument, its design, and its stringency for reducing carbon dioxide emissions. Australia is one of the highest emitters on a per-capita basis in the OECD, but emits only 1.5% of global emissions. In February 2011, the Department of Climate Change and Energy Efficiency predicted Australia's emissions will increase by as much as 23% by 2020 compared to 2000 levels, 3% higher than last year's projections.

A Carbon Pollution Reduction Scheme (CPRS), based on emissions trading, was announced in 2008 but failed to pass the Australian Senate at the end of 2009. On 10 July 2011, the government announced a carbon price commencing on 1 July 2012, with a fixed price phase of three years' duration to be followed by a shift to a flexible price under an emissions trading system. A package of legislation outlining the new arrangements was passed into law in November 2011.

The IEA compliments Australia on the breadth of this mechanism. There is support for trade-exposed industries (they receive free allocation), and one-off compensation paid to the most polluting coal-fired power generators. Special transition plans are proposed for the coal mining and steel industries. There will also be negotiated payments to shut down 2 gigawatts (GW) of the most emissions-intensive electricity generation.

From 2015, participants are allowed to use international credits (from CDM or any other overseas emissions trading scheme) for up to 50% of their obligations. An independent expert committee – the Climate Change Authority – will be established to provide advice on setting caps for the trading scheme and will undertake regular reviews. The Productivity Commission will regularly review industry's assistance levels in line with international action on climate change.

The scheme also includes a AUD 10 billion new commercially oriented Clean Energy Finance Corporation which will invest in renewable energy, low-pollution and energy-efficient technologies. This is just one of a set of measures to complement the pricing system. The scheme includes measures to assist less affluent Australians in dealing with the increased cost of energy from the pricing system.

The IEA supports carbon pricing – it is the most effective tool there is for reducing emissions, and it is a very important part of cost-effective climate change policy. It is very encouraging to see the announcements from Australia, Korea and China that they intend to implement emissions trading schemes. In 2010, the IEA published a review of existing ETS designs, based on international experience, and found some key emerging design lessons.¹⁹ The Australian proposal fits well with these lessons: it has wide coverage, it seeks to avoid windfall profits, it provides flexibility by having a phase-in period, and there will be regular reviews.

The proposal will cover stationary energy, industry, waste, fugitive emissions, and some transport fuel use. Transport fuels used by domestic consumers are exempted. The scheme phases in gradually. It has a fixed-price transition period starting in July 2012, then a transition to a full trading scheme in July 2015. There will be a price cap until 2018.

The IEA review, however, recommends no free allocation for electricity generators, but Australia provides some as a one-off transition measure. The IEA paper also notes that there will need to be compromises in the early stages of every scheme, and the nature of these will be different in each jurisdiction. In the case of Australia, the government has introduced transitional measures to ensure energy security and market stability through targeted support for emissions-intensive electricity generators that make up a significant part of the generation system. The transitional assistance will require generators to prepare and annually lodge an updated Clean Energy Investment Plan with the Minister for Resources and Energy.

The IEA supports complementing the carbon price with a package of energy efficiency and technology development measures. The IEA view is that a package of all three of these is needed for a cost-effective climate policy response – and all three need to be designed to support rather than undermine one another. The IEA also welcomes the agreement between Australia and New Zealand to strengthen links between their emissions trading schemes.

The policy to actively negotiate retirement of old sunk coal plants is very interesting. Globally, there will be a need for significant retirement of existing plants before the end of their technical life – an issue that was explored in the *World Energy Outlook 2011*. Countries are just beginning to think about policies to manage this transition at reasonable cost.

19. *Reviewing Existing and Proposed Emissions Trading Systems*, Information Paper, IEA Paris, November 2010.

The biggest challenge for all countries is to make their climate change targets more ambitious: countries have acknowledged as part of the Cancún Agreement that the pledges put forward so far are not yet sufficient to reach the agreed two degrees goal. Rather than waiting for an international agreement to be completed, it is the IEA view that getting on with implementing good policy helps: the more countries gain experience with actual implementation of climate policy, the more comfortable they may be in increasing their level of commitment.

The IEA also commends government proposals to use revenues from the carbon-price mechanism to fund energy efficiency programmes in the industrial, transport, residential, commercial and small business sectors where these interventions do not unduly distort the market and where they complement the introduction of a price on carbon. We also understand that householders will be compensated. While it is difficult in times of rising electricity prices to institute a carbon price, the effects on the most vulnerable residential and commercial sector could be offset by increased energy efficiency as well financial compensation.

The carbon price will also impact on the building stock both new and old. Slow capital stock turnover reduces the effectiveness of some of the proposed measures as they only apply to new capital. Experience with such vintage-based approaches in other countries is that they retard capital stock turnover even more as investors turn to refurbishment rather than new builds owing to increased performance uncertainty and cost of newer technologies.

The Australian government should consider extending incentives not only to new builds but also to influencing the refurbishment decision. While it is true that a carbon price would operate in the totality of the investment decision, it is nevertheless possible that the structure of other incentives may have vintage differentiation impacts which should be considered in government policy to both affect new builds, but also to keep existing capital very productive and environmentally responsible.

A successful mitigation strategy has elements that empower emissions reductions in various periods over time. From near-term measures that largely save energy to research and development (R&D), which will make available the low-emitting technologies of the future. While a price/trading system is effective in every period and the absence of an implemented system is a policy deficiency, there are other measures in place in Australia. A good example is the energy-related R&D programme, which targets technologies on the basis of Australia's comparative advantage and potential. Not all technologies are included, but the programme is significant, focused and can be expected to deliver some of the technologies that the market will need to cost-effectively respond to the more aggressive mitigation requirements in the future.

Historically, those countries with the most indigenous fossil fuel resources have the most difficulty politically in proposing carbon pricing. When Australia implements this scheme, it will be the first major fossil energy resource-rich economy to take the most cost-effective mitigation measure. Given recent economic events internationally and in Australia, the government is to be commended for taking a least-cost approach to emissions reductions and international leadership. This is an example of the standard of leadership that the IEA has been calling for so that the energy sector can be protected from sudden and vacillating climate policy that paralyses investors and disrupts energy markets.

RECOMMENDATIONS

The government of Australia should:

- ☐ *Continue to develop energy efficiency policies to unlock low-cost abatement, and technology policies to lower the cost of renewable energy, carbon capture and storage, and other technologies for the long term. These policies interact with the carbon price, so need to be carefully designed as a package.*
- ☐ *Take into account that different sectors have varying ability to pass on carbon costs, so the level of any compensation to them should not necessarily be the same.*
- ☐ *Ensure that the carbon-pricing mechanism is flexible and transitional, to allow for phase-outs of overgenerous allocations, and for changing international commitments.*

4. ENERGY EFFICIENCY

Key data (2010)

Energy supply per capita: 5.5 toe (IEA average: 4.7)

Energy intensity: 0.15 toe per 1 000 USD (IEA average: 0.15), -15% since 2000

Total final consumption: transport 38%, industry 36%, residential 13%, services and agriculture 12% (IEA average: transport 32%, industry 32%, residential 20%, other 16%)

OVERVIEW

Largely because of its relatively inexpensive energy prices, and the dominance of energy intensive industry, Australia's energy intensity is higher than the average in IEA member countries. Nonetheless, over time, Australia's economy has become more service-driven resulting in a decrease in energy intensity, adjusted for purchasing power parity (PPP), of around 1.7% per year between 1990 and 2007.

FINAL ENERGY USE

FINAL CONSUMPTION PER SECTOR

Total final consumption (TFC) of energy increased steadily in recent decades at an average rate of 1.7% per year since 1990, reaching 75 million tonnes of oil equivalent (Mtoe) in 2010. Transport is the largest energy-consuming sector with 38% of TFC. The industry sector is the second-largest with 36%, followed by the residential sector with 13% and the service and agriculture sector with 12% in 2009.

Among IEA member countries, Australia has the lowest share of energy consumption in residential and service sectors. On the other hand, the transport and industry sectors are among the highest, respectively fifth- and sixth-largest share of TFC among IEA member countries.

In the industry sector, energy consumption amounted to 27.5 Mtoe in 2010. Fossil fuels make up 70% of this amount, electricity accounts for 23%, and biofuels and waste for 7% of final energy consumption in industry. In the transport sector, energy consumption has increased at a similar rate as other sectors, growing by 36% since 1990. The amount of biofuels consumed by the transport sector has doubled between 2007 and 2009.

ENERGY INTENSITY

Energy intensity, measured as the ratio of energy supply by GDP, decreased by 15% since 2000, but most of this decrease took place at the beginning of the decade. Since 2004 the evolution has been relatively flat. Australia is close to the IEA average energy intensity. Looking at energy intensity by sector, Australia has the highest energy intensity in the manufacturing industry sector among IEA member countries. This is largely because of the large proportion of energy-intensive industries in the country.

Figure 9. Total final consumption by sector and by source, 1973-2010

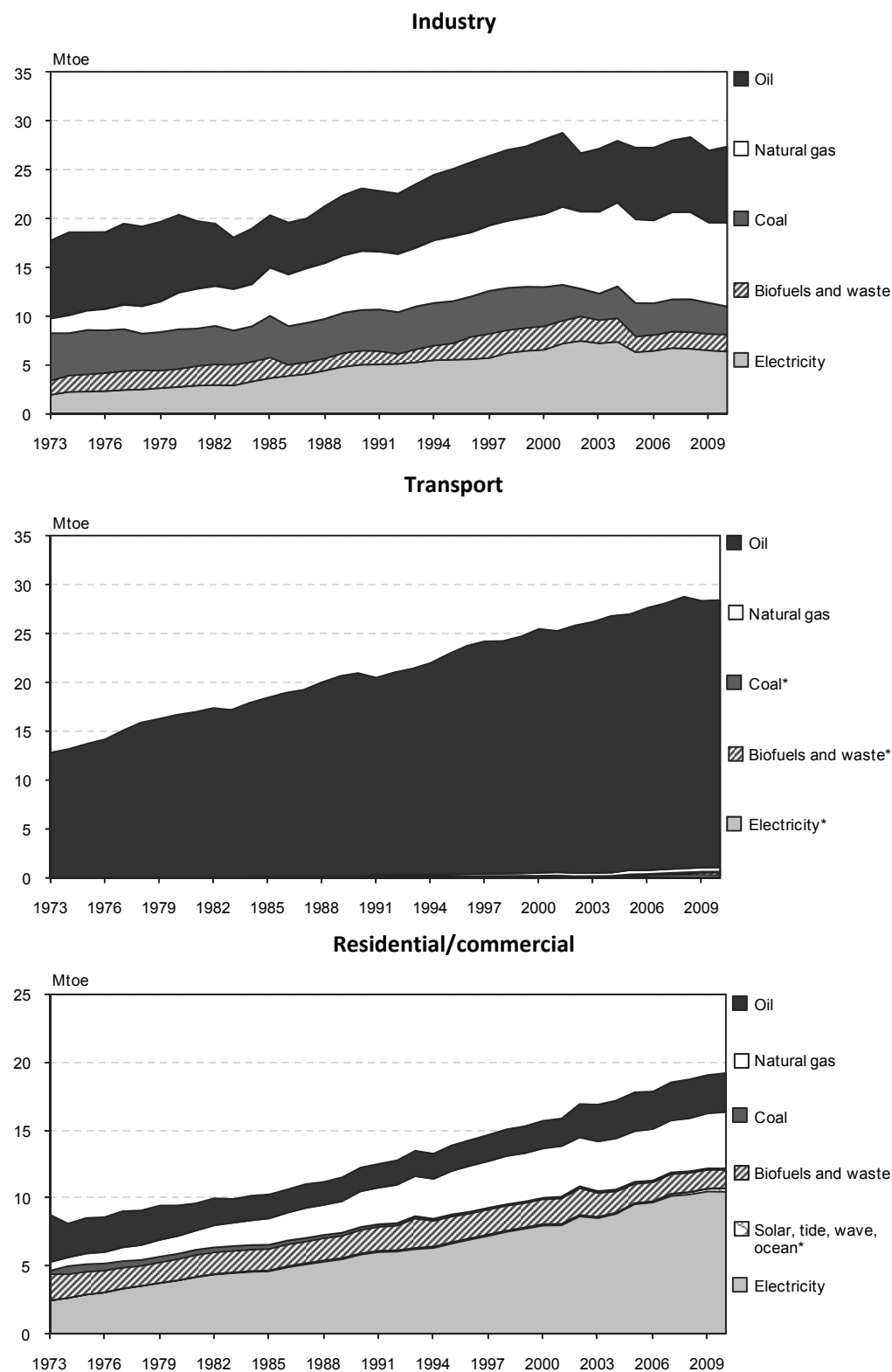
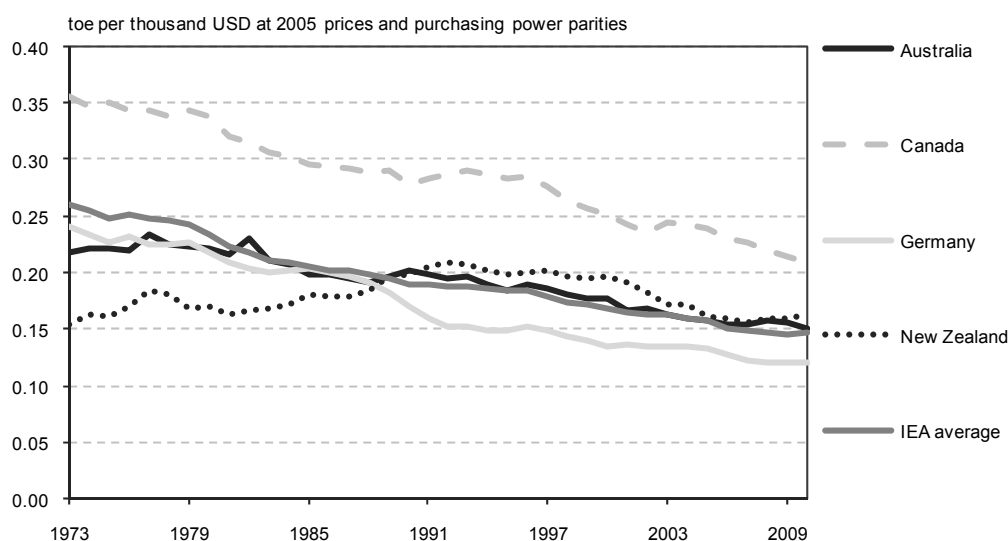
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011.

Figure 10. Energy intensity in Australia and in other selected IEA member countries, 1973-2010



Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011 and *National Accounts of OECD Countries*, OECD Paris, 2011.

INSTITUTIONS

The federal system of government means that the responsibility for energy efficiency policy is spread across different levels of government. Energy efficiency policy is co-ordinated with state and territory governments through the **Council of Australian Governments'** (COAG) **Select Council on Climate Change (SCCC)**.

The SCCC was established on 18 January 2012 to support an effective response on climate change policy issues with national implications and to provide a forum for the Australian government to engage on implementation issues. The SCCC will now oversee the National Partnership Agreement on Energy Efficiency (NPA-EE), including the National Framework on Energy Efficiency (NFE) and the National Strategy on Energy Efficiency (NSE), described under Policies and Measures below.

The SCCC is chaired by the Federal Minister for Climate Change and Energy Efficiency with membership comprising state, territory and New Zealand government climate change and environment ministers, and a representative from the Australian Local Government Association.

Since the last in-depth review in 2005, the **Department of Climate Change and Energy Efficiency (DCCEE)** has been established to assist in Australia's transition to a low-carbon economy. DCCEE is the lead policy maker on energy efficiency policy. The **Department of Resources, Energy and Tourism (RET)** has direct responsibility for industrial energy efficiency; it administers the Energy Efficiency Opportunities Program.

As part of the Clean Energy Future Plan, a **Climate Change Authority (CCA)** is being established as an independent body to provide advice on the Australian government's policies for reducing carbon pollution. The CCA is to be established by legislation as an independent body to provide expert advice on key aspects of the carbon-pricing mechanism.

DATA AND RESEARCH

Formed in July 2011, The **Bureau of Resources and Energy Economics (BREE)** is a professionally independent, economic and statistical research unit within the Department

of Resources, Energy and Tourism (RET). BREE provides high-quality data, forecasts and research on resources and energy, including energy use in the transport sector from an economic perspective.

The **Bureau of Infrastructure, Transport and Regional Economics** (BITRE) regularly publishes data on the fuel efficiency of new light-vehicle sales in Australia (for the 2009/10 estimate, see *BITRE Information Sheet 30*). BITRE is completing a project linking past fleet fuel efficiencies by vehicle type with transport fuel use, and relating this to overall fuel use in Australia.

POLICIES AND MEASURES

DRAFT ENERGY WHITE PAPER

A *Draft Energy White Paper 2011: Strengthening the Foundation for Australia's Energy Future* was published for public consultation in December 2011. The paper fulfils the Australian government's commitment to publish a Draft Energy White Paper (EWP) by the end of 2011. Following the completion of the consultation process, the government anticipates that a final EWP will be released late in 2012.

The Draft EWP points to the availability of evidence from government energy programmes and research suggesting that there is potential to improve energy use productivity or improve end-use energy efficiency. Key actions identified in the Draft EWP include further work (with states and territories and energy market institutions) to improve energy productivity and a review of energy efficiency governance structures.

NATIONAL FRAMEWORK ON ENERGY EFFICIENCY

Previously through the NFEE, COAG worked to define the future framework of national energy efficiency policy in Australia's residential, commercial and industrial sectors. In August 2004, the Ministerial Council on Energy agreed a comprehensive set of measures comprising the first stage of the NFEE.

In December 2007, ministers agreed to the second stage of NFEE. NFEE Stage Two comprised of a package of five new energy efficiency measures for delivery. Implementation committees were established to deliver NFEE. The implementation committees covered energy efficiency measures relating to buildings; commercial and industrial; appliances and equipment; government; trade and professional training and accreditation; consumer information; green leases; water heating; inefficient lighting; heating, ventilation and air-conditioning; and data gathering. The NFEE concluded on 30 June 2011 and its work continues through the National Strategy on Energy Efficiency (NSEE) which is outlined below.

NATIONAL PARTNERSHIP AGREEMENT ON ENERGY EFFICIENCY

On 2 July 2009, COAG agreed to a National Partnership Agreement on Energy Efficiency (NPA-EE). The NPA-EE established a co-operative approach to delivering and implementing energy efficiency measures across all Australian jurisdictions to assist the transition towards a low-carbon economy.

In July 2009, COAG agreed to a new comprehensive ten-year NSEE to accelerate energy efficiency improvements for households and businesses across all sectors of the economy. The NSEE, under the NPA-EE, is currently the main mechanism for co-ordinating energy efficiency policy between the federal, state and territory governments.

The NSEE is intended to accelerate energy efficiency efforts, streamline roles and responsibilities across levels of government, and help households and businesses prepare for the introduction of a carbon-price mechanism. The NSEE is a landmark agreement between federal, state and territory governments designed to substantially improve minimum standards for energy efficiency and accelerate the introduction of new technologies through improved regulatory processes and by addressing barriers to the uptake of new energy-efficient products and technologies.

The NSEE is designed to improve energy efficiency by implementing 37 measures under the following themes: assisting households and businesses to move to a low-carbon future; reducing impediments to the uptake of energy efficiency; making buildings more efficient; and government working in partnership and leading the way.

In combination, NSEE measures are expected to deliver a total of 42.6 Mt of CO₂-eq abatement in calendar year 2020. Total funding for NSEE measures, incorporating Australian government and state/territory funds, is AUD 88.3 million for the initial four-year period of its operation, with further funding to be agreed.

PRIME MINISTER'S TASK GROUP ON ENERGY EFFICIENCY

The Prime Minister's Task Group on Energy Efficiency (the Task Group) advised the Australian government in 2010 on options to improve Australia's energy efficiency by 2020. The Task Group submitted a report to government which set out recommendations to deliver a step-change improvement in energy efficiency and place Australia to the front of OECD energy efficiency improvements by 2020. To inform and advise the Task Group, the government established an Advisory Group with experts from industry and non-governmental organisations, and sought the views of a wide range of stakeholders in preparing the report,

The Task Group report was published in October 2010 and set out measures that, taken together, could provide the basis for a marked improvement in Australia's energy efficiency performance. The Task Group made six broad recommendations:

- an aspirational national energy efficiency target of improving Australia's primary energy intensity by 30% between 2010 and 2020;
- the introduction of a transitional national energy savings initiative to replace existing and planned state energy efficiency schemes, subject to detailed consultation on its design;
- further work that will outline new national governance arrangements for consideration by the Council of Australian Governments;
- improve the data, information and analysis tools necessary to enable energy efficiency innovation, track the national target and underpin future policy development;
- development and design of a long-term national strategy to build a culture of energy efficiency; and
- consider the suite of other sectoral proposals in the report aimed at addressing specific barriers to energy efficiency improvement in particular areas of the economy.

The Task Group made clear that the most important element towards accelerating Australian energy efficiency performance is the presence of an explicit price on carbon.

Government response to the Task Group

In the Australian government's "Securing a Clean Energy Future" plan, the government recognised the findings of the Task Group but did not support proceeding with the implementation of an aspirational national target. Instead, the government agreed to focus its efforts on the other recommendations contained in the report.

The government will consider the development of a national energy savings initiative and will examine further how such a scheme may assist households and businesses to adjust to rising energy costs. The Minister for Climate Change and Energy Efficiency and the Minister for Resources and Energy will undertake further work on national energy efficiency governance arrangements, for consideration by the end of 2012.

The government will also:

- commission the Australian Bureau of Statistics to improve the extent and availability of household energy use data, filling a critical gap in national data;
- provide advice to households, small and medium-sized businesses and the community sector to assist them in managing rising energy costs;
- extend the Energy Efficiency Opportunities Program to include electricity generators, energy transmission and distribution networks, major greenfield and expansion projects and establish a voluntary scheme for medium-sized energy users (for more details, see Box 3); and
- implement mandatory carbon dioxide standards for light vehicles.

NATIONAL ENERGY SAVINGS INITIATIVE

Under the Clean Energy Future Plan, the Australian government committed to do further work to investigate the merits of a possible national Energy Savings Initiative (ESI). Accordingly, the government established an ESI Working Group to:

- draw together the experiences and lessons learned from Australian and international energy savings schemes;
- commission economic and energy market modelling; and
- undertake comprehensive consultation with state and territory governments, industry and the community.

Subject to the findings of economic modelling and a regulatory impact analysis, the Australian government will take a final decision on whether to adopt a national ESI. A national scheme would be conditional on the agreement of the Council of Australian Governments and the abolition of existing and planned state schemes.

SECTOR POLICIES

RESIDENTIAL SECTOR

Phase-in of mandatory disclosure of residential buildings (NSEE)

Mandatory disclosure of residential building energy, greenhouse and water performance at the time of sale or lease:

- The objective of mandatory disclosure is to provide credible and meaningful information to potential home buyers or tenants to assist them in taking purchase/lease decisions, in order to lead to improved energy, greenhouse and water performance of existing homes.
- Expected costs and energy savings of this measure are subject to the outcomes of a Regulatory Impact Analysis (RIA). This policy measure is still at the development stage. Extensive consultation against a draft regulation impact statement took place over July-September 2011 with industry stakeholder groups and the public.
- Consideration of the information provided through public consultation has led to further work being undertaken by the federal, state and territory governments to more clearly distinguish the differences between single title, strata title, owner occupier and rental property markets, and how these differences would be best reflected in a performance disclosure scheme for the residential property sector. Further work is also being done by governments to refine a number of key cost and benefit parameters in order to improve the economic modelling of scheme options. A decision on the Regulation Impact Statement is expected to be delivered by the end of 2012.

Phase-out of greenhouse-intensive (electric) water heaters in existing homes (NSEE)

Currently, about 50% of Australia's eight million homes get their hot water from electric water-heating systems. These systems produce up to three times more greenhouse gas emissions than solar or other low-emission water heaters and account for a quarter of a households' energy use. The federal, state and territory governments have agreed to phase out greenhouse-intensive (electric resistance) water heaters in Australian houses. The phase-out will apply in all states and territories except Tasmania.

The phase-out is targeting existing detached, terraced and town houses – Class 1 buildings under the Building Code of Australia. Apartments, flats and high-rise buildings are defined as Class 2 buildings. Restrictions are already in place for the installation of greenhouse-intensive water-heating systems in new Class 1 buildings. Each state and territory is responsible for implementing its own phase-out programmes for existing houses, and making necessary changes to plumbing regulations. South Australia and Queensland currently have restrictions in place for some existing houses in gas-reticulated and metro areas. During 2012, the phase-out will extend to cover all Class 1 buildings across the country (except in Tasmania).

To assist industries adjust to the shift towards low-emission technologies, training programmes and materials have been developed and are available for download. Research projects investigating the costs and benefits of extending the phase-out to include new Class 2 buildings are currently under way.

COMMERCIAL SECTOR

Building Code of Australia (commercial buildings) (NSEE)

The energy efficiency provisions in the Building Code of Australia for all new commercial buildings will be significantly raised from 2010. The new provisions will seek to minimise energy use through improvements to the building fabric, glazing, artificial lighting, and heating, ventilation and air-conditioning systems in new commercial buildings.

Heating, Ventilation and Air Conditioning High Efficiency Systems Strategy

The Heating, Ventilation and Air Conditioning (HVAC) High Efficiency Systems Strategy is designed to achieve long-term improvements in the energy efficiency of HVAC systems, particularly in commercial building applications. The programme is aimed at whole-of-life improvements in HVAC efficiency, encompassing design, manufacture, installation, operation and maintenance. The HVAC strategy's targeted gains are largely in the maintenance and operation of existing systems in buildings, and through the establishment of national standard systems of documentation on the design, installation, operation and maintenance of equipment.

Mandatory disclosure of commercial buildings (NSEE)

Commercial office buildings or spaces of over 2 000 square metres are required to disclose their energy efficiency performance by way of a standardised Building Energy Efficiency Certificate (BEEC) and disclose a National Australian Built Environment Ratings System (NABERS) energy rating in advertising materials. A BEEC includes a NABERS energy rating, an assessment of the energy efficiency of the lighting, and general guidance on improving energy efficiency, that are made publicly available on a register (www.cbd.gov.au).

These energy certificates are providing purchasers and tenants with valuable information about potential energy operating costs of an office building. Recent independent studies have shown that making public information on energy efficiency has real value for the market. A recent IPD Research study showed that office buildings with a four- to five-star NABERS rating had lower vacancy rates and higher rentals than lower rated buildings. Overall rates of return on buildings of four to five stars were more than double those of buildings rated 3.5 stars or less, and nearly double those of unrated buildings.

For a one-year transition period, between 1 November 2010 and 1 November 2011, buildings were only required to disclose a NABERS energy rating. New buildings (less than two years old) are not covered, and exemptions are available where a rating cannot be undertaken, or for police or security operations where access to the building to complete a rating cannot be provided.

APPLIANCES

Smarter appliances

The Equipment Energy Efficiency (E3) Program is a joint initiative of the Australian government, state and territory governments and the New Zealand government. The initiative has been in place for fifteen years and has developed minimum energy performance standards, which have successfully removed the most inefficient appliances and equipment from the market. A second tool is mandatory energy rating labelling, which allows consumers to take informed decisions while providing an incentive for manufacturers to innovate to gain a marketing advantage. In addition, the Australian government is continuing the phase-out of inefficient lighting.

INDUSTRY

Energy Efficiency Exchange

To assist medium-sized and large business energy users in having access to the latest high-quality information on energy efficiency, the Department of Resources, Energy and Tourism, in collaboration with state governments under the National Framework on Energy Efficiency, has established the Energy Efficiency Exchange (EEX) website (<http://eex.gov.au>). EEX aims to source and develop high-quality information on energy procurement, energy management, improving the energy efficiency of different technologies and processes, and information on business support programmes in a format that is readily searchable and accessible. It tries to capture the lessons learnt by companies as they improve their understanding of energy and disseminate information on best practice developed through state, federal (the Energy Efficiency Opportunities, EEO) and international energy efficiency programmes.

Box 3. Energy efficiency in industry: The Energy Efficiency Opportunities (EEO) Program

The Energy Efficiency Opportunities (EEO) Program requires large Australian energy users to assess in detail their energy consumption and identify cost-effective ways with an up to four-year payback period to reduce it. Each company must report the results to its board, the government and the public. The rules do not require the company to implement identified savings. Instead, the company decides which savings to pursue, taking account of its business priorities and resources.

Other energy-intensive countries can learn from Australia's approach, which enables a business to identify opportunities and then develop its own tailor-made approach to realising the gains. Besides improving energy efficiency, the programme also focuses on bolstering productivity while cutting costs and greenhouse gas emissions. The IEA included a case study on the EEO Program, highlighting successful elements such as encouraging self-assessments and focusing boardrooms on energy consumption, in its *Policy Pathway on Industrial Energy Management Programmes* publication.

Australia introduced the EEO Programme in 2006 for all industrial sectors, including mining, resource processing, manufacturing, transport and commercial sectors, and, starting July 2011 expanded it to include electricity generators. With the extension, the percentage of Australian consumption of energy covered by EEO nearly doubled, to almost 60%. From 1 July 2013, EEO will be further expanded to include electricity and gas transmission and distribution networks, the design phase of major green field and expansion projects, and voluntarily to medium-sized energy users.

Legislation underpinning EEO requires all corporations that consume more than 0.5 petajoule (PJ) of energy per year (approximately equivalent to the energy used by 10 000 households in a year) to assess the energy they use, and produce the reports.

At present, there are 319 companies, responsible for 65% of Australia's energy use, registered under the EEO Program. At the end of 2011, 252 registered corporations were obliged to report. The other 67 companies are relatively new to the programme and do not have to submit their first reports until 30 months after joining. Data obtained from those reports is still being processed and will form the basis of the programme evaluation.

Box 3. Energy efficiency in industry: The Energy Efficiency Opportunities (EEO) Program (continued)

Reported assessments in 2011 revealed identified opportunities to save 164.2 PJ of energy per year: 10% of the companies' assessed energy use, or 2.8% of Australia's total energy consumption. The reporting companies then committed themselves to implementing more than half of the possible savings, or 88.8 PJ annually, which represents a 17% increase on adopted savings compared with 2010 (75.5 PJ) and a 44% increase against 2009 (61.5 PJ). These savings reduce Australia's total annual CO₂ emissions by 1.5% or the equivalent of an estimated 8 million tonnes per year, generating financial benefits worth an estimated AUD 808 million per annum, given the average net benefit of about AUD 198 per reduced tonne of CO₂-equivalent.

In October 2010, the Prime Minister's Task Group on Energy Efficiency reported on the most economically and environmentally effective mechanisms to improve energy efficiency sharply and to address shortfalls in policy. The Task Group's findings proposed a wide range of measures, including a call to enhance the assessment and verification requirements and expand coverage of the Energy Efficiency Opportunities Act of 2006 to include large energy generators effective on 1 July 2011, as well as transmitters and distributors, and major green field and expansion projects from 1 July 2012. Including transmission and distribution networks could reduce network losses significantly, cutting carbon pollution from electricity use and potentially lowering energy prices. The proposal also calls for assessment and reporting on energy efficiency opportunities at the design and commissioning phase, of major greenfield and expansion projects.

In 2011, the Prime Minister announced long-awaited plans for the largest carbon-reduction programme outside Europe. As part of Australia's plan for a Clean Energy Future, the government also recommitted to the EEO Program, deciding to extend funding until 2017 and to establish a voluntary system for medium-sized energy users as well as expand EEO to include energy transmission and distribution networks.

The EEO Mid-Cycle Review recognised positive changes in the use of energy management systems and procedures, with companies reporting that the EEO Program had brought greater structure and focus to their energy efficiency activities. Assessments had also brought about behavioural changes, with a greater appreciation within companies of their energy use and the benefits of implementing identified opportunities.

The Department of Resources, Energy and Tourism is undertaking a major evaluation of the EEO Program in 2012. The evaluation will assess industry performance in energy efficiency over the first cycle and use the findings to develop strategies for improvements in the second cycle. As part of the evaluation, the department will be consulting with industry and seeking ways to improve monitoring and evaluation procedures.

CROSS-SECTOR**Building Code of Australia: upgrades (NSEE)**

In April 2009, the Council of Australian Governments requested that the Australian Building Codes Board develop more stringent provisions to allow for a six-star home rating being included in the 2010 Building Code of Australia (BCA). The new proposals must be subject to a regulatory impact assessment (cost-benefit analysis) and be cost-

effective. The 2010 BCA energy efficiency provisions for residential buildings were agreed by the states and territories for adoption from 1 May 2010. To date five states have adopted.

National Building Energy Standard-Setting, Assessment and Rating Framework

Under the National Strategy on Energy Efficiency (NSEE), the federal, state and territory governments agreed to develop a National Building Energy Standard-Setting, Assessment and Rating Framework. Its aim is to establish a consistent national approach to increasing the energy efficiency of residential and commercial buildings over time, underpinned by new national measurement and reporting metrics for rating the environmental performance of buildings. Further public consultation on the framework will take place in 2012.

Equipment and Energy Efficiency (E3) Program (NSEE)

The Equipment and Energy Efficiency (E3) Program delivers energy and greenhouse savings through implementation of minimum energy performance standards (MEPS) and mandatory energy rating labels for equipment and appliances in the residential, commercial and industrial sectors. The E3 Program is co-funded by the Australian government, state and territory governments, and the New Zealand government. MEPS remove the worst performing products from the market while energy rating labels provide information to consumers to compare the energy efficiency of domestic appliances on a fair and equitable basis, while also providing an incentive for manufacturers to improve the energy performance of appliances.

The label also displays an estimated energy consumption figure based on typical use of the appliance (usually kWh/year). In October 2010, the E3 Program covered a total of 22 different products in the residential, commercial and industrial sectors. Seventeen of these products have mandatory MEPS, seven products have mandatory energy rating labels, two products have voluntary labels and two products have high-efficiency performance standards (HEPS). Five of the 22 products have both mandatory MEPS and labels. A further 12 products are at various stages of being regulated.

The impact of MEPS will be broadened by the greenhouse and energy minimum standards (GEMS) scheme – to come into effect on 1 October 2012. GEMS expands the categories of products covered by MEPS, and also includes non-energy-using products that affect the energy efficiency of other products (such as HVAC insulation and window glazing).

Household website and advice line

The Australian government website, *Living Greener* (<http://www.livinggreener.gov.au>) provides consumers with a broad range of easy-to-read, practical information on how to save energy, cut power bills, conserve water, reduce waste and travel smarter. It also provides up-to-date summaries of all government energy efficiency and sustainability rebates and assistance.

This website was created through a process of user-centred design, including quantitative and qualitative research in the design phase, user-testing of the site and testing of site refinement. This website has been expanded over time to provide more information on how households can improve their energy efficiency to save money and manage the impacts of increasing energy costs. Advice to householders is also being delivered through a phone advice line and via social media.

National Australian Built Environment Rating System

The National Australian Built Environment Rating System (NABERS) is a performance-based rating system for existing buildings using measured operational impacts on the environment in categories such as energy, water, waste and indoor environment.

Low Carbon Australia

The Australian government has provided over AUD 100 million to establish Low Carbon Australia (formerly Australian Carbon Trust) to further support energy efficiency action by businesses. Low Carbon Australia is a Commonwealth company limited by guarantee, with an independent board of directors. Low Carbon Australia manages two innovative programmes:

- An Energy Efficiency Program to provide finance and advice to eligible businesses and the public sector for the retrofit of commercial properties.
- The Carbon Neutral Program which provides certification for organisations that have products or operations that are carbon-neutral under the National Carbon Offset Standard (NCOS).

Community Energy Efficiency Program

The AUD 200 million Community Energy Efficiency Program will provide matched funding through competitive grants to local governing bodies and non-profit community organisations to undertake energy efficiency upgrades to council or community-use buildings, facilities and sites.

Low Income Energy Efficiency Program

The AUD 100 million Low Income Energy Efficiency Program will provide grants to consortia of local councils, community welfare organisations, state and territory governments and energy companies to trial and evaluate approaches to improve the energy efficiency of low-income households.

Home Energy Saver Scheme

The AUD 30 million Home Energy Saver Scheme will assist low-income households find more sustainable ways to manage their energy consumption.

Charities Maritime and Aviation Support Program

The Charities Maritime and Aviation Support Program will offer a rebate for the fuel cost increase, due to the effective carbon price, that is incurred by charities in conducting maritime and aviation activities.

Energy Efficiency Information Grants Program

The AUD 40 million Energy Efficiency Information Grants Program will provide grants to industry associations and non-profit organisations for the development and delivery of practical, tailored energy efficiency information to small and medium-sized enterprises and community organisations.

TRANSPORT

Vehicle fuel efficiency measures

In July 2009, the Council of Australian Governments (COAG) considered the final report from the Australian Transport Council and the Environment Protection and Heritage Council on a package of vehicle fuel efficiency measures. Following consideration of the report, COAG requested a regulatory assessment be undertaken to assess the merits of CO₂ emission standards for light vehicles, and also adopted a range of consumer information measures. The measures agreed by COAG are incorporated in the National Strategy on Energy Efficiency.

CO₂ emission standards

On 24 July 2010, the government announced its commitment to introduce mandatory CO₂ emission standards for new light vehicles sold from 2015. The actual targets to be achieved under the standards will be determined as part of consultations with industry and others.

Fuel consumption labelling

Since 2001, all new cars, four-wheel drives and light commercial vehicles in Australia have been required to display a fuel consumption label at the point of sale. The label has been progressively improved to provide more useful comparative information on both fuel consumption and CO₂ emissions of different vehicle models. The information is based on a standardised test, which all new vehicle types undergo before their supply to the market.

A revised fuel consumption label was implemented in April 2009. The new label displays three fuel consumption numbers from the standard test – “combined”, “urban” and “extra-urban” – as well as the combined CO₂ value. The new label is particularly valuable in highlighting the significantly higher fuel consumption rates that users can expect when driving in urban environments compared to highway operation. The label is linked with the Green Vehicle Guide, and the fuel consumption and CO₂ data displayed on the label match those which are provided through the guide.

In September 2010, the government developed an “energy consumption” label (using the same format as the fuel consumption label) which is required to be placed on electric vehicles and plug-in hybrids, and which displays the range and energy consumption of the vehicles under standard test conditions. The government is also developing a code of practice for the inclusion of fuel consumption and CO₂ data in advertising and promotional material for the sale of new light vehicles.

Green Vehicle Guide

The Green Vehicle Guide website, developed by the Australian government, is a tool to assist consumers in taking informed decisions regarding the environmental performance of new vehicles. It covers all light vehicles (up to 3.5 tonnes) released onto the Australian market since late 2004, and is regularly updated as new models are released. The Green Vehicle Guide provides consumers with user-friendly ratings on the environmental performance of specific models, addressing greenhouse gas emissions, air pollution emissions and fuel efficiency. It also provides information on safety features and has the capacity to calculate annual fuel costs and CO₂ emissions.

It enables side-by-side comparisons of individual models on a common basis, as all the vehicles undergo the same standard emissions tests. The Green Vehicle Guide is recognised as the definitive source for assessing the environmental performance of light vehicles in Australia, and is increasingly used by fleets, in both government and industry, to determine the environmental benchmarks in their purchasing criteria.

Amendments to the Guide were made in 2010 to enable the listing of electric vehicles, including plug-in hybrids. These amendments also provide additional information to consumers on recharging emissions.

Other transport measures

Road freight transport

The COAG Road Reform Plan is a heavy vehicle reform agenda focusing on productivity and efficiency gains in the road freight transport sector with the aim of improving the connection between network prices, funding and usage. A feasibility study which assessed the feasibility of more direct heavy vehicle charging and related funding reform was completed in 2011. Work is continuing on improving access to the road network for higher productivity vehicles, yielding greater freight energy efficiencies.

Infrastructure investment

The present government has invested nearly AUD 37 billion in transport infrastructure including nearly AUD 4.5 billion for nine metropolitan rail projects in Adelaide, Brisbane, the Gold Coast, Melbourne, Perth and Sydney. This investment in public transport will assist in minimising carbon emissions and the effects of climate change.

Aviation

In December 2009 the Australian government released the National Aviation Policy White Paper, providing planning, regulatory and investment certainty for the aviation industry out to 2020 and beyond. Among other things, the White Paper sets out initiatives to ensure better planning and integrated development on and around airports and to lessen the adverse effects of aviation activity on the environment and communities.

Australia is actively engaged in the International Civil Aviation Organization in exploring options for more ambitious action in reducing aviation fuel consumption and emissions. Through the Asia and Pacific Initiative to Reduce Emissions (ASPIRE) partnership, Australia's air service navigation provider, Airservices Australia, is collaborating with other regional partners to improve air traffic management procedures in the Asia-Pacific region. Within its own borders Australia is implementing a range of operational measures to improve fuel efficiency such as flexible flight tracks, continuous descent approaches, and better management of aircraft on the ground.

PUBLIC SECTOR

The Australian government's Energy Efficiency in Government Operations (EEGO) policy aims to improve the energy efficiency of operations with particular emphasis on buildings energy efficiency. It commits to a progressive improvement of overall agency energy performance through annual energy intensity reporting and minimum efficiency requirements. A major component of the EEGO policy is the Green Lease Schedule,

through which Australian government tenants and their building owners commit to working collaboratively to maintain and maximise the energy efficiency of the building.

The Green Lease Schedule framework enables agencies to incorporate required energy efficiency standards into their leases and other procurement activities. Green leases are designed to overcome barriers, such as the tenant-landlord barriers that inhibit the wider uptake of commercial energy efficiency actions. Green Lease Schedules have been a successful strategy for reducing energy consumption in offices occupied by Australian government agencies with a 35% decline in tenancy energy intensity having been achieved since the inception of the EEGO policy.

The Australian government is leading the development of Green Leasing principles for the private commercial buildings sector, which will suit the needs of both landlords and tenants. As leading property portfolios continue to adopt their own green lease policy strategies, further transformation of the commercial property market is expected. Furthermore, the Australian government has facilitated the promulgation and development of green leases in the United Kingdom, France, the United States and Canada.

POLICY IN THE STATES AND TERRITORIES

Many states also have industrial energy efficiency programmes. In total, around 300 separate energy efficiency programmes or policies are currently operating in Australia.

For example, Victoria (Energy and Resource Efficiency Plans), New South Wales (Energy Savings Action Plan) and Queensland (Smart Energy Savings Program) have programmes that require large energy-using companies to identify energy efficiency opportunities, and, in the case of Victoria's Energy and Resource Efficiency Plans, implement identified energy efficiency opportunities with a payback period of less than three years.

Some states provide subsidies for business energy efficiency audits, such as Western Australia's Regional Energy Efficiency Program, the New South Wales Sustainability Advantage Energy Saver Program, Queensland's ecoBiz Program, and Tasmania's CleanBiz Program.

Other states provide information to companies, such as through Victoria's Resource Smart Business and Resource Smart Commercial Buildings programmes. Some states provide grants to companies to improve their energy efficiency, such as the Queensland Smart Energy Savings Fund, and the New South Wales Green Business and Energy Efficiency for Small Business programmes. The New South Wales Greenhouse Gas Reduction Scheme – Energy Efficiency is a white certificate scheme that covers the residential, commercial and industrial sectors in that state.

CRITIQUE

Improvements in energy efficiency may be pursued for productivity, climate change and energy security reasons; Australia pursues energy efficiency improvements for all these reasons. Given that much energy policy is a state and territorial responsibility, its energy-intensive economy and the strong link between energy and climate change, a welcome feature of the policy landscape is that all levels of government are actively involved in energy efficiency initiatives.

Since the last in-depth review, the Department of Climate Change and Energy Efficiency (DCCEE) has been established. While the Department of Resources, Energy and Tourism (RET) is responsible for industrial energy efficiency policy, DCCEE has the lead on

household and commercial energy efficiency policy. Other agencies, such as the Department of Infrastructure and Transport, also have energy efficiency policy responsibilities. Energy efficiency programmes are similarly delivered by a number of agencies. This multiplicity of agencies is replicated across the states and territories.

Recognising the need for co-ordination, the risk of duplication and the number of governments active in the energy efficiency sector, the Council of Australian Governments (COAG) agreed to a National Partnership Agreement on Energy Efficiency (NPA-EE) with the primary commitment to implement the National Strategy on Energy Efficiency. The measures in this strategy cover all the sectors of the economy. The Select Council on Climate Change (SCCC) will support an effective response on climate change policy issues with national implication, by providing oversight of the NPA-EE, which includes the National Strategy on Energy Efficiency (NSEE).

In July 2010, Australia updated its NSEE to include a full range of policy measures to overcome barriers that prevent energy efficiency uptake. The NSEE focuses on demand-side efficiency across all end-use sectors and seeks to accelerate energy efficiency efforts by setting clear goals and addressing information barriers. This work has been supported by Low Carbon Australia, which is leading efforts to develop a range of innovative financing and delivery models for energy efficiency improvements across sectors.

The Prime Minister's Task Group on Energy Efficiency reported to government on options to deliver a step change improvement in energy efficiency. The Task Group reported to government in July 2010. One recommendation was that the Australian government should *"agree to the introduction of a transitional national energy savings initiative to replace existing and planned state energy efficiency schemes, subject to detailed consultation on its design."* While the government did not support the Task Group proposal for a 30% energy efficiency target, the IEA welcomes the government's commitment to consider the possible development of a national energy savings initiative following comprehensive consultation with stakeholders. There are many such "white certificates" schemes operating in other OECD member countries, which can provide guidance to Australia. The IEA also welcomes proposals to examine the potential of establishing a complementary implementation body to co-ordinate national action and plans to collect better data on energy use and energy efficiency across the economy.

A key driver for energy efficiency improvements is to assist progress in meeting climate change policy objectives. Efficiently priced energy is a necessary prerequisite for ensuring that many energy efficiency opportunities are recognised and realised. Hence, there is a close link between carbon pricing and energy efficiency improvement. Even with a carbon price, the introduction of which is welcome, there is likely to be a need for complementary measures, which need to be appropriate and well designed.

The range of Australian energy efficiency measures currently extends from sector-specific regulation (such as minimum energy performance standards, MEPS), to programmes for upgrades to information provision. Hence, it is important that the policy objective is clear, that the market failure to be addressed is identified, and that the best delivery mechanism is implemented.

Australia has an exemplary MEPS programme which includes standard procedures for compliance, monitoring and enforcement. Since January 2010, subscription television set-top boxes have been covered by a Voluntary Code of Conduct requiring performance that meets or exceeds the European best-practise benchmarks. A Voluntary Energy Rating Labelling Program is also under way in relation to swimming pool pumps to

increase consumer awareness and assist the manufacturing industry in preparing for future MEPS. In addition to increasing product coverage of MEPS through the Equipment Energy Efficiency (E3) Program, Australia's overarching energy efficiency programme for energy-using products, Australia is implementing stage one of a phase-out of inefficient electric water-heating systems. Work is also under way to develop demand response interfaces for a range of major appliances.

In the lighting sector, the phase-out of incandescent lighting, started in 2009, is expected to deliver a saving of 28 million tonnes of CO₂ by 2020. In 2010, Australia updated its building code to impose a limit on general service lighting systems in commercial buildings of no more than 10 W/m² of internal floor area. The government is also taking steps to help developing and emerging economies to phase out inefficient lighting and replace fuel-based lighting with efficient alternatives through its participation in the Building and Appliances Taskforce of the Asia-Pacific Partnership on Clean Development and Climate, working with developing countries, including India and China.

The Energy Efficiency Opportunities (EEO) Program is an example of progressive thinking; it is an interesting mix of voluntary and mandatory approaches, which has delivered tangible benefits. Given the distribution of Australian energy use and emissions, a successful programme aimed at large energy consumers is important and delivers most value. Enabling individual businesses to identify opportunities and then develop tailor-made means to realise these opportunities is consistent with the strong Australian market-based ethos. The IEA notes the increased coverage of the scheme and welcomes the extension of the scheme to the electricity generation sector and also commends the authorities on steps taken to promote and communicate the benefits of the scheme to potential participants.

Despite the great number of positive examples, it is not clear that the present range and mix of energy efficiency expenditure and initiatives are as well designed and targeted as it could be. Some, apparently attractive, energy efficiency measures may not deliver the lowest cost abatement. At present there are a large number of agencies involved in policy design and programme delivery; it may also be appropriate to rationalise these arrangements.

In the transport sector, Australia is also making progress. In May 2011, the Australian government announced it will reform the car fringe benefit treatment of cars to remove the unintended incentive for people to drive their vehicle further than they need to, in order to obtain a larger tax concession. The government has also committed to introducing mandatory CO₂ emission standards for light-duty vehicles to take effect from 2015, and a consultation process to determine emissions targets and design standards is under way. Much more work will be needed to improve energy efficiency in this sector. Consideration should be given to setting energy efficiency standards and test procedures for tyres as well as implementing labelling schemes in line with international best practice. Australia could also consider extending mandatory vehicle labelling in relation to fuel consumption and CO₂ emissions for light- and heavy-duty vehicles.

Electricity network losses in Australia vary between networks and are in the range of 3% to 8% for distribution and 1% to 4% for transmission (2008/09 figures), which appear comparably high.²⁰ Reducing these losses should lead to a reduction in the amount of

20. *Energy Network Infrastructure and the Climate Change Challenge*, Energy Networks Association, 2009. (See also *List of Regional Boundaries and Marginal Loss Factors for the 2008/09 Financial Year and Distribution Loss Factors for the 2008/09 Financial Year*, NEMMCO, 2008).

electricity production required and fossil fuels consumed. Reducing network losses should also form part of the review of network incentive structures proposed in the Draft EWP.

Notwithstanding Australia's recent strong progress, the government should continue efforts to fully implement, where appropriate, the IEA recommendations for improving energy efficiency (see Box 4).

Box 4. IEA 25 energy efficiency recommendations

To support governments with their implementation of energy efficiency, the IEA recommended the adoption of specific energy efficiency policy measures to the G8 summits in 2006, 2007 and 2008.

In 2011, in order to reflect emerging priorities, the IEA, in consultation with international experts and member countries, streamlined and updated the 25 recommendations. The updated 25 recommendations cover a robust portfolio of policies that member and non-member countries should consider in the context of their energy economies.

This portfolio of recommendations includes policies to cost-effectively increase energy efficiency by establishing market signals to motivate effective action, accelerate the introduction of new technologies, and strengthen and enforce minimum energy performance standards (MEPS) for appliances, lighting, equipment and building energy codes.

1. To improve *energy efficiency* across all sectors, the IEA recommends action in the following areas:
 - energy efficiency data collection and indicators;
 - strategies and action plans;
 - competitive energy markets, with appropriate regulation;
 - private investment in energy efficiency; and
 - monitoring, enforcement and evaluation of policies and measures.
2. To achieve savings in the *buildings sector*, the IEA recommends:
 - mandatory building energy codes and minimum energy performance requirements;
 - aiming for net zero energy consumption buildings;
 - improving energy efficiency of existing buildings;
 - building energy labels and certificates; and
 - energy performance of building components and systems.
3. To achieve significant energy savings in the *appliances and equipment* sector the IEA recommends:
 - mandatory energy performance standards and labels for appliances and equipment; and
 - test standards and measurement protocols for appliances and equipment.
4. To achieve significant energy savings in the *lighting sector*, the IEA recommends:
 - phase-out of inefficient lighting products and systems; and
 - energy-efficient lighting systems.

Box 4. IEA 25 energy efficiency recommendations (continued)

5. To achieve significant energy savings in the *transport sector*, the IEA recommends:

- mandatory vehicle fuel efficiency standards;
- measures to improve vehicle fuel efficiency;
- fuel-efficient non-engine components;
- improving operational efficiency through eco-driving and other measures; and
- improve transport system efficiency.

6. To achieve significant energy savings in the *industrial sector*, the IEA recommends:

- energy management in industry;
- high-efficiency industrial equipment and systems;
- energy efficiency services for small and medium-sized enterprises; and
- complementary policies to support industrial energy efficiency.

7. To achieve significant energy savings in *energy utilities* and end-use energy efficiency, the IEA recommends:

- governments should establish regulatory and other policies to ensure that energy utilities support cost-effective, verifiable end-use energy efficiency improvements.

RECOMMENDATIONS

The government of Australia should:

- ☐ *Complete delivery of the EWP and use it to articulate the role of renewable energy and energy efficiency in Australia's future energy mix.*
- ☐ *In parallel with the recent introduction of a carbon-price mechanism, develop an enhanced consumer and residential energy efficiency programme, including a review of existing energy efficiency initiatives. The outcome of this review should be clarity of objectives and to ensure that efforts, particularly funding, are directed into the most appropriate initiatives.*
- ☐ *Extend the Energy Efficiency Opportunities Program to the electricity and gas transmission and distribution sectors to provide improved information on the size of network losses and opportunities for reducing them, noting the government is in the process of doing this. Examine mechanisms to provide incentives for networks to implement opportunities they identify through the EEO Program.*
- ☐ *Continue its efforts to improve energy efficiency in the transport sector, including the implementation of mandatory CO₂ emissions standards for light-duty vehicles.*

PART II

SECTOR ANALYSIS

5. RENEWABLE ENERGY

Key data (2010)

Share of renewable energy: 5.6% of TPES and 8.9% of electricity generation (IEA average: 8.0% and 18.0%), from 6.0% and 8.4% in 2000

Biofuels and waste: 4.2% of TPES and 1.6% of total electricity generation

Hydropower: 0.9% of TPES and 5.2% of total electricity generation

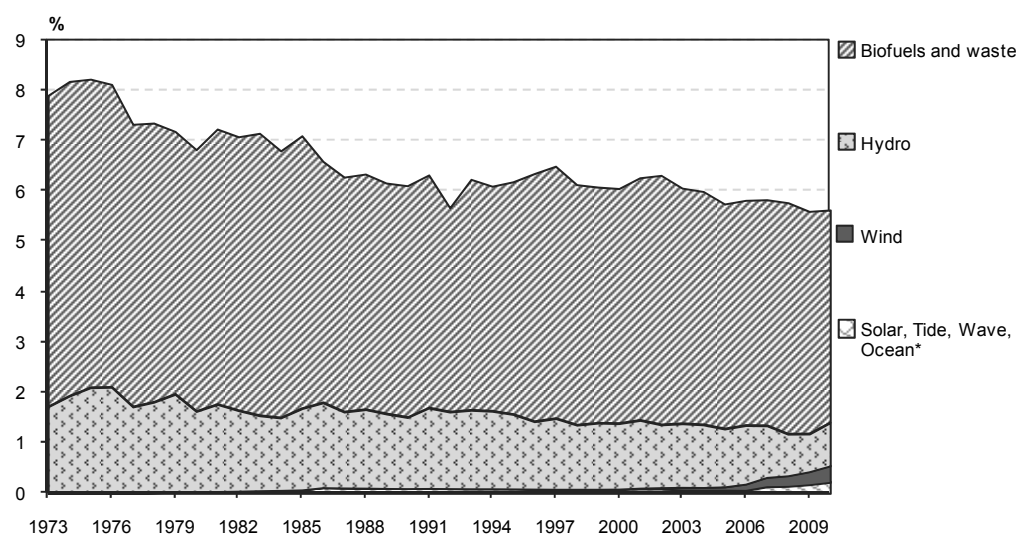
Other renewable energy: 0.5% of TPES and 2.1% of electricity generation

SUPPLY AND DEMAND

Australia is one of the few OECD member countries where the share of renewable energy in total primary energy supply (TPES) has been decreasing over the past ten years. Renewable energy represented 6% of TPES in 2000 and 5.6% in 2010. In terms of volume, it increased from 6.5 Mtoe in 2000 to 7.0 Mtoe in 2010. Compared to other IEA member countries, Australia has a low share of renewable energy in energy supply; it is ranked eighth-lowest among the 28 member countries.

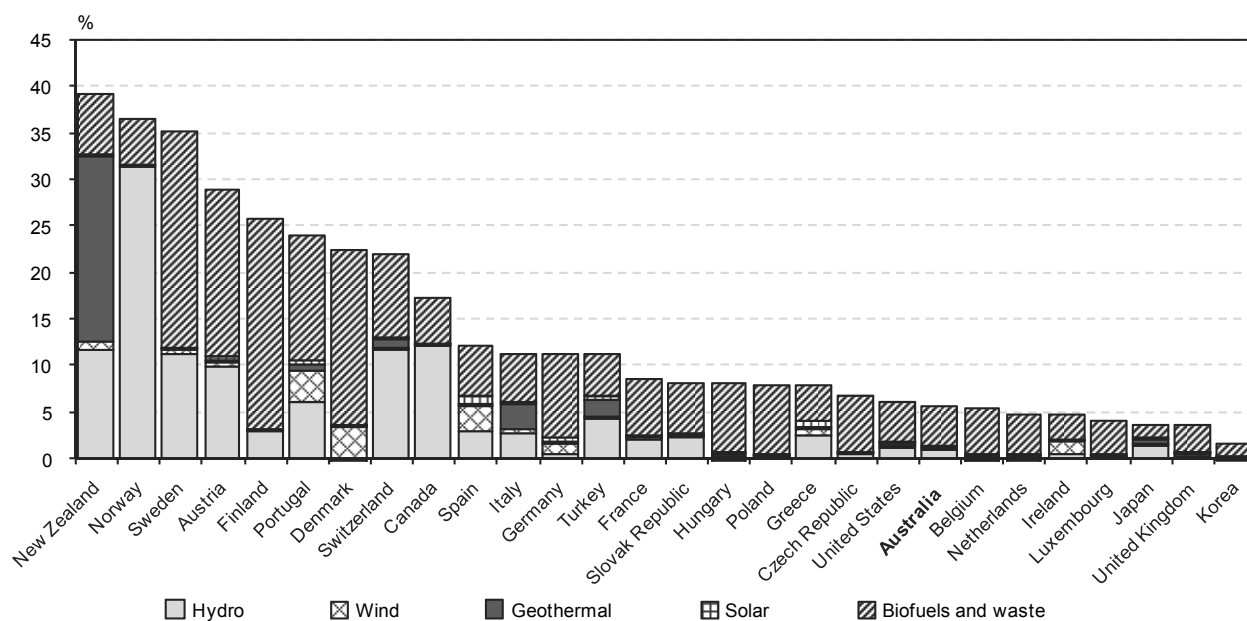
Biofuels and waste are the largest renewable energy source; they amounted to 5.3 Mtoe in 2010. Primary solid biomass such as wood and vegetal waste is by far the largest biofuel used in Australia, representing 87% of the total. Biogases account for 5% of total biofuels, and biodiesel and bio-gasoline sums up to 5%. The remaining 3% are produced from industrial wastes.

Figure 11. Renewable energy as a percentage of total primary energy supply, 1973-2010



Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011.

Figure 12. Renewable energy as a percentage of total primary energy supply in IEA member countries, 2010



Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011.

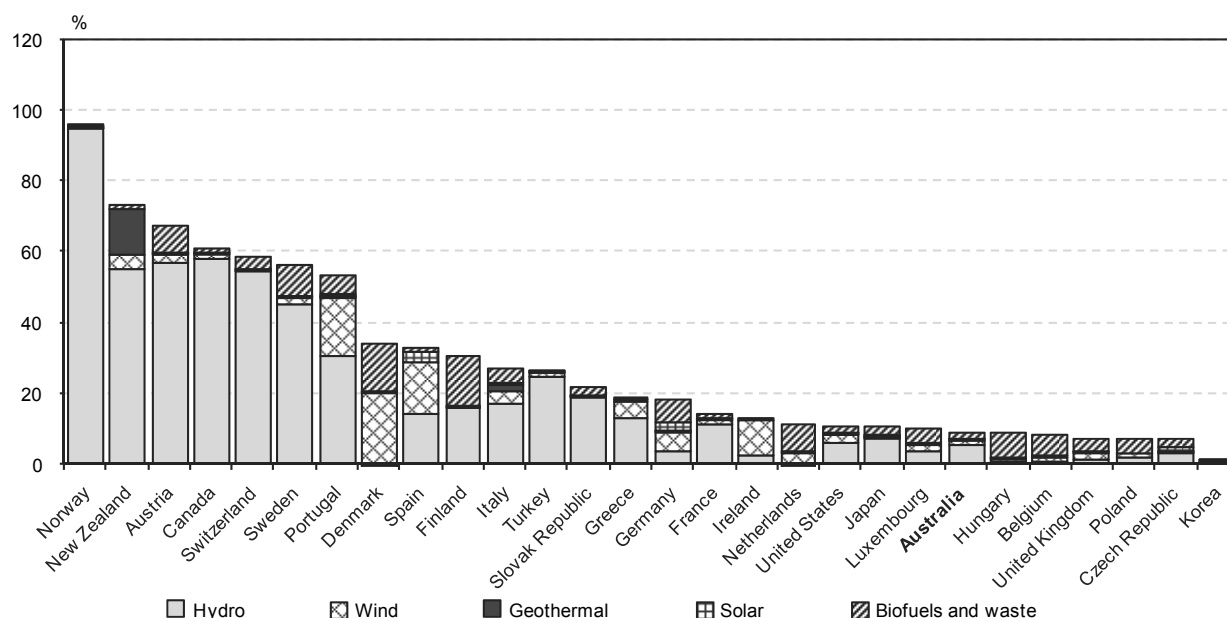
More than a third of primary solid biomass is used as energy in the industry sector, mainly in food and tobacco industry, as well as in wood and paper industry. Use in the residential sector accounted for 30% and the remaining 24% were used in the transformation sector for electricity and heat production.

The second-largest renewable energy source in Australia is hydropower with around 1.0 Mtoe or 12 TWh. Wind and solar energy developed rapidly over the last years, and accounted for 0.4 and 0.3 Mtoe in 2010, respectively. Solar photovoltaic represented 11% of total energy produced from solar, the larger share of which was solar thermal energy and was used in the residential sector.

ELECTRICITY GENERATION

Electricity generated from renewable energy sources represented 8.9% of total electricity generation or 21.5 TWh in 2010. This is the seventh-lowest share among IEA member countries. After hydro with 5%, wind power has the second-largest share in renewable electricity generation with 2.0% of total electricity generation. Among renewable energy sources, wind power had the fastest growth; increasing on average by 67% per year since 2000, whereas solar and biofuels grew respectively by 23% and 16% per year on average over the same period.

Figure 13. Electricity generation from renewable sources as a percentage of all generation in IEA member countries, 2010



Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011.

INSTITUTIONS

Generally, responsibility for renewable energy policy is shared between the Australian government and the state and territory governments. There have been a number of administrative changes since the last in-depth review.

A Department of Climate Change was established in December 2007 and replaced by a new **Department of Climate Change and Energy Efficiency** in March 2010. The new department is responsible for mandatory Renewable Energy Target policy, regulation and co-ordination; renewable energy; and community and household climate action. The **Department of Resources, Energy and Tourism** is responsible for renewable energy technology development and employs around 30 full-time equivalent staff.

The **Australian Centre for Renewable Energy** (ACRE) was established by government in October 2009 to promote the development, commercialisation and deployment of renewable energy. As part of the government's 2011 Clean Energy Future package, ACRE, along with a range of other existing renewable energy measures, will be incorporated into the **Australian Renewable Energy Agency** (ARENA), which commenced operations on 1 July 2012.

ARENA is an independent statutory authority established under the Commonwealth Authorities and Companies Act 1997, tasked with the objectives of improving the competitiveness of renewable energy and enabling technologies, and increasing the supply of renewable energy in Australia. Staff from the Department of Resources, Energy and Tourism have been made available to ARENA to provide its operational and administrative support. Unallocated funding previously allocated to the Connecting Renewables Initiative will be consolidated into ARENA, with ARENA's Board taking responsibilities for developing ARENA's funding priorities.

The **Australian Solar Institute** (ASI) was established in 2009 to advance Australia's research and development capabilities in solar energy technology. The ASI will form part of ARENA by 1 January 2013.

The Clean Energy Regulator Act 2011 established the **Clean Energy Regulator** as a statutory authority tasked with administering the carbon-pricing mechanism, the Renewable Energy Target, the **Carbon Farming Initiative**, and the **National Greenhouse and Energy Reporting System**, and with enforcing the related regulations. The Clean Energy Regulator commenced operations on 2 April 2012.

In terms of the Renewable Energy Target, the Clean Energy Regulator is responsible for administering the Renewable Energy (Electricity) Act 2000 (the Act), Renewable Energy (Electricity) (Charge) Act 2000, the Renewable Energy (Electricity) (Small-scale Technology Shortfall Charge) Act 2010, and the Renewable Energy (Electricity) Regulations 2001. These acts and regulations support the implementation of the Australian government's Large-scale Renewable Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES).

POLICIES AND SUPPORT MEASURES

DRAFT ENERGY WHITE PAPER 2011

A Draft Energy White Paper 2011: Strengthening the Foundation for Australia's Energy Future was published for public consultation in December 2011. The paper fulfils the Australian government's commitment to publish a Draft Energy White Paper (EWP) by the end of 2011. Following the completion of the consultation process, the government anticipates that a final EWP will be released late in 2012. The pace of Australia's clean energy transformation will be determined through the interaction of carbon, renewable energy certificate and energy prices in the market, with commercial outcomes driven by the ability of emerging technologies to establish commercial reliability and competitive cost.

The Draft EWP acknowledges that Australia has some of the world's best renewable energy resources and it contains significant proposals in relation to renewable energy. The Draft EWP also acknowledges that the true energy potential of some of Australia's renewable energy resources, such as hot rock geothermal and ocean energy, is not as well understood as its fossil fuel base.

The Draft EWP proposes a number of key actions to drive the clean energy transformation, including the establishment of the Australian Renewable Energy Agency by July 2012 and the Clean Energy Finance Corporation from 2013/14 as priority actions and regular review of the Renewable Energy Target scheme by the Climate Change Authority. The Draft EWP also proposes to work with other jurisdictions to harmonise state- and territory-based micro-distributed generation feed-in tariff schemes (consistent with agreed Council of Australian Governments principles) and improve the quality of Australia's clean energy information base. Another key action is to work with state and territory governments to identify the need for nationally consistent and supportive regulatory arrangements for geothermal and ocean energy systems.

RENEWABLE ENERGY TARGET

The Mandatory Renewable Energy Target (MRET), which was in place from 2001 until 31 December 2009, required an increase in electricity generation from renewable energy

sources of 9 500 gigawatt-hour (GWh) a year by 2010. Under the MRET, retailers and large users of electricity were required by law to earn or obtain Renewable Energy Certificates (RECs) equivalent to a set proportion of their electricity purchases. Households and small businesses could also earn RECs on a voluntary basis for small-scale renewable energy installations. RECs could then be traded to ensure that companies reached their legislated quota and to provide incentives for the adoption of renewable energy sources.

Enhancements to the Renewable Energy Target

The Renewable Energy (Electricity) Amendment Act 2009 expanded the existing Mandatory Renewable Energy Target by more than four times to deliver the government's commitment to the equivalent of 20% of Australia's electricity to come from renewable sources by 2020. This equates to 45 TWh of new renewable electricity by 2020. Together with 15 TWh of existing hydroelectric generation, this will equate to 60 TWh, or the equivalent of 20% of Australia's projected electricity consumption coming from renewable sources by 2020. Upfront support for small-scale solar PV systems was also boosted through the solar credits mechanism which multiplies the allocations of renewable energy certificates for eligible installations.

In 2010, further legislation, the Renewable Energy (Electricity) Amendment Act 2010, was introduced to separate the Renewable Energy Target scheme into two parts from January 2011 – the Small-scale Renewable Energy Scheme (SRES) and the Large-scale Renewable Energy Target (LRET).

Liabe entities will need to meet separate obligations under both the LRET and SRES by acquiring and surrendering certificates created from both large and small-scale renewable energy technologies. The LRET, covering large-scale renewable energy projects like wind farms, commercial solar and geothermal, will deliver the majority of the 2020 target. The LRET includes legislated annual targets and operates much the same as the previous Renewable Energy Target, but as a separate scheme from the SRES. Liabe parties can acquire and surrender RECs, generally equivalent to 1.0 megawatt hour (MWh), to demonstrate compliance. Alternatively, they are required to pay a shortfall charge of AUD 65 per MWh where liabilities are not met from 2010.

The Australian government has recognised the need to provide a stable legislative framework to support the uptake of renewable energy and to assist liabe entities in managing their future energy target liability. As required under the legislation, the target will be reviewed biennially. The first review will take place in the second half of 2012 by the independent Climate Change Authority (CCA), which commenced operations on 1 July 2012. The CCA must provide its report to government by 31 December 2012.

FEED-IN TARIFFS

Most Australian jurisdictions provide feed-in tariff (FiT) schemes, which provide owners of small renewable-energy systems with guaranteed fixed rates for the sale of electricity fed into the grid. There is no nationally mandated programme; however, the Australian government has worked through the Council of Australian Governments (COAG) to develop a set of four National Principles, released on 29 November 2008. These principles were introduced to help guide the implementation of FiT schemes and aim to increase consistency across jurisdictions. The COAG-agreed National Principles for Feed-in Tariff Schemes are set out in Box 5. A summary of the FiT schemes operating in Australia at present is set out in Table 4.

Table 4. Renewable energy feed-in tariffs in Australian states and territories

Jurisdiction*	Vic (standard)	Vic (transitional)	Vic (premium)	SA	SA	Qld (Fair)	WA (Fair)	WA	NSW	NSW (Fair)	Tas	ACT
Status	Legislated	Legislated	Legislated. Closed from 29 Dec 2011. Transitional scheme is open.	Legislated. Closed from 1 Oct 2011. Transitional scheme is open.	Legislated. 27 Jan 2012 to 30 Jun 2014	Legislated. Closed to new applications from 9 Jul 2012.	Legislated. Opens 10 Jul 2012.	Announced (non-legislated). Suspended from 1 Aug 2011.	Legislated. Closed to new applications from 29 Apr 2011	Legislated.	Announced (non-legislated)	Legislated. Closed to new applicants from 1 Jun 2011, but ActewAGL offers a 1:1 net FIT.
Rate of FIT	A fair price, at a rate not less than the rate the customer pays to buy electricity from the retailer – i.e. a one-for-one payment rate.	25 c/kWh for excess electricity fed back into the grid. Retailers may "top up" this rate.	25 c/kWh to 33 c/kWh, depending on the retailer (transitional scheme, from 1 Jan 2012). 60 c/kWh to 68 c/kWh, depending on retailer (premium FIT, before 29 Dec 2011).	From Oct 2011 fixed 16 c/kWh plus the fair and reasonable that is no less than the minimum rate determined by ESCOSA. 44 c/kWh + fair payment from retailer (before 1 Oct 2011).	7.1 c/kWh in 2011/12. 9.8 c/kWh in 2012/13. 11.2 c/kWh in 2013/14. Note there is no end date for the obligation.	44 c/kWh	8 c/kWh	Fair and reasonable rate with contracts approved by the Coordinator of Energy. Currently set at marginal cost (avoided energy, network losses).	40 c/kWh + buyback rate (Fair). Installations installed from 1 Jul 2011 to 1 Aug 2011 receive 20 c/kWh + Fair buyback rate.	2012/13. 7.7 c/mWh to 12.9 c/mWh.	Fair and estimated Fair and reasonable rate (equivalent to the relevant retail rate which for residential customers is currently 25.132 c/kWh. The rate adjusts each time the regulated retail tariff changes).	45.7 c/kWh to 30 Jun 2012. Premium price set each year.

Jurisdiction*	Vic (standard)	Vic (transitional)	Vic (premium)	SA	SA	Qld	Qld (Fair)	WA (Fair)	WA	NSW	NSW (Fair)	Tas	ACT
Period of operation	No end date set – the standard FIT will remain open to solar customers whose solar PV capacity is greater than 5 kW and less than 100 kW in capacity, and will continue to offer a 'fair and reasonable' rate for various forms of renewable energy including wind, hydro, biomass and solar.	Five years from Jan 2012, but may be closed earlier if 75 MW is reached or the Minister thinks appropriate.	Transitional scheme: 2012-16: 75 MW cap. 2009-24 (exceeded 100 MW cap).	The 0.44 cent rate is available from 1 Jul 2008 and paid to 30 Jun 2028. The new 0.16 cent rate is open until 30 Sep 2013 and will be paid until 30 Sep 2016.	27 Jan 2012 to 30 Jun 2014	2008-28	10 Jul 2012 to 30 Jun 2014. Retailers may offer more.	No end date	Ten years from 1 Aug 2010; payments for ten years (exceeded 150 MW cap).	Seven years from 1 Jan 2010.	30 Jun 2013 (exceeded 300 MW cap).	No end date specified.	20 years from connection of generator. Announced cap of 15 MW as part of the Stage 2 expansion to medium and large-scale generators (exceeded 15 MW cap).
Gross or net?	Net	Net	Net	Net	Net	Net	Net	Net	Net	Gross	Net	Net	Gross
Who funds?	No subsidy	Information not available	Cross-subsidy from electricity consumers through distributor.	Cross-subsidy from electricity consumers through distributor.	Cost-neutral to retailers and customers.	Cross-subsidy from electricity consumers through distributor.	Cross-subsidy from electricity consumers through distributor.	No subsidy	On budget	On budget	No subsidy	Cross-subsidy from electricity consumers through distributor.	Cross-subsidy from electricity consumers.
Delivery agents	Retailer	Information not available	Distributor and retailer	Distributor and retailer	Retailer	Distributor and retailer	Distributor and retailer	Franchise retailers (government owned)	Retailer	Distributor and retailer	Retailers	To be determined	Distributor with retailer required to pay "normal" cost of electricity (~6 c/kWh)

Jurisdiction*	Vic (standard)	Vic (transitional)	Vic (premium)	SA	SA	Qld	Qld (Fair)	WA (Fair)	WA	NSW	NSW (Fair)	Tas	ACT
Capacity limit	100 kW installed, non-pool	Small-scale solar PV systems of	5 kW	First 45 kWh/d	The 45 kWh/d export limit	5 kW	5 kW	5 kW (regional retailer)	5 kW (regional retailer)	10 kW	Information not available	Generally 3 kW but subject to	30 kW
Eligibility	Households, community organisations and small businesses	Households, community groups and small businesses with consumption <100 MWh/yr	Households, community groups and small businesses with consumption <100 MWh/yr	Domestic, small business and community groups consuming <160 MWh/yr	Domestic, small business and community groups consuming <160 MWh/yr	Domestic/s mall energy users consuming <100 MWh/yr	Domestic/s mall energy users consuming <100 MWh/yr	Residential, educational and not-for-profit community organisations	Residential only. Applicant must be eligible for & participate in Renewable Energy Buyback Scheme (fair)	Small electricity consumers with annual consumption up to 160 MWh	Information not available	Small customers (NB not restricted to residential customers)	Domestic/commercial/industrial/educational (except non-educational government agencies).
Eligible forms of RE generation	Wind, solar, hydro, biomass	Solar PV	Solar PV	Solar PV	Solar PV	Solar PV	Solar PV	Solar PV, wind and micro hydro	Solar PV, wind and micro hydro, emerging technologies on review	Solar PV or wind turbines	Solar, although information not clear	Renewable generation only – solar PV, wind, micro hydro	All NEL-compliant renewable energy
How often is the tariff set?	Fixed in legislation	Fixed in legislation	Fixed in legislation	Fixed in legislation	Fixed in legislation	Fixed in legislation	Fixed in legislation	Annually	Was reviewed after 10 MW capacity installed or 3 years, however, now suspended	Fixed in legislation	Information not available	Linked with relevant retail rate, therefore automatically adjusted	Rate is determined by the Minister for each financial year

Jurisdiction*	Vic (standard)	Vic (transitional)	Vic (premium)	SA	SA	SA	Qld	Qld (Fair)	WA (Fair)	WA	NSW	NSW (Fair)	Tas	ACT
How is the tariff amount paid?	Tariff paid as a credit to the customer's bill, unused credit may expire or be paid out depending on contract with retailer	Tariff paid as a credit to the customer's bill, unused credit may expire or be paid out depending on contract with retailer	Tariff paid as a credit to the customer's bill, unused credit may expire or be paid out depending on contract with retailer	Tariff paid as a credit to the customer's bill, unused credit, after 12 months of being in credit cash payment made	Information not available	Tariff paid as a credit to the customer's bill, unused credit, after 12 months of being in credit, cash payment made	Information not available	Information not available	Paid as a credit on the customer's electricity account. Can receive payment if electricity account is in credit by AUD 100 or more	Paid as a credit on the customer's electricity account. Can receive payment if electricity account is in credit by AUD 100 or more	Tariff paid as a credit to the customer's bill, or as a cash payment, at the retailer's discretion.	Information not available	Generally credited to customer's account at the end of the billing period, but subject to individual consideration. May be paid to customer if in net credit at the end of a billing period	Tariff paid as a credit to the customer's bill, unused credit dealt with in contracts with retailers
Reporting requirements - distributor	Information not available	Monthly: - the number connected - the aggregate capacity - total amount of electricity generated	Bi-annually: - the number connected - the aggregate capacity - total amount of electricity generated	None	Information not available	Every six months on the number of customers, the amount of electricity supplied, total generation capacity	Information not available	Information not available	Information not available	When directed	Every six months on number of customers. Postcodes of each total generation capacity, amount of electricity supplied to area	Information not available	To be determined	Quarterly on number of connection applications by suburb, number of new connections by suburb, total installed capacity by suburb, total metered output by suburb
Reporting requirements - retailer	Monthly: - the number connected - the aggregate capacity - total amount of electricity generated	Information not available	Information not available	None	Information not available	Every six months on: the no of small customers receiving credit, the amount credited	Information not available	Information not available	When directed.	Uptake, capacity and forecast capacity are reported monthly. Additional reporting as directed.	Nil	Information not available	To be determined	Quarterly on the number of customers receiving the FIT, the total premium FIT paid

For further information see Annex D.

Source: Department of Resources, Energy and Tourism.

Box 5. National principles for feed-in tariff schemes

1. Micro renewable generation to receive fair and reasonable value for exported energy.

That governments agree that residential and small business consumers with small renewables (small renewable consumers) should have the right to export energy to the electricity grid and require market participants to provide payment for that export which is at least equal to the value of that energy in the relevant electricity market and the relevant electricity network it feeds into, taking into account the time of day during which energy is exported.

2. Any premium rate to be jurisdictionally determined, transitional and considered for public funding.

That any jurisdictional or cooperative decisions to legislate rights for small renewable consumers to receive more than the value of their energy must:

- be a transitional measure (noting that a national emissions trading system will provide increasing support for low emissions technologies), with clearly defined time limits and review thresholds;
- for any new measures, or during any reviews of existing measures, undertake analysis to establish the benefits and costs of any subsidy against the objectives of that subsidy (taking into account other complementary measures in place to support small renewable consumers);
- give explicit consideration to compensation from public funds or specific levies rather than cross-subsidised by energy distributors or retailers; and
- not impose a disproportionate burden on other energy consumers without small renewable generation.

3. Ministerial Council on Energy to continue to advance fair treatment of small renewables.

That the Ministerial Council on Energy (MCE) should continue to implement the regulatory arrangements for small renewable customers, consistent with the objectives of the relevant electricity legislation, whereby the:²¹

- terms and conditions for PV customers should be incorporated into the regulation of the minimum terms and conditions for retail contracts such that they are no less favourable than the terms and conditions for customers without small renewables;
- connection arrangements for small renewables customers should be standardised and simplified to recognise the market power imbalance between small renewable customers and networks; and
- assignment of tariffs to small renewable consumers should be on the basis that they are treated no less favourably than customers without small renewables but with a similar load on the network.

21. The Council of Australian Governments' (COAG) Standing Council on Energy and Resources (SCER) was established in November 2008 and will carry on key reform elements of the Ministerial Council on Mineral and Petroleum Resources and the Ministerial Council on Energy.

Box 5. National principles for feed-in tariff schemes (continued)

4. FiT policy to be consistent with previous COAG agreements (particularly the Australian Energy Market Agreement).

That the arrangements for PV consumers by the MCE and jurisdictions:

- should not deter competition for their business from electricity retailers in jurisdictions where there is full retail contestability and innovation in the tariff offerings available to PV customers;
- in relation to jurisdictions in the National Electricity Market (NEM), should not interfere with the regulation of distribution tariffs or operation of the NEM under the National Electricity Law or duplicate the regulatory arrangements that are part of that law;
- should be subject to independent regulatory oversight according to clear principles; and
- should be consistent with implementation of other intergovernmental agreements relating to energy, competition policy or climate change.

Source: Council of Australian Governments Meeting, Canberra, 29 November 2008.

RENEWABLE ELECTRICITY GENERATION

OVERVIEW

Australia has large, widely distributed wind, solar, geothermal, hydroelectricity, ocean energy and bioenergy resources. Nonetheless, much of this potential remains to be exploited. To date, production of renewable energy has been dominated by bagasse, residue leftover after juice extraction from sugar cane, wood and wood waste, and hydroelectricity, which together accounted for 83% of renewable energy production in 2009/10. Wind energy, solar energy and biofuels accounted for the remainder of renewable energy production.

Table 5. Australian electricity generation, by fuel type

Generation output (GWh)	2005/06	2006/07	2007/08	2008/09	2009/10
Renewable fuels					
Bagasse, wood	935	950	960	1 440	1 220
Biogas	85	90	68	884	893
Wind	1 713	2 611	3 093	3 806	4 798
Hydro	16 029	14 517	12 057	11 052	12 522
Solar PV	105	123	156	156	278
Total renewable	18 867	18 291	16 333	17 338	19 711
Total non-renewable	225 794	230 103	237 626	227 056	221 855
Total generation output	244 660	248 394	253 959	244 395	241 567

Source: *Energy in Australia 2012*, Bureau of Resources and Energy Economics, Commonwealth of Australia, 2012.

Recent projections from the Bureau of Resources and Energy Economics suggest that the share of renewable energy is projected to increase from 5% of total primary energy consumption in 2008/09 to 9% in 2034/35. This implies an average annual growth rate of 3.4%, with the most significant growth occurring in wind energy.

The relative shares of non-renewable and renewable energy in total electricity generation are also expected to change considerably over the projection period when the Renewable Energy Target and the introduction of carbon pricing are taken into account. The incentives provided to generators under the Renewable Energy Target are expected to be the major driver of the accelerated uptake of renewable technologies in the period to 2020. After 2019/20, renewable electricity generation is projected to continue to increase, albeit at a slower pace.

The use of renewable energy resources in electricity generation is expected to grow considerably at 6% a year over the projection period. Wind energy is projected to account for the majority of this growth, representing 14% of total electricity generation in 2034/35. Strong growth is also expected in other renewable energy sources, including solar energy, geothermal energy and bioenergy, although from a lower base.

Wind power

According to the Clean Energy Council, the total operating wind capacity at the beginning of 2011 in Australia was 1 991 MW.²² The amount of installed capacity of wind power has increased by an average of 30% a year over the past decade and supplies over 5 100 GWh of electricity annually, around 2% of Australia's overall electricity needs.

Currently there are 53 operating wind farms in Australia, with a total of 1 089 operating turbines. South Australia has the largest installed capacity with around 51% of the nation's total wind capacity. Wind energy is projected to account for the majority of the increase in generation from renewable energy sources, growing at an average annual rate of 10.1% to 2034/35 when it is projected to account for 14% of electricity generation.

Wind energy in South Australia and Western Australia

South Australia is the largest producer of wind energy in the country and hosts 51% of installed capacity. There are currently 13 wind farms operating across the state with an installed capacity of 1 018 megawatts (MW) of power. A further 184 MW of wind farm projects are under construction. The Australian Energy Market Operator (AEMO), in its *2010 South Australia Supply Demand Outlook*, estimates that in 2009/10, 18% of the state's energy production came from wind power. South Australia has been highly successful in attracting a significant portion of the investment in wind energy in the country. In mid-2009, Renewables SA was established to encourage further investment in renewable energy to the state.

Renewable energy fuels about 5% of all electricity generated for Western Australia's largest power grid, the South West Interconnected System (SWIS). In June 2010, there were 18 renewable energy facilities on the SWIS, with a combined installed generating capacity of 218 MW. Wind produces 79% of the renewables-based electricity on the SWIS.

22. The Clean Energy Council (CEC) is an industry association made up of more than 600 member companies operating in the fields of renewable energy and energy efficiency.

Bioenergy

Currently, Australia's bioenergy resources are dominated by bagasse, wood waste, and capture of gas from landfill and sewage facilities for generating heat and electricity. Commercialisation of second-generation technologies using a range of non-edible biomass feed stocks indicates that bioenergy has the potential to make a growing contribution to renewable electricity generation in Australia. However, this growth may be constrained to some extent by competition for inputs used in the production of bioenergy, such as water availability and logistical issues associated with handling, transport and storage. Nonetheless, the use of bioenergy for electricity generation is projected to increase by 3.5% a year over the projection period, but will still account for only 1.0% of total generation by 2034/35.

Solar energy

Australia takes a leading role in developing solar technologies; however, uptake has been low largely because of their relatively high investment cost. Electricity generation from solar energy in Australia is largely sourced from photovoltaic (PV) installations and until recently has been limited to small-scale pilot projects. Nonetheless, solar in electricity generation is projected to grow at 13.6% a year over the period to 2034/35, but from a very low base.

The cost of installing solar capacity has generally been declining over time and there is potential for the cost of solar technologies to continue to decline over the projection period given the substantial R&D funds allocated towards these technologies. This will contribute to their competitiveness over the period to 2034/35. In addition, the Australian government has implemented a number of policies that are expected to increase the uptake of solar technologies, including the Solar Flagships Program and the establishment of the Australian Solar Institute.

Hydropower

Hydroelectricity generation is projected to remain broadly unchanged in volume terms over the projection period because of the limited availability of suitable locations for capacity expansion and water supply constraints. Over the period to 2034/35, most of the expected expansion in capacity is assumed to be associated with the upgrading of existing equipment and small-scale schemes.

Geothermal electricity

Australia has large geothermal energy potential. However, these resources are currently considered sub-economic because geothermal technologies for electricity generation have not been demonstrated to be commercially viable in Australia. There is one geothermal electricity project in operation in Australia, at Birdsville in Queensland and there are several proposed geothermal projects at the early stages of development. Geothermal energy is not expected to play a major role in electricity generation over the medium term although it is forecast to increase to 4% of total electricity generation by 2034/35.

SMALL-SCALE RENEWABLE ELECTRICITY

Renewable Remote Power Generation Program (RRPGP)

Since 2001, the Renewable Remote Power Generation Program (RRPGP) has supported replacement of stand-alone fossil fuel generation with renewable energy in parts of

Australia not close to the main grid with a particular focus on improving energy outcomes in remote Indigenous communities. RRPGP closed to new applications in 2009 though several projects supported by the program are still in-development. The program offered rebates of up to 50% of the capital cost of installations ranging from household level to small townships in scale.

Solar Homes & Communities Plan (SHCP)

The SHCP, previously named the Photovoltaic Rebate Program (PVRP), was introduced in 2000 with a budget of AUD 31 million over four years for 1 kW photovoltaic systems. When the then-PVRP was amended in November 2007, the programme had helped to install almost 10 000 solar power systems and was receiving on average 153 applications per week. The renamed SHCP was scheduled to terminate on 30 June 2012, but because of very high demand, the closing date for the acceptance of pre-approvals was brought forward to 9 June 2009.

The change to the SHCP in 2007 ensured that rebates based on a rate of AUD 8.0 per watt to a maximum of 1.0 kW were paid. This rate of rebate combined with a reduction in the production costs of panels led to an unprecedented uptake of rebates under the programme. The SHCP was formally closed on 9 June 2009 at which time the cost of a 1.0 kW system had plateaued to equal the price of the government rebate of AUD 8 000.

Over the life of the programme, close to 130 000 installations will be achieved. From 9 June 2009, assistance is being offered through the solar credits mechanism within the small-scale (SRES) component of the Renewable Energy Target scheme.

Solar credits

Solar credits under the SRES provide additional support to households, businesses and community groups that install small renewable energy generation units, such as rooftop solar panels, and small-scale wind and hydroelectricity systems by multiplying the tradable certificate allocations for eligible installations. The multiplier declines over time, reflecting expected reductions in system costs.

Box 6. New South Wales Renewable Energy Development Program

The Renewable Energy Development Program is administered under the NSW Climate Change Fund and provides AUD 40 million over five years to support projects which are expected to lead to large-scale greenhouse gas emission savings in New South Wales by:

- demonstrating renewable energy technologies in NSW;
- supporting the early commercialisation of renewable energy technologies in NSW.

The programme supports renewable energy projects which will generate electricity or displace grid electricity use in NSW for stationary energy purposes. It defines renewable energy as energy which is naturally occurring and which is theoretically inexhaustible, such as energy from the sun or wind. It includes energy sourced from hydro, wind, solar, wave, tide and ocean, food waste and biomass. Round One of the Renewable Energy Development Program allocated AUD 24.8 million to six renewable energy projects.

Source: Government of New South Wales, Office of Environment and Heritage.

HEATING AND COOLING

The Australian government offers a small number of schemes to promote renewable heating technologies.

The **Renewable Energy Bonus Scheme—Solar Hot Water Rebate (REBS)** is available to help eligible home-owners, landlords or tenants to replace electric storage water-heating systems with solar or heat pump water-heating systems. Under REBS, eligible households can claim a rebate of AUD 1 000 for a solar water-heating system or AUD 600 for a heat pump system. On 28 February 2012, the Australian government announced that REBS will close on 30 June 2012. The government remains committed to securing a clean energy future and continues to support Australian households and industry through the Small-scale Renewable Energy Scheme. Under this scheme, solar and heat pump water-heating systems are assigned a number of small-scale technology certificates (STCs). These are commonly bought back by the retailer through a discount of around AUD 1 000 off the upfront cost of a medium-sized system.

The **National Solar Schools Program (NSSP)** offers eligible primary and secondary schools grants of up to AUD 50 000 (up to AUD 100 000 for eligible multi-campus schools) to install solar and other renewable power systems, solar water-heating systems, rainwater tanks and a range of energy efficiency measures. More than 90% of funded schools are installing solar power systems and almost a third are installing other energy efficiency measures such as lighting. More than 2 500 schools are participating in the scheme.

TRANSPORT

According to the Australian government, alternative fuels currently account for approximately 5% of transport fuels consumption with liquefied petroleum gas (LPG) accounting for around 4% and biofuels almost 1%.

At the moment the fuel industry consists of three ethanol producers and four biodiesel producers, plus a small number of very small biodiesel producers who produce small quantities. Total Australian ethanol production in 2010/11 was 319 million litres (ML), while 77 ML of biodiesel was supplied into the Australian market through both domestic production and imports. Of the approximate 6 400 service stations across Australia, 4 300 sell at least one alternative transport fuel. LPG has the largest network at an estimated 3 700 locations. Approximately 20% of Australia's retail fuel distribution outlets provide biofuels of which petrol-ethanol blends generally contain up to 10% ethanol, while biodiesel is generally sold wholesale in bulk to fleet operators.

Nonetheless, the government has introduced a number of initiatives to increase the deployment of next generation biofuels. These include AUD 12.6 million for the Second Generation Biofuels Research and Development Program and AUD 20 million for the Advanced Biofuels Investment Readiness Program, which will focus on advanced biofuels development. The Ethanol Production Grants Program and the Energy Grants (Cleaner Fuels) Scheme have been extended indefinitely, with both programmes to be subject to a review after 30 June 2012. The Ethanol Distribution Program ended in 2008.

Second Generation Biofuels Research and Development Program

The Second Generation Biofuels Research and Development (Gen 2) Program is a competitive grants programme which supports the research, development and

demonstration of new biofuel technologies and feed stocks that address the sustainable development of a biofuels industry in Australia.

Applications for participation in the Gen 2 Program closed in January 2009 and the scheme is expected to expire in June 2012. In August 2009, funding of AUD 12.617 million was allocated to six projects over three years from 2009/10 to 2011/12 as part of the Clean Energy Initiative. The scheme is funding up to 50% of eligible expenditure on a number of approved projects, including:

- An AUD 1.24 million University of Melbourne project researching biofuel potential from micro algae involving the efficient separation, processing and utilisation of algal biomass.
- An AUD 2.724 million Algal Fuels Consortium project to develop a pilot-scale second-generation bio refinery for sustainable micro algal biofuels and value-added products located at Torrens Island, South Australia.
- An AUD 2.5 million Curtin University of Technology project located in Perth, Western Australia, which is investigating the sustainable production of high-quality second-generation transport biofuels from mallee biomass by pyrolysis and utilising the biorefinery concept.
- An AUD 1.326 million Bureau of Sugar Experiment Stations project, located at Indooroopilly, Queensland, which is developing an optimised and sustainable sugar cane biomass input system for the production of second-generation biofuels,.
- An AUD 2.539 million Microbiogen Pty Ltd project, located at Lane Cove, New South Wales, which aims to produce commercial volumes of ethanol from bagasse using patented yeast strains.
- An AUD 2.288 million Licella Pty Ltd project, located at Somersby, New South Wales, will examine the commercial demonstration of lignocellulosics to stable bio-crude.

Ethanol Production Grants scheme

The Ethanol Production Grants scheme was introduced in September 2002 to encourage the use of ethanol in the Australian transport industry. Grants are payable to fuel ethanol producers at a rate of AUD 0.38143 per litre for eligible ethanol. The scheme is ongoing and scheduled for review after 30 June 2021.

Ethanol Distribution Program

The purpose of the Ethanol Distribution Program was to increase the number of service stations selling 10% ethanol-blended petrol (E10), to increase the volume of E10 sold and encourage the sale of E10 at a lower price than regular unleaded petrol. The programme, which offered two types of grants, is now closed.

An Infrastructure Upgrade Grant of up to AUD 10 000 was available to retail service stations that had upgraded existing equipment or installed new equipment to provide for the sale of E10. The upgrade completion date had to be between 1 October 2006 and 31 March 2008. A further Sales Target Grant of up to AUD 10 000 was available to retail service stations that received the Infrastructure Upgrade Grant and achieved an E10 sales target within 12 months of its upgrade completion date.

Australian states may also determine their own fuel mandates. For example, New South Wales (NSW) currently has a biofuel mandate and other states may have set, or are

considering, their own biofuel targets. The NSW government's ethanol mandate is currently 6% of all petrol sold. On 15 February 2012, the NSW government introduced legislation to remove the requirement for all regular unleaded petrol to be 10% ethanol blended (E10) from 1 July 2012.

Taxation of alternative transport fuels

In the 2010/11 budget, the Australian government announced that it would complete the long-standing plan for energy content-based taxation of alternative fuels with a 50% discount for alternative fuels. On 29 June 2011, the package of four bills in respect to the taxation of alternative transport fuels attained Royal Assent. The new taxation arrangements apply from 1 December 2011. The excise and excise-equivalent customs duty rates for alternative transport fuels are set out in Table 6.

Table 6 reflects the five-step process for introducing gaseous fuels into the taxation regime and the Australian government's decision to maintain a ten-year moratorium on the current taxation and grant arrangements for ethanol, biodiesel, renewable diesel and methanol.

Table 6. Excise and excise-equivalent customs duty rates for alternative transport fuels

	From 1 Dec 2011	From 1 Jul 2012	From 1 Jul 2013	From 1 Jul 2014	From 1 Jul 2015 (final rate)
LPG cents per litre (cpl)	2.5	5.0	7.5	10.0	12.5
LNG cents per kilogramme (c/kg)	5.22	10.45	15.67	20.9	26.13
CNG c/kg	5.22	10.45	15.67	20.9	26.13
Ethanol cpl *	38.143	38.143	38.143	38.143	38.143
Biodiesel cpl **	38.143	38.143	38.143	38.143	38.143

* Domestic ethanol producers will continue to receive grants of 38.143 cpl under the Ethanol Production Grants Program. These grants are subject to compatibility with the relevant programme's eligibility criteria and will continue until at least 30 June 2021.

** Domestic producers and importers of biodiesel will continue to receive grants of 38.143 cpl under the Energy Grants (Cleaner Fuels) Scheme. These grants are subject to compatibility with the relevant programme's eligibility criteria.

Source: Department of Resources, Energy and Tourism.

As noted before, grants of 38.143 cpl are provided for domestic production of ethanol under the Ethanol Production Grants Program. The Energy Grants (Cleaner Fuels) Scheme provides grants of 38.143 cpl for the domestic production and import of biodiesel and renewable diesel. These arrangements will continue until at least 30 June 2021.

Fuel tax credits are also available for heavy-duty vehicles and rates vary depending on how the fuel is used for business purposes. They are also affected by the rate of the road user charge, which is currently 23.1 cpl.

Fuel taxation measures are expected to be reviewed over the next ten years, starting with a review of arrangements for LNG and compressed natural gas (CNG) after 12 months, a broader review of arrangements for gaseous fuels after 1 July 2015 and a review of arrangements for ethanol, biodiesel, renewable diesel and methanol after 1 July 2021. The Productivity Commission also intends to conduct a review of fuel excise arrangements, including an examination of the merits of a regime based explicitly and precisely on the carbon and energy content of fuels.

In June 2011, the Assistant Treasurer announced that the Government would work with the Biofuels Association of Australia and the International Organization for Standardization (ISO) to develop internationally agreed sustainability criteria that can be applied to industry to ensure that support for biofuels does not compromise sustainable production practices and will help facilitate development and use of advanced biofuels. As the ISO process will take several years, a parallel process will occur to develop an interim biofuels standard for Australia.

CRITIQUE

A notable feature of Australia is the abundance of a diverse range of fossil fuels and renewable energy resources. To date, much of the latter resource potential has remained underdeveloped. Nonetheless, Australia has a long history of drawing from its renewable energy resources: the sugar-cane industry has been producing heat and power from bagasse for over 100 years alongside a well-developed hydropower generation system.

At present, Australia relies on fossil fuels for most of its energy needs; in 2009/10 primary energy production was dominated by fossil fuels with renewable energy, largely hydropower, accounting for only 2%. Conversely, in the same year, renewable energy sources accounted for 5% of energy consumption. The deployment of renewable energies can make a major contribution to the reduction of energy-based greenhouse gas (GHG) emissions. Much authority rests within the jurisdiction of the states and territories; therefore, the Australian government must continue to use existing forums to co-operate closely with states and territories to place renewable energy as a strategic feature for Australian energy policy.

Many renewable energy generation technologies need support to bridge the time until they become more competitive with conventional energy. A firm support strategy that contains an element of reducing subsidies over time is essential for a sustainable policy and emerging renewable energy technologies. In Australia, renewable energy technologies receive different direct and indirect financial supports such as the Renewable Energy Bonus Scheme (REBS), feed-in tariffs (state and territorial level), renewable energy certificates (RECs) and benefits from a range of grant programmes, such as the Emerging Renewables Program.

The government has broadened previous goals and set a policy target that the equivalent of 20% of Australia's electricity supply comes from renewable energy sources by 2020 to reduce greenhouse gas emissions. To deliver on this goal, the government has adopted the Renewable Energy Target, a mandatory green certificate scheme.

While the carbon price will help transform the sector over time, the scheme is a key transitional measure designed to accelerate deployment of renewable energy technologies by guaranteeing a market for renewable energy over the next 20 years.

Australia has an abundance of solar, wind, wave and other clean energy sources and the IEA welcomes the range of proposals related to the sector included in the Clean Energy Future Package. Obviously, the most significant of these is the introduction of a carbon price which should provide investors with a strong incentive for the development of clean technologies, especially renewable energy. The IEA also welcomes the establishment of the Clean Energy Finance Corporation which will direct public sector financing for renewable energy and clean technology projects. We also note the independence of the new institution and the significant level of capital available. The Clean Technology

Innovation Program will be making AUD 200 million available for the research and development of clean technologies. A significant challenge for the Australian government will be monitoring the performance and delivery of these large-scale initiatives and ensuring each brings maximum value for the Australian taxpayer.

The Clean Energy Legislative Package, which was transposed into law in November 2011, will have a significant impact on the renewable energy sector. The Clean Energy Regulator Act 2011 has established the Clean Energy Regulator as a statutory authority that will administer, among other things, the Renewable Energy Target. The IEA also understands that legislation establishing the Australian Renewable Energy Agency (ARENA), the new independent statutory agency responsible for funding new renewable energy projects, was implemented in November 2011. Given the scale of the renewable energy programmes Australia is introducing, we welcome this move that will concentrate decisions relating to renewable energy funding in one agency. This will bring many advantages, including targeted funding for early-stage renewable energy technology, such as geothermal, wave and large-scale solar, and will introduce a greater level of investment stability and regulatory certainty to the sector, something that was missing in the past.

In January 2011, the Renewable Energy Target was separated into small-scale and large-scale technology components, and electricity retailers are required under this scheme's legislation to purchase tradable certificates created from the eligible renewable energy installations under both the Small-Scale Renewable Energy Scheme (SRES) and the Large-Scale Renewable Energy Target (LRET). The latter is expected to deliver the bulk of the 20% target (the equivalent of 20% of Australia's electricity to come from renewable sources by 2020) as the Australian government has set the LRET target at 41 000 GWh in 2020. (In states and territories, feed-in tariffs exist primarily for small-scale renewables.)

The Australian Constitution empowers states and territories to legislate energy and, with the exception of the Renewable Energy Target and Energy Efficiency Opportunities, there is no nationally mandated programme, but the Council of Australian Governments agreed in 2008 on a set of principles to increase consistency across jurisdictions for feed-in tariffs.

The amount of greenhouse gas abatement by small-scale renewable energy technologies is limited whereas the strain on the grid, if they are grid-connected, can be noticeable. The challenge of how to co-ordinate regulatory and competitive aspects renewables energy integration also needs to be addressed.

Less than 15% of the total fuel consumption in Australia is biofuels. The Australian government does not support mandates for alternative transport fuels; however some state governments have legislated or proposed biofuels mandates.

States and territories also support R&D in renewables (e.g. the New South Wales Renewable Energy Development Fund or the Queensland Geothermal Energy Centre of Excellence). The economic chances for growth when developing a commercial sector for renewable energy technology should not be underestimated.

RECOMMENDATIONS

The government of Australia should:

- ☐ *Develop a reporting mechanism to regularly monitor and evaluate progress of the various renewable energy-related strands of the Clean Energy Future package in order to ensure the timely and cost-effective delivery of policy and maximum value for Australians.*

- *Maintain an efficient market-oriented approach, such as the Large-scale Renewable Energy Target, to support the integration of large-scale renewables into the grid and, following the recent introduction of a carbon price, review the renewable energy certificates scheme for large-scale renewable generation in order to maintain a cost-effective approach regarding the deployment of renewable energy.*
- *Work closely with the states and territories on the structure and level of feed-in tariffs to ensure that Australia receives maximum benefit for its expenditure.*

6. ELECTRICITY

Key data (2010)

Installed capacity: 58.8 GW

Total gross electricity generation: 242 TWh (+15% since 2000)

Peak demand: 41.6 GW

Electricity generation mix: coal 75%, gas 15%, hydro 5%, wind 2%, biofuels and waste 2%, oil 1%, solar 0.1%

OVERVIEW

Australia is home to one of the most advanced markets for electricity in the OECD. There are few barriers to interstate trade and a national market for electricity now exists along Australia's eastern seaboard, extending into South Australia and Tasmania.

Since the last in-depth review, the Australian and state and territory governments have created a new governance framework. This new framework included the creation of the Australian Energy Market Commission (AEMC), the Australian Energy Regulator (AER) and the Australian Energy Market Operator (AEMO). The AEMC is responsible for rule changes and market development, the AER is responsible for the economic regulation of electricity and gas transmission and distribution networks (except in Western Australia and electricity in the Northern Territory), and the AEMO is now the single electricity and gas market operator in southern and eastern Australia, and co-ordinates high-level national transmission planning.

SUPPLY AND DEMAND

ELECTRICITY GENERATION

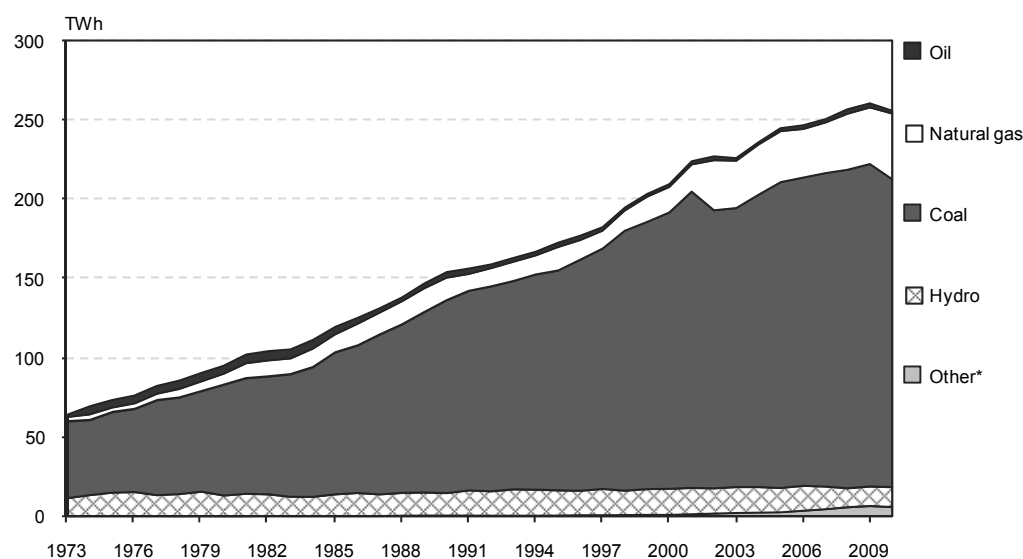
Electricity generation in Australia has followed a strong growth trend over recent decades. The average increase in total electricity generation was 3.2% per year since 1980, while at the same time electricity generation grew on average by 2% per year in IEA countries. In 2009, total gross electricity generation in Australia reached an all-time high at 244 TWh, in contrast to 2010, when it decreased slightly to 242 TWh.

Coal is by far Australia's largest fuel source for electricity generation. In 2010 it accounted for 75% of total electricity generation. Natural gas, the second-largest source in Australia, fuelled 15%, hydro 5%, other renewable energies summed up to 3.7% and oil represented 1.3%. In absolute terms, electricity generated from coal increased by 3.8 TWh between 2000 and 2010, but the share of coal in the generation mix decreased because generation from gas has satisfied much of the growth in demand over that period.

Wind energy has developed rapidly over recent years, from 0.06 TWh generated in 2000 up to 4.8 TWh in 2010, and electricity produced from biofuels and waste more than tripled over the same period, from 1.1 TWh to 3.9 TWh. Despite this rapid growth,

Australia is, together with Poland, the country with the largest share of fossil fuels in its electricity mix. By way of comparison, New Zealand is generating nearly two times more electricity from renewable sources than Australia.

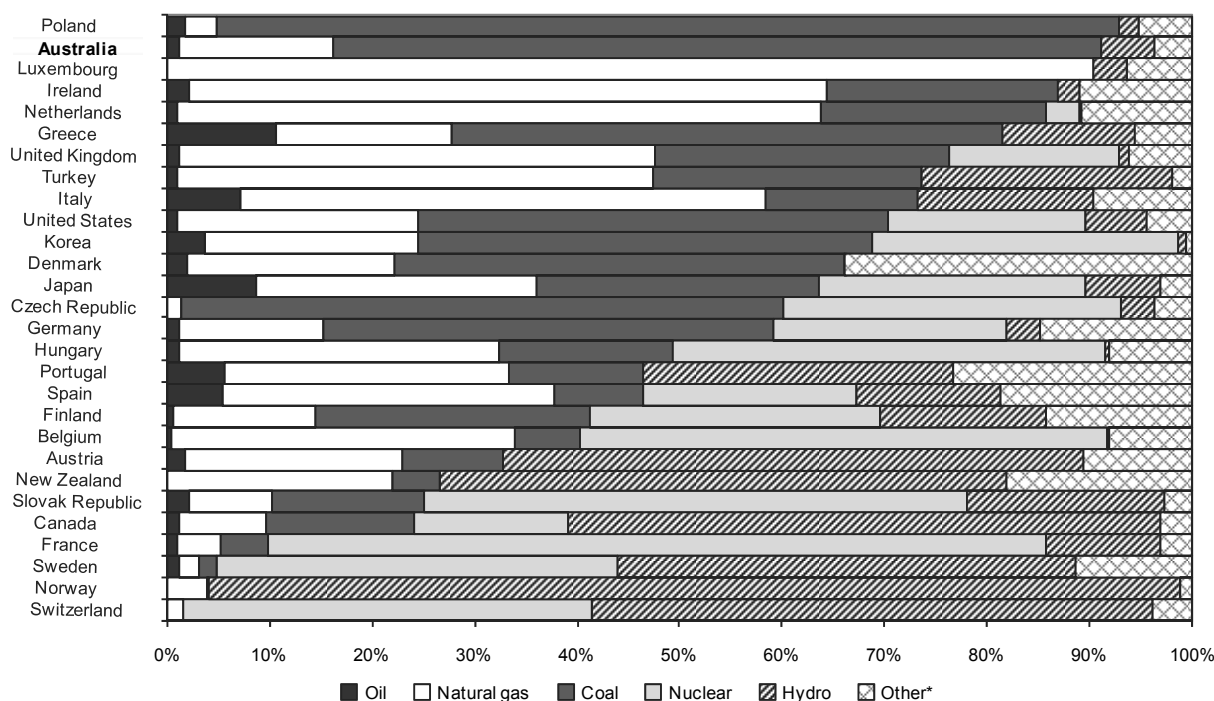
Figure 14. Electricity generation by source, 1973-2010



* Other includes wind, solar, biofuels and waste.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011.

Figure 15. Electricity generation by source in IEA member countries, 2010



* Other includes geothermal, solar, wind, and ambient heat production.

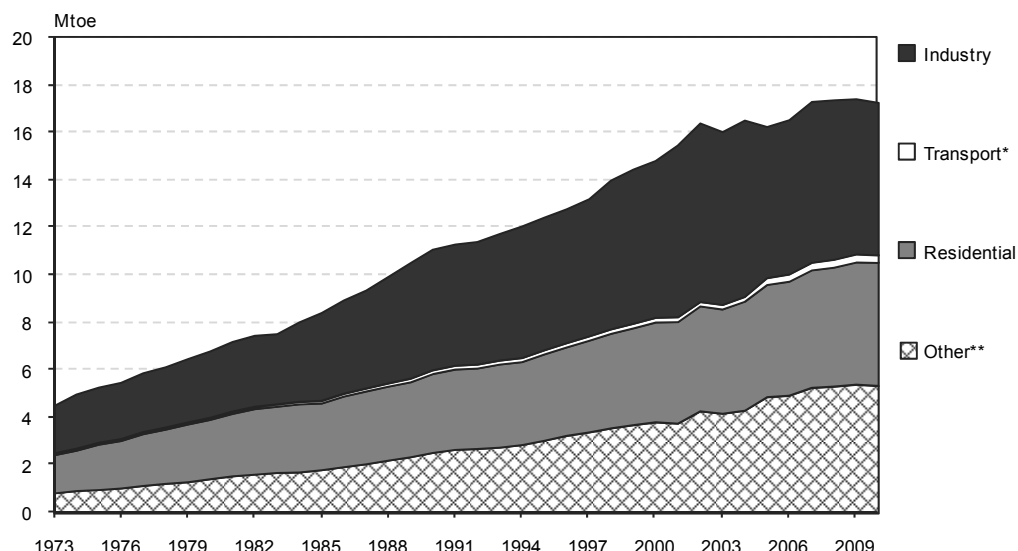
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011.

ELECTRICITY CONSUMPTION

The largest electricity-consumer is the industry sector, which used more than a third of total electricity supply (37%) in 2010. Both the residential sector and the services sector accounted for around 30% of electricity consumption in 2010, with the transport sector accounting for 2%. The shares have remained stable during the last decade as all the sectors are increasing electricity consumption at a similar pace.

Electricity consumption per capita is high in Australia. With 11.3 MWh per capita per year, it is ranked seventh-highest among IEA member countries, the IEA average being 9.5 MWh.

Figure 16. **Electricity consumption by sector, 1973-2009**



* Negligible.

** Other includes commercial, public service, agricultural, fishing and other non-specified sectors.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011.

INSTITUTIONS

At the Special Premiers' Conference in July 1991 it was agreed to "establish a National Grid Management Council (NGMC) to encourage and co-ordinate the most efficient, economic and environmentally sound development of the electricity industry in eastern and southern Australia having regard for key national and State policy objectives". The NGMC was responsible for the creation of the National Electricity Market (NEM), which commenced operation in December 1998.

The **Ministerial Council on Energy (MCE)** was established by the **Council of Australian Governments (COAG)** in 2001 to deliver the full benefits of implementation of the COAG national energy policy framework set out in the COAG Australian Energy Market Agreement (AEMA) of 30 June 2004 as amended.

Since the mid-1990s, MCE-led reforms have included the development of consistent national regulation of natural gas and electricity transmission and distribution infrastructure through national energy market legislation.

In November 2011, the MCE (along with the **Ministerial Council on Mineral and Petroleum Resources**, MCMPR) was formally replaced by the **Standing Council on Energy and Resources** (SCER).

The Australian government's **Department of Resources, Energy and Tourism, with its state and territory counterparts**, currently delivers national policy in the energy market reform programme.

The **Australian Energy Regulator** (AER) is responsible for the regulation of the wholesale electricity market and the economic regulation of the electricity transmission and distribution networks in the NEM. The AER is federally funded and performs its regulatory role at arm's length from the governments. The AER consists of a board of three members, one of which is appointed as Chair.

The AER's current functions are focused on regulating the natural monopoly transmission and distribution sectors of the NEM, monitoring the wholesale electricity market and enforcing electricity market rules. The AER assumed responsibility for regulating energy retail markets from 1 July 2012. Its regulatory functions and powers are conferred upon it by the national electricity law and rules.

The **Australian Energy Market Commission** (AEMC) is the rule maker and developer for Australia's energy markets. As a national, independent body, it develops the detailed rules for the NEM and elements of natural gas markets. It also provides strategic and operational advice to the Council of Australian Governments' Standing Council on Energy and Resources, the successor to the MCE.

In 2009, the **Australian Energy Market Operator** (AEMO) was established by COAG and developed under the guidance of the MCE. AEMO was created by merging six industry bodies from both the electricity and gas markets.²³ AEMO amalgamates the functions previously carried out by these organisations, incorporating management of the NEM and the retail and wholesale gas markets of eastern and southern Australia, and oversees system security of the NEM electricity grid and the Victorian gas transmission network. In addition, AEMO is responsible for national transmission planning.

Retail price regulation, where enforced, is administered by state-based regulatory authorities, including the Queensland Competition Authority, the Independent Pricing and Regulatory Tribunal of New South Wales, the Independent Competition and Regulatory Commission (Australian Capital Territory), the Essential Services Commission of South Australia, and the Office of the Tasmanian Energy Regulator. Retail price regulation no longer applies in Victoria.

WESTERN AUSTRALIA

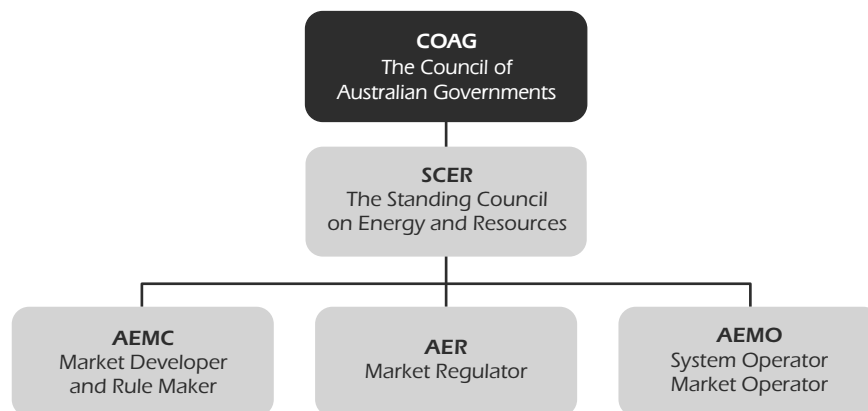
In Western Australia, access arrangements to the transmission network in the South West Interconnected System (SWIS), which covers most of the populated region of Western Australia, including charges payable by generators and retailers are governed by the Electricity Networks Access Code administered by the Economic Regulation Authority.

The independent market operator is responsible for the operation and development of the wholesale electricity market (WEM) in Western Australia. The WEM commenced in

23. National Electricity Market Management Company (NEMMCO), Victorian Energy Networks Corporation (VENCORP), Electricity Supply Industry Planning Council (ESIPC), Retail Energy Market Company (REMCO), Gas Market Company (GMC) and Gas Retail Market Operator (GRMO).

September 2006 after the state government reformed its electricity utility (Western Power) and created a wholesale market open to competition and private sector investment. The IMO, which is owned by the state government, promotes the ongoing development of the WEM and is responsible for ensuring that Western Australia has an adequate supply of electricity.

Figure 17. **Electricity market institutions**



Source: Department of Resources, Energy and Tourism.

MARKET STRUCTURE

NATIONAL ELECTRICITY MARKET

Since 1998 the generation, distribution and supply of electricity in eastern and southern Australian states has been amalgamated under the NEM. There are six participating jurisdictions in the NEM – Queensland, New South Wales, the Australian Capital Territory (ACT), Victoria, South Australia and Tasmania – that are physically linked by an interconnected transmission network.

The NEM, the largest geographical interconnected power system in the world, has approximately 270 registered generators (two-thirds of which is government-owned or controlled), six state-based transmission networks (linked by cross-border interconnectors) and 13 major distribution networks that collectively supply electricity to end users. NEM covers a distance of 4 500 kilometres, from Cairns in northern Queensland to Port Lincoln in South Australia and Hobart in Tasmania. The market has five regions: New South Wales, Queensland, Victoria, South Australia and Tasmania, and supplies electricity to almost nine million residential and business customers.

The main other electricity network is the South West Interconnected System (SWIS), which accounts for over 90% of Western Australia's electricity generation. The state-owned utility, Verve Energy, owns about two-thirds of generating capacity in SWIS, with the remainder privately owned.

GENERATION

In the NEM, black and brown coal together account for around 56% of registered generating capacity but supplies approximately 78% of output, largely in Victoria, New South Wales and Queensland. Gas-fired generation accounts for around 21% of registered

capacity in the NEM but as mid-merit and peaking capacity, gas supplies only around 12% of output while hydroelectric generation accounts for around 16% of registered capacity but less than 8% of output.

Across the states and territories, the ownership profile of generation assets varies: in Victoria and South Australia, generating capacity assets tend to be privately owned while in New South Wales and Queensland the state owns a majority of capacity, although there is growing private-sector activity. In Tasmania, the generation sector remains largely in government hands.

In Victoria and South Australia, the major players are AGL Energy, International Power, TRUenergy and Alinta Energy. Origin Energy has also entered the market in both states. The publicly owned Snowy Hydro owns approximately 20% of Victoria's generating capacity, largely legacy hydropower assets in the Snowy Mountains scheme. In New South Wales, the government owns about 90% of capacity but sold the electricity trading rights of some state-owned power stations and new private generators have entered the market.

In Queensland, state-owned corporations control around 70% of generating capacity, including power purchase agreements over privately owned capacity. There has been some rationalisation of state ownership through the amalgamation and restructuring of electricity assets in 2011, but this did not result at that time in any overall reduction in state control.

Private generation in the South West Interconnected Systems (SWIS) accounted for about 45% of total electricity generating capacity within the state. Synergy and Horizon Power are currently the major suppliers of electricity to the residential and commercial markets, though other suppliers are competing for contestable customers (those who consume more than 50 MWh per year).

TRANSMISSION NETWORKS

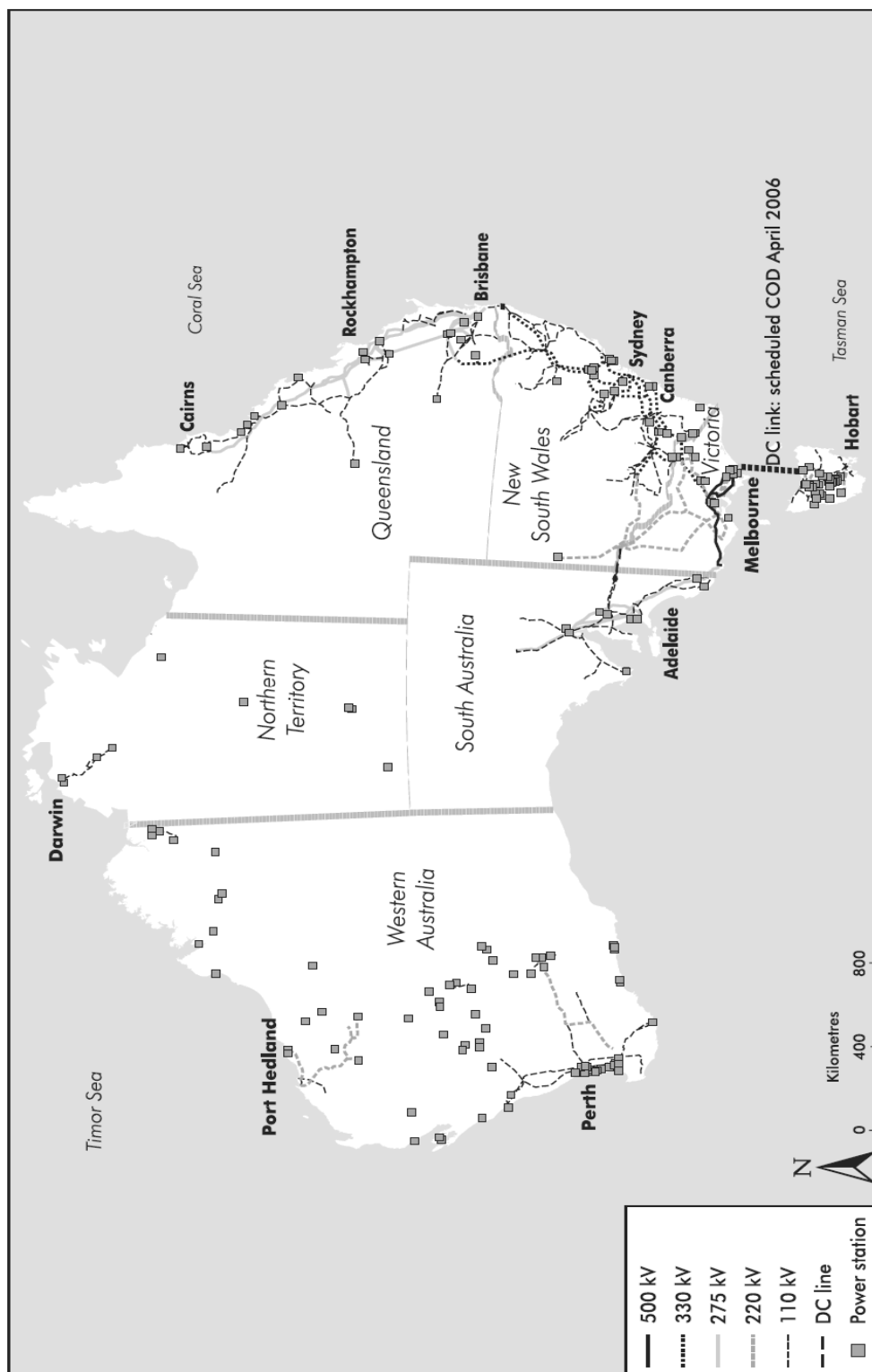
In Australia, there are transmission networks in each state and territory, with cross-border interconnectors linking some of these networks. The NEM in eastern and southern Australia provides a fully interconnected transmission network from Queensland through to New South Wales, the Australian Capital Territory, Victoria, South Australia and Tasmania. The electricity network reaches across the Bass Strait into Tasmania via an undersea interconnector. The transmission networks in Western Australia and the Northern Territory do not interconnect with the NEM or with each other.

Important features of the NEM transmission network include its long distances, low density and long, thin structure. Often, these features are a reflection of the sometimes long distances between demand centres and fuel sources for generation. The 290-kilometre link between Victoria and Tasmania, for example, is one of the longest submarine power cables in the world. A consequence of these attributes is that transmission charges are a more significant contributor to end prices in Australia than they are in many other countries, comprising about 10% of retail prices in the NEM.

Transmission networks consist of equipment that transmits electricity at or above 220 kilovolts (kV), along with assets that operate at 66 to 220 kV and are parallel to, and provide support to, the higher-voltage transmission network.

Planning for the transmission grid is undertaken by jurisdictional planning bodies and augmentations are assessed against a Regulatory Investment Test for Transmission, which seeks to identify net gains on market benefits and reliability grounds. Major upgrades are therefore undertaken on a case-by-case basis.

Figure 18. Australian electricity transmission system



Source: Department of Resources, Energy and Tourism.

The Ministerial Council on Energy (now the Standing Council on Energy and Resources) has recently established a new National Transmission Planning function within the Australian Energy Market Operator (AEMO). In December 2010, AEMO published its first National Transmission Network Development Plan (NTNDP). The NTNDP will provide AEMO's view of the efficient development of the national transmission grid for a planning horizon covering the next 20 years under a range of credible scenarios. A draft version of the second plan was published in January 2011.

The transmission networks in Victoria and South Australia, and the three direct current interconnectors (Directlink, Murraylink and Basslink) are privately owned. Victoria has a unique transmission network structure, which separates asset ownership from planning and investment decision making. SP AusNet owns the transmission assets, but the AEMO plans and directs network augmentation.

In some jurisdictions, electricity networks and other sectors of the electricity supply remain in common ownership. In Tasmania and the Australian Capital Territory, electricity distribution and retailing tend to be one business, with ring-fencing arrangements for operational separation. While Queensland has privatised much of its energy retail sector, the state-owned Ergon Energy continues to provide both distribution and retail services.

In Western Australia are three major electricity networks: the South West Interconnected System, North West Interconnected System and Esperance System. While there are some privately owned electricity transmission and distribution networks within the state; Western Power (SWIS) and Horizon Power (non-SWIS) own the major electricity networks supplying the public. Horizon Power also owns and operates 28 isolated power systems.

DISTRIBUTION NETWORKS

Australia has 16 major electricity distribution networks, 13 of which are located in the NEM. Queensland, New South Wales, Victoria and Western Australia have multiple networks, of which each is a monopoly provider in the designated area. In other jurisdictions, there is one major network. Victoria's five distribution networks are also privately owned, while the South Australian network (ETSA Utilities) is leased to private interests. The ACT distribution network (ActewAGL) has joint government and private ownership. All networks in Queensland, New South Wales and Tasmania are government-owned and the non-NEM jurisdictions of Western Australia and the Northern Territory have retained government ownership of the electricity distribution sector.

The Northern Territory has three small distribution systems with a total of 440 MW capacity operated by government-owned utilities. The total length of the distribution infrastructure in the NEM is around 750 000 kilometres or 18 times longer than transmission infrastructure.

NETWORK REGULATION

The Australian Energy Regulator (AER) regulates all electricity networks in the NEM. The Economic Regulation Authority regulates networks in Western Australia, and the Utilities Commission regulates networks in the Northern Territory. The National Electricity Law is the basis of the regulatory framework for electricity networks. It sets out the national electricity objective: to promote efficient investment in, and operation of, electricity services in the long-term interest of consumers. It also established revenue and pricing principles, notably that network businesses should have a reasonable opportunity to recover at least its efficiently incurred costs.

Regulated network businesses are periodically, generally every five years, required to apply to the AER to assess their revenue needs. Generally, the regulatory regimes are similar and, regardless of the regulatory approach, the AER is required to forecast the revenue requirement of a business to meet its efficiently incurred costs and provide a commercial return.

The aim of the regulatory process is to create incentives for efficient investment. At the start of each regulatory period, the AER approves a capital expenditure forecast for each network. It may also approve large contingent investment projects, foreseen at the time of a regulatory determination, but that may involve significant uncertainty.

Network investment over the present five-year cycle is forecast at over AUD 7 billion for transmission networks and AUD 35 billion for distribution networks. These forecasts represent an increase on investment in the previous regulatory periods of around 82% in transmission and 62% in distribution (in real terms). On an annual basis, transmission investment in the NEM totalled around AUD 1.4 billion in 2009/10 and was forecast to plateau around this level to 2011/12.²⁴ Distribution investment was expected to rise from around AUD 5 billion in 2009/10 to AUD 6 billion in 2011/12.

RETAIL

Victoria and South Australia privatised their energy retail businesses in the 1990s, and Queensland privatised most of its energy retail entities in 2006/07. Three privately owned retailers – AGL Energy, Origin Energy and TRUenergy – supply the majority of small customers in the eastern mainland states. The Australian Capital Territory government operates a joint venture with the private sector to provide retail services. New South Wales, Tasmania, Western Australia and the Northern Territory retain government ownership in the retail sector, although the New South Wales government intends to privatise its energy retail businesses.

The Queensland government owns Ergon Energy, which cannot compete for new customers, has significant market share in rural and regional Queensland. The ACT government has a 50% interest in ActewAGL. Snowy Hydro (owned by the New South Wales, Victorian and Australian governments) owns Red Energy.

All NEM jurisdictions except Tasmania have introduced full retail contestability (FRC) in electricity, which allows all customers to enter a contract with the retailer of their choice. (On 1 July 2011, Tasmania extended contestability to customers that consume at least 50 MWh per year.) All jurisdictions, with the exception of Victoria, apply some form of retail price regulation for electricity services. The Australian Energy Market Commission is currently assessing the effectiveness of retail competition in each jurisdiction in order to advise on ways to remove price regulation where competition is found to be effective. State and territory governments have agreed to phase out price regulation where competition is agreed to be effective.

Data on customer switching rates are available for some Australian states and territories. The Australian Energy Regulator's *State of the Energy Market 2011* report shows that Victoria continues to have a higher switching rate than other jurisdictions. At June 2011 Victoria's cumulative switching rate was around double the New South Wales rate for electricity. While Queensland introduced FRC later than other jurisdictions, its annual switching rates are higher than those in New South Wales and South Australia. While

24. *State of the Energy Market 2011*, Energy Networks, AER, 2011.

churn was higher in gas than in electricity in Victoria and Queensland in 2010/11, cumulative switching levels remain lower in gas than electricity in all jurisdictions. There are limited data available on switching for commercial customers.

While state and territory governments are responsible for regulating retail energy markets at present, the AER will take on significant functions when national reforms take effect on 1 July 2012 whereby state and territory governments are expected to implement a package of reforms under the National Energy Retail Law. The reforms aim to streamline national regulation to support an efficient retail market with appropriate consumer protection. The states and territories will remain responsible for regulating retail energy prices.

SMART GRIDS AND METERING

Both the Australian and state governments have developed plans relating to the introduction of smart meters. Furthermore, COAG has committed to the progressive roll-out of smart meters in jurisdictions where the benefits outweigh costs. Consequently, the development of a framework to support rolling out smart electricity meters in the NEM was continuing in 2011.

Outside of the COAG process, the Victorian government has initiated a programme to provide smart meters to all customers over four years from 2009. While roll-out is continuing, the government initiated a review of the programme's future in 2011. The review included a cost-benefit analysis to determine whether, and under what circumstances, the programme can deliver consumers value for money. A moratorium exists on the introduction of time-of-use tariffs for customers with smart meters. New South Wales, in December 2007, confirmed its commitment to a roll-out of smart meters.

While some smart meters have been rolled out in New South Wales, a further roll-out requires investigation of the benefits outweighing costs. Western Australia (WA) is also considering the possibility and timing of a roll-out of smart meters in the SWIS as part of a review of broader energy market policy in the state. Queensland has some jurisdiction-specific cost concerns and will consider roll-out scope and timeline after further investigation via the pilots and further cost modelling.

In 2009, a report focusing on potential consumer impacts arising from the availability of interval data, including their potential use by network and retail businesses in offering time-related tariffs was published by the Department of Resources, Energy and Tourism.²⁵ Since 2009, a series of studies have been carried out, which have been followed by a series of National Electricity Law and Rules Amendments.

In 2009, the Australian government announced the Smart Grid, Smart City initiative. The aim of the AUD 100 million initiative is to deploy Australia's first commercial-scale smart grid which will in turn generate robust information and data to inform future market activities, broader adoption by industry and government policy around smart grid applications. Based primarily in Newcastle, New South Wales, the initiative explores the use of advanced communication, sensing and metering equipment to provide customers with more transparent information on energy use, cost-reflective energy tariffs, system automation, to improve network reliability and security, and to undertake electric vehicle trials. The initiative is also looking at options to connect additional renewables, distributed generation and storage technologies to the grid.

25. *Smart Meter Consumer Impact Analysis*, EMCA, Department of Resources, Energy and Tourism, April 2009.

The Smart Grid, Smart City project will provide information about the real costs, benefits and impacts of commercial scale deployments of smart grid technologies in the areas of customer, grid and distributed energy applications. The information will be used to enable the industry to better understand and take more informed decisions about the potential opportunities to undertake similar initiatives within its own jurisdictions. The project will deliver reports and data formats that can be tailored and disseminated to meet the information needs and interests of key stakeholders across the Australian energy market, including, but not limited to, the electricity industry, government policy makers and regulators, consumers, the wider community and other utility businesses, such as the National Broadband Network (NBN), and water and gas suppliers.

DEMAND-SIDE PARTICIPATION

At present, large scheduled loads, such as smelters, may elect to withdraw from the market when the spot price reaches a particular threshold, and resume trading when the price falls back to the level of their bids.

The Ministerial Council on Energy (MCE) has acknowledged the potential for demand-side participation (DSP) to improve the efficiency of the NEM and has expressed support for a regulatory framework that promotes the efficient adoption of DSP opportunities. Work to date has focused on addressing barriers to DSP when establishing new national distribution and retail regulatory frameworks under the Australian Energy Market Agreement. DSP opportunities for small customers, particularly residential customers, are also being explored as part of the National Framework for Smart Metering.

MARKET DESIGN

NATIONAL ELECTRICITY MARKET

The NEM, managed by the Australian Energy Market Operator (AEMO) is a gross-pool spot market that operates on the network that covers six of Australia's eight states and territories. The NEM covers about 80% of Australia's electricity generation (including off-grid electricity).

AEMO dispatches generators into production every five minutes according to the merit order of their bids and determines a dispatch price for each of the NEM's five regions on the basis of the next lowest undispached bid. AEMO averages these prices to determine a half-hourly trading price that is used for settlement between market participants.

An interesting feature of the NEM is that it has a market price cap of AUD 12 500 per MWh and a market floor price of minus AUD 1 000 per MWh. The spot price is limited to an administered price cap (APC) of AUD 300 per MWh by AEMO, where the spot price sum of the half-hourly wholesale market spot prices over a rolling seven-day period exceeds the cumulative price threshold (CPT) of AUD 187 500. A Reliability Panel reviews the level of the market floor price, the market price cap and the CPT every four years. The AEMC determines the APC.

AEMO uses the spot price as the basis for the settlement of financial transactions for all energy traded in the NEM. Most market participants enter into financial contracts (options, swaps, etc.) with other parties to hedge against price volatility. The NEM also has an ancillary spot market for ancillary services.

ANCILLARY SERVICES

Ancillary services are services used to secure the safety, security and reliability of the power system and maintain key technical characteristics of the system, including standards for frequency, voltage, network loading and system restart processes.

AEMO operates eight separate markets for the delivery of frequency control ancillary services (FCAS), and purchases network control ancillary services (NCAS) and system restart ancillary services (SRAS) under agreements with service providers.

FCAS providers bid their services into the FCAS markets in a similar way to the way generators bid into the energy market. The FCAS markets were introduced to the NEM in September 2001 and provide simpler, more dynamic and transparent arrangements that have further increased competition and contributed to improved overall market efficiency.

Payments for ancillary services include payments for availability and for the delivery of the services. The market participants or participants responsible for a situation that requires ancillary services pay for individual services whenever FCAS regulations are needed to automatically raise or lower frequency to within the normal operating band of 49.9 hertz to 50.1 hertz.

INTER-REGIONAL TRADE

The NEM comprises five interconnected regions. There is a designated region reference node in each region where the regional spot price of electricity is set. The Queensland, New South Wales, Victoria, Tasmania and South Australia regions all contain both major generation and demand centres.

Interconnectors

Interconnectors are used to import electricity into a region when demand is higher than can be met by local generators, or when the price of electricity in an adjoining region is low enough to displace the local supply.

AEMO's ability to schedule generators to meet demand using an interconnector to facilitate importing electricity is sometimes limited by the physical transfer capacity of the interconnector or by elements of the transmission networks linking the interconnector to load. When the technical limit of an interconnector's capacity is reached, the interconnector is said to be constrained. For example, if prices are very low in one region and high in an adjacent region, electricity can be sent from the first to the second region across an interconnector up to the maximum technical capacity of the interconnector. AEMO's systems will then dispatch local generators with the lowest price offers from within the second region to meet the outstanding consumer demand.

Regulated interconnectors

A regulated interconnector is an interconnector that has been deemed to add net market value to the NEM. Having passed the test, a regulated interconnector becomes eligible to receive fixed annual revenues on the basis of the value of the asset, regardless of actual usage. At present, regulated interconnectors operate between all adjacent regions of the NEM, except Tasmania.

Unregulated interconnectors

Unregulated (or market) interconnectors derive revenue by trading in the spot market. They do this by purchasing energy in a lower-price region and selling it to a higher-price region, or by selling the rights to revenue generated by trading across the interconnector. Unregulated interconnectors are not required to undergo regulatory test evaluation.

An unregulated interconnector – Basslink – operates between the Tasmanian and Victorian regions of the NEM. Murraylink and Directlink were built as unregulated interconnectors between Victoria and South Australia, and New South Wales and Queensland respectively. They successfully applied for conversion to regulated status.

Losses

Loss factors within each region of the NEM are calculated by forecasting demand, and fixed for a period of 12 months to facilitate efficient scheduling and settlement processes in the NEM. Loss factors between regions of the NEM are dynamically calculated and reflect the operating conditions at the time of the transmission of the electricity. The losses are equivalent to approximately 10% of the total electricity transported between power stations and market customers.

SWIS MARKET

Electricity in the South West Interconnected System (SWIS) is traded through a combination of bilateral contracts, a short-term energy market (STEM, a day-ahead market) and a balancing market. Generators and consumers submit their supply and demand to the independent market operator (IMO) days before each trading day, according to their bilateral contracts. The day before the trading day, parties trade around their positions on the STEM, and the IMO sets a market price and clears trades.

On the trading day, the IMO balances actual supply and demand and sets a market price for deviations to STEM positions, usually the same as the STEM price, and settles trades. The IMO also administers a capacity market in the SWIS in which generators are assigned capacity credits entitling them to payments for offering capacity into the market at all times. The SWIS has a generating capacity of about 400 MW (some privately owned) and is operated by a government-owned vertically-integrated utility.

DRAFT ENERGY WHITE PAPER

A Draft Energy White Paper 2011: Strengthening the Foundation for Australia's Energy Future was published for public consultation in December 2011. The paper fulfils the Australian government's commitment to publish a Draft Energy White Paper (EWP) by the end of 2011. Following the completion of the consultation process, the government anticipates that a final EWP will be released late in 2012. The Draft EWP contains significant proposals in relation to both the electricity and natural gas markets.

The Draft EWP asserts the Australian government belief that the fundamental design of the electricity market is sound and that there is no justification for another "root and branch" review. Nonetheless, the Draft EWP acknowledges a need to follow through on outstanding actions from previous energy market reviews, notably retail price deregulation (while empowering consumers and protecting vulnerable consumers), reducing government ownership in energy markets and furthering the transition to truly national markets by extending market governance arrangements and principles to all electricity and gas markets.

The Draft EWP identifies a number of key actions that need to be taken including improving the investment climate (the Draft EWP acknowledges that there are a range of largely non-market climate-related interventions that are adding to the complexity of investment decisions for market participants), improving market competition and innovation, enhancing electricity network efficiency and productivity, development of a robust smart metering framework and the commissioning of an independent review by the Productivity Commission into the use of benchmarking of network businesses to improve efficiency.

PLANNING AND FORECASTS

ELECTRICITY STATEMENT OF OPPORTUNITIES

The Australian Energy Market Operator (AEMO) publishes a ten-year forecast called the *Electricity Statement of Opportunities* (ESOO) each year. This publication provides information to assist market participants assess the future need for electricity generating capacity, demand-side capacity to support the operation of the NEM. It also contains forecasts of ancillary service requirements, minimum reserve levels, and economic and operational data to assist potential investors gain a full understanding of the NEM.

AEMO is the national transmission planner for the electricity transmission grid and is required to prepare annual network development plans to guide investment in the power system. In 2009, an interim national transmission statement (NTS) replaced the previous annual national transmission statement produced by the National Electricity Management Company (NEMMCO). This document is superseded by the National Transmission Network Development Plan (NTNDP) since 2010.

Planning for individual transmission networks is the responsibility of transmission network service providers in Queensland, New South Wales and Tasmania. AEMO carries transmission planning functions for Victoria and South Australia. The planning document, *Annual Planning Report* (APR), is published yearly. The National Electricity Rules require that AEMO and transmission network service providers must develop their plans in a co-ordinated manner. The Energy Market Commission (AEMC) also holds the last-resort planning power. The purpose of a last-resort planning power is to ensure timely and efficient inter-regional transmission investment for the long-term interests of consumers of electricity.

ELECTRICITY SECURITY

In the NEM, AEMO is required to operate the power system efficiently and ensure agreed standards of security and reliability are maintained. An Energy Security Council (ESC) was announced by the Australian government in July 2011 as part of its Clean Energy Future package. The aim of this mechanism is to provide assurance that energy supply security will be maintained during the transition to a clean energy future and to help manage any residual energy security concerns. Accordingly, the ESC will advise the Government on emerging risks to energy security. The ESC includes the heads of the AEMC, the regulator AER, the Australian Securities and Investment Commission and experts in the fields of business, public finance, insolvency and the energy market, and will consult with the managing director of AEMO.

SECURITY OF SUPPLY

AEMO's highest priority as power system and market operator of the NEM is the management of power system security. Security of electricity supply is a measure of the

power system's capacity to continue operating within defined technical limits despite the disconnection of a major power system element, such as a generator or interconnector. The maintenance of power system security ensures that the power system is operated within system security limits after a credible contingent event.

POWER SYSTEM RELIABILITY

In the NEM, the reliability standard for generation and bulk supply is set to ensure that unserved energy per year for each region does not exceed 0.002% of the total energy consumed in that region that year. In 2009/10, the peak load in the NEM was 34.5 GW while maximum generating capacity was 44.8 GW on 30 June 2009, giving a reserve capacity of over 22% in the NEM. Generating capacity in the SWIS on 30 June 2009 was 5.4 GW compared with peak demand in 2008-09 of 3.5 GW giving a reserve level of over 35%. Each year, AEMO publishes the *Electricity Statement of Opportunities* which forecast supply capacity and demand outlook data for the next decade for the NEM to flag opportunities for growth, in generation and demand-side investment.

There has been significant investment in transmission and distribution networks. Investment in NEM transmission networks over the ten years to 2011/12 is forecast to total around AUD 12.4 billion. Investment in most distribution networks has risen steadily over the current decade to forecast levels in 2008/09 of over AUD 4.1 billion in the NEM and AUD 380 million in Western Australia.

Market enhancements since 2005 involving the development of relevant national governance arrangements, laws, rules and institutions to facilitate infrastructure investment, network interconnection and effective energy competition, have included:

- the creation of a new governance framework made up of the Australian Electricity Market Commission, to carry out rule changes and market development, and the Australian Energy Regulator, responsible for the economic regulation of electricity and gas transmission and distribution networks (except in relation to electricity and gas in Western Australia and electricity in the Northern Territory);
- the establishment of AEMO in 2009 as the single electricity and gas market operator in southern and eastern Australia, to co-ordinate high-level national transmission planning;
- the introduction in 2010 of a new regulatory investment test for transmission;
- the amendment of the National Electricity Law and the National Electricity Rules to transfer economic regulation of electricity distribution to the national framework; and
- further amendment of the National Electricity Law, National Electricity Rules, to transfer non-price national retail and non-economic distribution regulation from the states and territories into the national framework, including new National Energy Retail Law and Rules.

Associated with the introduction of a price on carbon in 2012, the Australian government is establishing an Energy Security Fund to smooth the transition and maintain energy security through transitional assistance to highly emissions-intensive coal-fired power stations. This assistance will come with conditions to ensure security of supply and transparent information on the action taken by these generators to move to a cleaner energy future.

NATIONAL ENERGY SECURITY ASSESSMENT

The National Energy Security Assessment (NESA) identifies key strategic energy security issues in the liquid fuels, natural gas and electricity sectors currently, and those likely to influence the level of energy security over the period 2011-35. The NESA was updated in December 2011 and concluded that energy security remains moderate over the 2011 NESA period (2011 to 2035).²⁶

The assessment noted that the electricity sector faces significant challenges during the assessment period, driven by reliability and price pressures associated with the implementation of climate change and renewable energy policies, as well as the upgrading and refurbishment of ageing network infrastructure in the face of rising demand. However, ongoing market maturity, established by market reforms and mechanisms associated with the Australian government's Clean Energy Future package will assist in facilitating a flexible market response to such challenges.

As part of the assessment, the government also published an electricity shock scenario, which examines the impact shock disruptions may have on Australia's energy security.²⁷ The scenario modelled in the report is the sudden exit or failure of a Victorian 2 270 MW baseload power station from the NEM. The report concludes that the flexibility in the electricity and gas markets would mean that even short-term capacity constraints to particular electricity transmission infrastructure would not result in any significant reduction in reliability. However, any short-term capacity constraints to gas transmission infrastructure would likely increase the cost of meeting electricity demand.

ELECTRICITY PRICES

Retail electricity prices for residential and small business customers are regulated in all Australian states and territories except Victoria (which removed price regulation in January 2009). Historically, Australian electricity prices tended to be lower than in many other IEA member countries but anecdotal evidence suggests that average electricity prices have grown by as much as 40% in the past five years and prices are now among the highest in the IEA.

Independent regulators in each jurisdiction set price caps which retailers can charge for consumers on standing offer contracts. These jurisdictional regulators include: the Queensland Competition Authority; the Independent Pricing and Regulatory Tribunal of New South Wales; the Australian Capital Territory's Independent Competition and Regulatory Commission; the Office of the Tasmanian Energy Regulator; and the Essential Services Commission of South Australia. The Western Australia and Northern Territory governments regulate prices in those jurisdictions.

All Australian states and territories have agreed under the Australian Energy Market Agreement (AEMA) to phase out retail price regulation for electricity and natural gas where effective competition can be demonstrated. The Australian Energy Market Commission (AEMC) has responsibility for reviewing the effectiveness of retail energy market competition in jurisdictions (the Economic Regulation Authority has responsibility in Western Australia).

26. *National Energy Security Assessment December 2011*, Department of Resources, Energy and Tourism, 2011.

27. *NESA: Electricity Shock Scenario; A Final Report* prepared for the Department of Resources, Energy and Tourism by Frontier Economics, September 2011.

To date, the AEMC has reviewed the effectiveness of retail energy market competition in Victoria and South Australia, and although competition was found to be effective in both states, only Victoria has since removed retail price regulation.

The Australian Energy Regulator's *State of the Energy Market Report 2009* provides a summary of wholesale electricity prices both within and outside the NEM. It also provides indicative data on retail electricity prices in each state and territory. The AEMC has also recently begun annual reporting on electricity prices across Australia.

CRITIQUE

Australia is home to one of the most advanced markets for electricity in the OECD. There are few barriers to interstate trade in electricity. A national electricity market, the NEM, now exists along Australia's eastern seaboard, extending into South Australia and Tasmania. Supplier choice is widespread in the states of New South Wales and Victoria.

Recently, the Australian government created a new governance framework made up of the Australian Energy Market Commission (AEMC), to carry out rule changes and market development, and the Australian Energy Regulator (AER) which will be largely responsible for the economic regulation of electricity and gas transmission and distribution networks. It also established the Australian Energy Market Operator (AEMO) as the single electricity and gas market operator in the NEM in southern and eastern Australia to co-ordinate high-level national transmission planning. The IEA commends this ongoing commitment of the Australian government to market reform.

Reliability of Australia's electricity system is high and security has been identified as a as an Australian Government priority. The *National Energy Security Assessment* (NESA), the most recent of which was published in December 2011, is prepared regularly and its purpose is to consider the key strategic energy-security risks facing Australia at present and in the short, medium and long term. The 2011 report noted that recent changes to energy policy driven by the Clean Energy package will bring with them significant challenges during the assessment period, most notably reliability and price pressures and that the level of electricity security to 2035 will be moderate. While the IEA acknowledges the limited role of the Australian government in this matter, it urges it to maintain close co-operation with state and territory governments and regulators to continue to develop the national energy market to enable it to deliver a stable and secure electricity system.

The Clean Energy legislative package, which was transposed into law in November 2011, will have significant impact on the structure of the electricity generation sector. It implements the carbon-pricing mechanism, first set out in *Securing a Clean Energy Future: the Australian Government's Climate Change Plan*, which was published earlier in 2011. The IEA also understands that the Australian government is now accepting applications for Energy Security Fund cash payments while at the same time the Clean Energy regulator is accepting application for free carbon units. The IEA notes the foresight of the Australian government in including the impacts of the Clean Energy Future package in *NESA 2011*.

The Australian commitment to energy markets has resulted in the large customers being able to actively participate in electricity markets and take advantage of potential efficiency savings and flexibility participation offers. Nonetheless, the review team notes that smaller consumers have yet to fully benefit and many consumers are restricted to

regulated tariffs. Once more, the bulk of competences lie outside the federal government, but the state and territorial governments and the government of Australia need to work together to ensure the market continues to deliver.

RECOMMENDATIONS

The government of Australia should:

- ☐ *Use the Standing Council on Energy and Resources as a co-ordination mechanism to address demands around:

 - *ensuring the delivery of a secure transmission system;*
 - *maintaining Australia's high levels of energy security;*
 - *monitoring the capacity of the grid to meet growth in renewable energy; and*
 - *promoting smart-grid technologies.**
- ☐ *Encourage state and territorial governments and regulators to pass the full benefit of modern metering technologies and market development to household consumers.*
- ☐ *Regularly update the National Energy Security Assessment to take into account the implementation of the Clean Energy legislative package and progress towards meeting the 20% renewable electricity generation target.*

7. COAL

Key data (2010)

Production: 72 Mt of brown coal and 352 Mt of hard coal

Net exports: 292 Mt of hard coal: 40% to Japan, 14% to China, 14% to Korea, 11% to India and 9% to Chinese Taipei

Coal contribution to energy supply: 41% of TPES and 75% of electricity generation

Coal consumption: 51 Mtoe, power and heat generation 88%, industry 6%, other sectors 6%

OVERVIEW

Australia is one of the world's largest coal producers and is a major source of energy for nearby Asian markets. The country is the largest coal exporter in the world, with 292 Mt of exports, representing around 20% of global steam-coal trade and more than 50% of global coking-coal trade. The impact of the coal industry reaches beyond the energy sector and it plays a significant role in the Australian economy in terms of employment and export revenues.

In 2009, Australia produced 451.44 million tonnes (Mt) of raw hard coal, was the fourth-largest coal-producing country in the world, behind China, the United States and India. Production of hard coal was 335 Mt of which, 130 Mt was coking coal and 205 Mt steam coal.²⁸ Brown coal production was 68 Mt. In 2010, coal accounted for 41% of Australia's total primary energy supply (TPES) and 75% of electricity generation. There are 26 coal-fired thermal power plants the majority of which are located in Queensland, New South Wales, Victoria, Western Australia and South Australia.

In 2011, there were over 100 coal mines in operation and at the end of April 2012, there were 21 coal mine projects valued at around AUD 17.3 billion, eleven of which are located in Queensland, while the other ten are in New South Wales.

SUPPLY, TRADE AND DEMAND

SUPPLY

Economic resources of hard coal are found in most Australian states, but are largely concentrated in Queensland and New South Wales, with 58% and 38% respectively of economic demonstrated resources (EDR).²⁹ Recoverable EDR of hard coal in 2010 decreased by 4.5% to 41.8 gigatonnes (Gt), which represents 6% of the world's economic recoverable hard coal resources and ranks Australia as having the world's fifth-largest resources.³⁰

28. Includes 448.01 Mt of saleable coal.

29. *Australia's Identified Mineral Resources*, Geoscience Australia, Commonwealth of Australia, 2012.

30. *Ibid.*

Hard coal production is largely concentrated in New South Wales and Queensland and, to a lesser extent, in Western Australia, South Australia and Tasmania. Queensland produces the most coking coal. The hard coal industry directly employs 42 000 people, approximately 22 000 in Queensland and almost 20 000 in New South Wales. Nonetheless, New South Wales and Queensland remain the most significant producing states responsible for 97% of Australia's output of hard coal, and the bulk of hard coal exports.

At present, most hard coal mining in New South Wales occurs near the eastern and western flanks of the Sydney-Gunnedah Basin. Large underground mines operate in the Wollongong-Appin-Bulli area, the Burragorang Valley and in the Lithgow-Mudgee area. Mines in the Hunter Valley and those near Gunnedah are generally opencast mines. Queensland produces hard coal in the Bowen Basin, from Collinsville to Blackwater and Moura, and at Newlands, Blair Athol and near Brisbane. Large deposits are also available in the Millmerran area west of Brisbane and have been earmarked to be developed to generate electricity.

Recoverable EDR of brown coal in 2010 was 39.3 Gt, a 5.8% increase over the 2009 estimate and represents about 19% of the world's recoverable brown coal. Australia has the world's second-largest EDR of brown coal behind the United States of America. All of Australia's brown coal EDR occurs in Victoria with about 93% of the total located in the Latrobe Valley.³¹

There were a number of significant announcements in 2011: in March 2011, BHP Billiton and its joint venture partners announced a total commitment of USD 2.9 billion to coal mining projects, Xstrata Coal's Ravensworth North development in New South Wales, which will be completed in 2012 and Jellinbah Resources is expanding the Lake Vermont mine, which will increase annual capacity by 4 Mt by 2013.

RESERVES AND TRENDS

Recoverable economic demonstrated resources (EDR) of hard coal in 2010 decreased by 4.5% to 41.8 Gt with New South Wales (37%) and Queensland (59%) enjoying the largest share of identified hard coal resources.³² Between them, they produce 97% of hard coal, of which approximately 75% is produced from opencast mines. The Sydney Basin (31%), Bowen Basin (33%), Surat Basin (13%) and the Galilee Basin (8%) contain most of the recoverable EDR in Australia. Using the international categories, Australia has 9.2% of the world's proven reserves of anthracite plus bituminous black coal, and 8.6% of the world's proven reserves of sub-bituminous black coal plus lignite. Only the United States, Russia, China and India have larger hard coal reserves.

Brown coal, or lignite, is mined only in Victoria where the Anglesea, Loy Yang, Yallourn and Hazelwood opencast mines supply coal to nearby power stations. Recoverable economic demonstrated resources (EDR) for 2010 totalled 39 254 Mt, which was a 5.8% increase over the 2009 estimate, 87% of which is accessible, representing about 500 years of reserves at today's level of production.³³ Victoria accounts for 96% of identified resources of brown coal, 93% of which is located in the Latrobe Valley, Victoria.

31. *Ibid.*

32. *Australia's Identified Mineral Resources 2011*, Geoscience Australia, Commonwealth of Australia, 2012.

33. *Ibid.*

Between 2008 and 2010, the sector underwent significant expansion: 20 new coal projects were completed, 54 Mt/year, valued at AUD 4.3 billion. There are plans for further expansions including Rio Tinto's AUD 1.3 billion Clermont opencast mine in Queensland, which is projected to produce 12 Mt/yr of steam coal. Kestrel, a Rio Tinto project in Queensland, is expected to produce an additional 1.7 Mt/yr of coking coal. In New South Wales, Xstrata Coal's AUD 1.0 billion Mangoola opencast mine development is expected to produce approximately 8 Mt/yr of thermal coal in 2012. In New South Wales, Yancoal's AUD 405 million Moolarben Stage 1 project will produce 12 Mt/yr, 8 Mt/yr from an opencast mine and 4 Mt/yr from an underground mine.

The Galilee Basin, the last undeveloped coal resource in Queensland, if present plans to develop are fully implemented, will make the area the largest coal-producing region in Queensland. In addition to other prospection activities, three major projects have been announced, to be developed by Adani, Hancock and Waratah Coal, with a joint exporting capacity of more than 100 Mt/yr. The project includes partners from India and China, to where most of the output will be exported.

Box 7. The impact of the Queensland floods

The first reports of heavy rain affecting some mines in Queensland were received on 3 December 2010 with major flooding occurring around 24 December 2010. The effects of these rains on the mining industry were significant, resulting in 29 coal mines declaring *force majeure* events in early January 2011 and making them unable to fulfill contract obligations.

All coal ports remained fully operational but there was some damage to a number of rail links, including the Blackwater line to Gladstone, which had to close for one month. The smaller Western System to Brisbane Port was also closed for a period of one month.

The Australian Bureau of Agricultural Resource Economics and Sciences (ABARES) estimates that Queensland's coal exports between December 2010 and March 2011 could be around 40 to 60 million tonnes lower than previously anticipated. This represents a reduction in export earnings of around AUD 2 to 2.5 billion.

The impact of the flood damage on coal prices was notable with the short-term price of metallurgical coal rising from USD 225 per tonne in December 2010 to USD 300 in January 2011. Prices were expected to remain high for a number of months.

Source: IEA.

DEMAND

More than 80% of the hard coal domestic consumption is for electricity production. Other uses are for oven coke, accounting for around 6%, and combined heat and power (CHP) accounting for around 3%. Brown coal is mostly used for electricity production, although there are some CHP use and consumption for industrial uses, including briquettes for domestic heating, fertilisers and others.

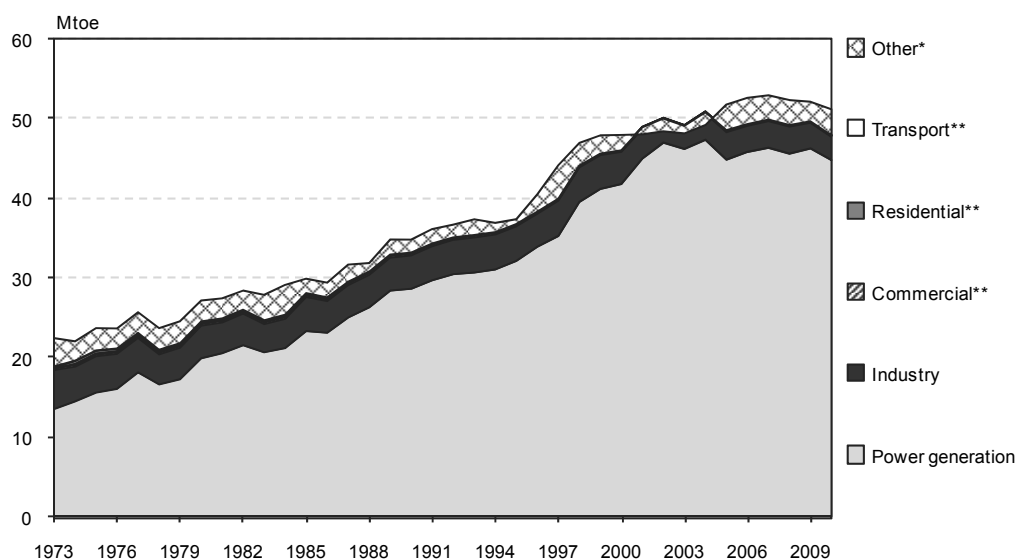
Table 7 lists coal-fired power plants in Australia; three-quarters of the capacity were commissioned before 1990 and only 3 GW was commissioned after 2000. These plants are supercritical; therefore almost 90 % of the coal-fired fleet is subcritical.

Table 7. Coal-fired plants in Australia, 2010

Plant name	Owner	Units, MWe (commissioned)	Fuel	City	State
Anglesea	Alcoa of Australia	160 (1969)	Lignite	Anglesea	Victoria
Bayswater	Macquarie Generation	4 x 660 (1985-86)	Bituminous	Muswellbrook	New South Wales
Callide	CS Energy Corp Ltd	2 x 350 (1989)	Sub-bituminous	Biloela	Queensland
Callide C	Intergen (Australia) Pty Ltd	2 x 420 (2001)	Sub-bituminous	Brisbane	Queensland
Collie Verve	Transfield Services Pty Ltd	350 (1999)	Sub-bituminous	Collie	Western Australia
Collinsville	Transfield Services Pty Ltd	4 x 30 + 60 (1968-74)	Sub-bituminous	Collinsville	Queensland
Eraring	Eraring Energy	4 x 660 (1981-84)	Bituminous	Dora Creek	New South Wales
Gladstone	Gladstone Power Station	6 x 275 (1976-82)	Sub-bituminous	Gladstone	Queensland
Hazelwood	International Power Australia	8 x 200 (1964-71)	Lignite	Morwell	Victoria
Kogan Creek	CS Energy Corp Ltd	750 (2007)	Bituminous	Brigalow	Queensland
Kwinana	Verve Energy	2 x 120 + 2 x 200 (1970-78)	Sub-bituminous	Naval Base	Western Australia
Liddell	Macquarie Generation	4 x 500 (1971-73)	Bituminous	Muswellbrook	New South Wales
Loy Yang A	Loy Yang Power Management	4 x 500 (1984-87)	Lignite	Traralgon South	Victoria
Loy Yang B	International Power Australia	2 x 500 (1993-96)	Lignite	Tralagon South	Victoria
Millmerran	Intergen (Australia) Pty Ltd	2 x 425 (2002-03)	Sub-bituminous	Millmerran	Queensland
Morwell	Energy Brix Australia Ltd	20 + 3 x 30 (1958-59)	Lignite	Morwell	Victoria
Mount Piper	Delta Electricity	2 x 700 (1993-1996)	Bituminous	Portland	New South Wales
Muja	Verve Energy	4 x 200 (1980-85)	Sub-bituminous	Muja	Western Australia
Munmorah	Delta Electricity	2 x 300 (1969)	Bituminous	Doyalson	New South Wales
Northern Augusta	Babcock & Brown Infrastructure	2 x 260 (1984-85)	Sub-bituminous	Port Augusta	Southern Australia
Redbank	Redbank Project Pty Ltd	150 (2001)	Bituminous	Warkworth	New South Wales
Stanwell	Stanwell Corp Ltd	4 x 350 (1992-96)	Sub-bituminous	Rockhampton	Queensland
Swanbank	CS Energy Corp Ltd	4 x 125 (1970-73)	Sub-bituminous	Ipswich	Queensland
Tarong	Tarong Energy Corp Ltd	4 x 350 (1984-86)	Sub-bituminous	Nanango	Queensland
Tarong North	Tarong North Power Station Jv	450 (2003)	Sub-bituminous	Nanango	Queensland
Thomas Playford	Babcock & Brown Infrastructure	4 x 60 (1960-63)	Sub-bituminous	Port Augusta	Southern Australia
Vales Point	Delta Electricity	2 x 660 (1978-79)	Bituminous	Mannering Park	New South Wales
Wallerawang	Delta Electricity	2 x 500 (1976-80)	Bituminous	Wallerawang	New South Wales
Yallourn	TRUenergy Ltd	2 x 360 + 2 x 380 (1973-82)	Lignite	Yallourn	Victoria

Source: Department of Resources, Energy and Tourism.

Figure 19. Coal use by sector*, 1973-2010



* TPES by consuming sector. *Other* includes other transformation and energy sector consumption. *Industry* includes non-energy use. *Commercial* includes residential, commercial, public services, agriculture/forestry, fishing and other final consumption.

** Negligible.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011.

Victoria's coal-fired power plants, which account for 6.35 GW of capacity, are fed with brown coal (lignite) while the rest consume hard coal. Bituminous coal is used in New South Wales and sub-bituminous coals are generally used in the rest of the country.

While Australian traded coal is of high quality, domestic consumption is not of the same quality. Although with low-sulphur content, lignite moisture is often over 60% and hard coal ash is often over 20%. This fact, combined with the age (three-quarters of the capacity was commissioned before 1990) and the technology (only 3 GW out of 29 GW are supercritical) of the coal-fired fleet may explain low values.

The National Pollutant Inventory (NPI) is a useful tool to monitor and assess emissions. However, there is no binding national standard for sulphur dioxide (SO₂) and nitrogen oxide (NO_x). States and territories generally set standards for such emissions, which, in general, tend to be less than the best available techniques. Profiting from the low sulphur content of Australian coals, no further control equipment or technology has been necessary in coal-fired plants to address this issue.

TRADE

In 2009, Australia exported 261.7 Mt of coal, representing over a quarter of the coal traded globally. It is the second-largest exporter of steam coal, behind Indonesia, with 136.5 Mt, representing almost 20% of the global trade of steam coal. New South Wales and Queensland are the principal exporting states. Australia exported 125.2 Mt of coking coal, more than half of the global trade. Queensland accounts for around 90% of these exports.

Coal exports form a significant part of the economy. In 2009, coking coal exports were valued at AUD 24.9 billion and steam coal at AUD 14.4 billion. Given the increase in exports and prices which occurred in 2010, the value of the coal exports was estimated to be over AUD 50 billion.

In the fiscal year 2011/12, thermal coal export volumes are forecast to increase by 13%, to 162 Mt. Due to increased export volumes, Australia's thermal coal export values are forecast to increase by 24% to AUD 17.9 billion in 2011/12. Australia's thermal coal export volumes are projected to reach 268 Mt by 2016/17, with export earnings reaching AUD 18.8 billion (in 2011/12 dollars).³⁴

Exports of metallurgical coal in 2010/11 decreased because of the impact of the Queensland floods. Metallurgical coal export volumes in 2011/12 are forecast to increase by 6% as production in Queensland recovers to 148 Mt, which is expected to result in an increase in export earnings by 1% to AUD 31 billion. Export volumes are forecast to rise by 8% a year to 218 Mt in 2016/17. Export earnings from metallurgical coal are projected to total AUD 30 billion (in 2011/12 dollars) in 2016/17.

COAL TRANSPORT AND EXPORT INFRASTRUCTURE

Generally, the established coal-producing areas are located close to the coast and can take advantage of existing transport infrastructure. The export industry is serviced by nine major coal-loading terminals located in Queensland and New South Wales. Following expansion work in recent years, the terminals had a combined handling capacity of almost 350 Mt and loaded approximately 300 Mt of coal.

Table 8. Exporting coal ports in Australia

Port	Capacity 2010 (Mt/yr)	Forecast 2015 (Mt/yr)	2010 exports (Mt)	State
	2010	2015		
Dalrymple Bay	85	85	62.7	Queensland
Abbot Point	25	50	17.42	Queensland
Hay Point	44	55	36.38	Queensland
Gladstone	76	106	61.7	Queensland
Newcastle	113	211	95.1	New South Wales
Port Kembla	18	18	13.28	New South Wales
Brisbane	7.5	10	7.3	Queensland
<i>Total Queensland</i>	<i>237.5</i>	<i>306</i>	<i>185.5</i>	
<i>Total New South Wales</i>	<i>131</i>	<i>229</i>	<i>108.38</i>	
Total	368.5	535	293.88	

Source: *Australian Coal Report*. (McCloskey Report), March 2011.

Port infrastructure

The Port of Newcastle, New South Wales, is one of the largest coal-exporting facilities in the world and is undergoing substantial expansion.

The Port Waratah Coal Services Limited (PWCS) facility is located in the Port of Newcastle and is one of the world's largest coal-handling operations through its two terminals:

34. *Resources and Energy Quarterly*, Bureau of Resources and Energy Economics, Commonwealth of Australia, March 2012.

Carrington and Kooragang. These terminals receive, assemble and load Hunter Valley coal for export. The Carrington Coal Terminal has a ship-loading capacity of 25 Mt/year and Kooragang Coal Terminal has a ship-loading capacity of 88 Mt/yr. PWCS has also commenced investigation of a new coal terminal to be known as Terminal 4. This project is currently in the pre-feasibility phase. PWCS recently approved an expansion to increase the capacity of Kooragang Island Coal Terminal by 20 Mt/yr to 108 Mt/yr, with an investment of AUD 670 million. There are plans to increase capacity to 145 Mt/yr.

The Port Kembla Coal Terminal, which is located in the Inner Harbour, services mines in the southern and western coalfields of New South Wales.

With investment over AUD 1.0 billion, the first stage of the Newcastle Coal Infrastructure Group's export terminal at the Port of Newcastle was completed in 2011. Further upgrades to this terminal could increase coal capacity to 66 Mt/yr.

In Queensland, the rail network delivers coal to six coal-export terminals which are located at four major ports: the Abbot Point Coal Terminal located near Bowen; the Dalrymple Bay Coal Terminal (DBCT) and Hay Point Services Coal Terminal (HPSCT) located near Mackay; the RG Tanna and Barney Point Coal Terminals at Gladstone; and the Fisherman Islands Coal Terminal at the Port of Brisbane. A major Coal Transport Infrastructure Investment Programme has been under way since 2005 and has delivered a 52 Mt/yr increase in total port capacity by mid-2008.

In Gladstone, Queensland there are plans for a new Wiggins Island Coal Terminal, which is expected to reach an export capacity of 30 Mt/yr in its first stage, with further potential expansions. Also in Queensland, the North Queensland Bulk Ports Corporation, a subsidiary company of the state of Queensland, approved the Abbot Point Coal Terminal X50 expansions, with investment of AUD 818 million, which will increase capacity from 25 Mt/yr to 50 Mt/yr. This terminal is currently operated by Xstrata. In addition, Hay Point Coal Terminal, owned by BMA (BHP Billiton Mitsubishi Alliance), is planning to increase capacity from 44 to 55 Mt/yr.

Port developments

Infrastructure constraints eased in 2011 following a slow-down in global demand, easing pressure in the former bottlenecks of the Hunter Valley in NSW and the Goonyella coal chain in Queensland. At the end of April 2012, there were 19 infrastructure projects at an advanced stage of development, with a total capital cost of USD 24.7 billion.³⁵ Of the 19 advanced infrastructure projects, 11 are coal-related.

Of the 11 coal-related advanced infrastructure projects, five are port expansions under construction. The largest of these projects in terms of capital expenditure was the Wiggins Island Coal Terminal which is located in Gladstone. The new coal terminal will have a capacity of 27 Mt a year and is expected to cost around AUD 2.5 billion to construct. A second and third stage of the terminal, which would take capacity up to 80 Mt a year, is at an advanced stage of planning. Associated with the Wiggins Island Coal Terminal is an AUD 900 million rail project that will support increased coal supply from the southern part of the Bowen Basin.

There are several port expansion developments under way at Newcastle: the Kooragang Island terminal is undergoing an expansion to bring annual capacity from 133 Mt to

35. *Mining Industry Major Projects April 2012*, Bureau of Resources and Energy Economics, Canberra, May 2012.

145 Mt, at a cost of AUD 227 million. There are also two expansion projects taking place at the Newcastle Coal Infrastructure Group (NCIG) terminal. The second stage expansion will increase capacity from 30 MT a year to 53 Mt a year at a cost of AUD 900 million. The third stage of the NCIG terminal will cost around AUD 1 billion and add 13 Mt of coal export capacity.

Rail infrastructure

Coal is generally carried to the coast by rail and in the major coal-producing states, coal tends to be the most significant rail freight item. The largest rail companies operating in the coal sector are QR National and Pacific National that supply rail service to the states of Queensland, New South Wales and South Australia. The ownership and management arrangements for rail infrastructure and rail operations are generally divided into below-rail (track management) and above-rail (operators of trains and rolling stock). These functions are performed by a mix of government and the private sector.

Of the aforementioned advanced infrastructure projects, six are coal-related rail expansions.³⁶ In Queensland, there is an AUD 900 million rail project associated with the Wiggins Island Coal Terminal that will support increased coal supply from the southern part of the Bowen Basin. Commissioning has also commenced on the GAPE project, connecting the Goonyella train network to Abbot Point, which was expected to be fully operational by the middle of 2011.

In New South Wales, two rail projects are under way; the Minimbah Bank and Nundah Bank projects, which will contribute to lifting the Hunter Valley's coal haulage capacity to 145 Mt.

QR National Coal is Australia's largest coal rail transporter. It provides rail services to the Queensland and New South Wales coal industries. QR National Coal operates in all major coal regions in Queensland and New South Wales. The Goonyella to Abbot Point rail line will support the X50 port expansion at Abbot Point, and is scheduled for completion in 2012. The Goonyella System Expansion (GSE) project is expected to increase rail capacity by 11 Mt a year and will deliver coal from the Bowen Basin to Mackay for export. Elsewhere, the Blackwater power system upgrade project will support the development of the Blackwater rail system, and support the delivery of coal to Gladstone.³⁷

Pacific National is the second-largest coal-haulage operator in Australia, delivering coal from the Hunter Valley and southern and western coalfields to the ports of Newcastle and Port Kembla, as well as domestic coal to power stations and steelworks located in NSW.

In New South Wales, the Australian Rail Track Corporation (a federal government-owned corporation that leases and operates the Hunter Valley coal rail system) is undertaking an AUD 1.2 billion investment programme to upgrade the Hunter Valley coal rail network following an AUD 580 million capital injection into the corporation by the Australian government in December 2008. This investment is targeted on reducing train transit times and increasing rail network capacity as demand for export coal capacity is forecast to increase from about 113 Mt/yr in 2009 to over 220 Mt/yr by 2013.

36. *Ibid.*

37. *Mining Industry Major Projects October 2011*, Bureau of Resources and Energy Economics, Commonwealth of Australia, Canberra, 2011.

The coal industry and federal, state and territory governments are co-operating to overcome capacity constraints by taking steps to improve the co-ordination of coal export infrastructure supply chains and investment in new capacity expansions in port and above- and below-rail infrastructure. For example an additional 141 Mt/yr of new coal terminal capacity should come on line by 2015 with a number of rail investments either under way or planned to complement these coal terminal projects.

INDUSTRY STRUCTURE

There are over 120 hard coal mines mainly in the states of Queensland and New South Wales. Hard-coal production is dominated by the four international coal majors (BHP Billiton, Xstrata, Rio Tinto and Anglo American Metallurgical Coal) who between them accounted for 58.7% of Australian saleable coal production in 2009. The largest producer and exporter, BHP Billiton Mitsubishi Alliance (BMA), is a company jointly, and equally, owned by BHP Billiton and Mitsubishi Development Pty Ltd. Many other multinational companies maintain stakes in Australian coal mining, including Peabody Energy and Vale.

Japan is a major investor with Mitsubishi having a strong alliance with BHP Billiton, and Mitsui has alliances with Anglo and BHP Billiton.

The industry has a strong regional focus. Export operations are in the Bowen Basin (Queensland), Newcastle/Hunter Valley and the Illawarra in New South Wales. Brown coal production is concentrated in Victoria, largely in four opencast mines (Anglesea, Long Yang, Yallourn and Hazelwood), which supply coal to nearby power stations. Brown coal production and consumption has been maintained at constant levels for the past decade.

GOVERNMENT POLICIES AND PROGRAMMES

MINERALS POLICY

While the ownership of Australia's non-renewable resources resides with the Crown, Australian states and territories have the Constitutional jurisdiction to regulate resource exploitation, including to tax onshore resources. In accordance with this, states and territories legislation establishes stringent environmental requirements at all stages of the mining, from exploration until post-operational rehabilitation. Moreover, projects requiring Commonwealth approval under other laws (*i.e.* foreign investment) must also comply with the environmental federal legislation. Some issues on subsidence have been reported near populated areas but, in general, mining in Australia may be considered as performed to high standards in relation to environmental protection.

Australian states and territories issue prospection and exploitation permits. They also regulate and monitor safety and health at work. Australian coal-mining development has been intensive and administrative red tape has not been identified as a bottleneck. The only point in which coal industry has expressed some concern is about potential growing difficulties in land access in some states, especially in relation to making agriculture and mining uses compatible.

Under the National Greenhouse and Energy Reporting Act 2007, mining companies must report greenhouse gas emissions production and energy consumption if they exceed set thresholds. These thresholds are 25 thousand tonnes (kt) of CO₂ for single facilities and 50 kt CO₂ for corporate groups. The mining companies must report the release of greenhouse gas as the direct result of the mining, including methane fugitive emissions.

This gives rise to an issue not related to the reporting itself, but to the inclusion of the fugitive emissions in the carbon price mechanism. In the absence of government support, the average gassy mine would face a cost of around AUD 7.40 per tonne of coal produced, and the gassiest mines could face a cost of around AUD 25 per tonne of coal produced. However, the government is offering assistance to eligible mines. Assistance will be provided to eligible coal mines for up to 80% of their fugitive emissions exposure above the 0.1 tonne CO₂-eq per tonne of saleable coal threshold. Assistance will be based on production up to a cap of base-period production levels (the higher of 2007/08 or 2008/09).

TAXATION REGIME

The Australian government undertook a comprehensive review of its tax and transfer system, *Australia's Future Tax System*, which was published in 2010.³⁸ A recommendation from that review was to adopt a resource-rent tax to return some of the benefits of resource exploitation to the community. It was motivated by the recognition that the royalty arrangements in place created distortions and failed to provide a fair return during boom times.

In May 2010, the Australian government announced the introduction of a new resource super-profit tax (RSPT), which was to have been in place by July 2012. The RSPT was to apply to profit levels above the ten-year government bond rate, and be applied to all current and future resource projects for all commodities. The tax rate would have been 40%. The government forecast the RSPT would deliver approximately AUD 12 billion in the first two years of application.

Following negotiations between the resources industry, that objected to the proposal, and the government, the mineral resource rent tax (MRRT) was introduced, which will apply to iron ore and coal only at an effective rate of 22.5% on the economic rents mines earn from the taxable resources (iron ore, coal and some gases) after they are extracted from the ground but before they undergo any significant processing or value added. The MRRT is applied to profits made from extracting taxable resources before they undergo any significant processing or value add. The hurdle rate is for projects which make over AUD 75 million. Should the states increase royalties that mining companies have to pay, the increase would be credited against MRRT. This tax was put in place in July 2012.

Starting based allowances recognise investments in assets (starting based assets) relating to the upstream activities of a mining project interest that existed before the announcement of resource tax reforms on 2 May 2010. They also recognise certain expenditure on such assets made by a miner between 2 May 2010 and 1 July 2012. The government has estimated that the MRRT will return revenues of around AUD 7.4 billion in the first two years.

CLEAN ENERGY PACKAGE

Securing a Clean Energy Future, the Australian government's Climate Change Plan, was introduced in 2011. The cornerstone of the plan is the introduction of a carbon price as the cheapest way of reducing pollution. The package involves a number of solutions, including investing in protecting jobs in the steel and coal industries in the form of the Coal Sector Jobs Package and a Steel Transformation Plan.

38. *Australia's Future Tax System, Report to the Treasurer*, Attorney-General's Department, Commonwealth of Australia, 2010.

ENERGY SECURITY PACKAGE

The government will establish an Energy Security Package to smooth the energy transition and maintain energy security. It will incorporate two main initiatives. First, government has signalled that it will seek to negotiate the closure of up to 2 000 MW of the highest polluting coal-fired capacity by 2020 in order to start the transformation of the energy industry in a managed way. This will start the process of replacing existing, highly polluting electricity assets with cleaner generation.

Secondly, there will be transitional assistance to highly emissions-intensive coal-fired power stations. This assistance will come with conditions to ensure security of supply and transparent information on the action taken by these generators to move to a cleaner energy future. The government will ensure that the timeframes for closure are realistic: they must leave enough time for replacement capacity to be built. The Australian Energy Market Operator will be asked to provide advice on any proposed closure timetable to ensure that it is consistent with maintaining secure energy supplies.

The transitional assistance measure will comprise a limited allocation of free carbon units and cash allocated until 2016/17, estimated at AUD 5.5 billion and amounting to around 23% of the coal-fired power stations' expected liability over this time.

The government may offer loans to emissions-intensive coal-fired electricity generators for the refinancing of existing debt where a coal-fired generator needs finance but is unable to obtain it from the market on reasonable terms. Loans will also be offered for a limited period for the purchase of future vintage carbon permits. Loans will be offered on terms that encourage generators to seek private finance in the first instance.

Assistance will be provided to generators with emissions intensity above 1.0 tonne CO₂-eq per MWh on an "as generated" basis.

A new Energy Security Council (ESC) will also be established to advise the government on emerging risks to energy security. The ESC will include the heads of the Australian Energy Market Commission, of the Energy Regulator, the Australian Securities and Investment Commission and experts in the fields of business, public finance, insolvency and the energy market, and will consult with the managing director of the Australian Energy Market Operator.

Support for mining

As a carbon price is introduced, the government will support Australia's coal-mining sector through targeted transitional assistance to gaseous coal mines, and will also provide support for the development of coal mining abatement technologies.

The government will support these mines through the AUD 1.26 billion Coal Sector Jobs Package. It will also provide AUD 70 million through the Coal Mining Abatement Technology Support Package to contribute to the development and deployment of technologies that reduce fugitive emissions from coal mines. It is expected that approximately 25 mines will be eligible for Coal Sector Jobs Package assistance – 18 in New South Wales and 7 in Queensland.

The Coal Sector Jobs Package will be administered by the Department of Resources, Energy and Tourism. Guidelines will be issued and consultation will occur in the period ahead.

Coal Mining Abatement Technology Support Package

An AUD 70 million Coal Mining Abatement Technology Support Package will be available over five years to support:

- research, development and pilot deployment of abatement, and measurement and verification technologies in the coal sector;
- work on safety and regulatory issues associated with the introduction of coal sector abatement technologies, including work with state and territory governments on safety requirements associated with the development and deployment of new abatement-related technologies, equipment and processes; and
- small and medium-sized coal-sector participants to adapt and undertake feasibility studies and other work to reduce emissions from current and proposed mines.

The Coal Mining Abatement Technology Support Package will be administered by the Department of Resources, Energy and Tourism, and guidelines will be issued and consultation will occur in the period ahead.

DRAFT ENERGY WHITE PAPER 2011

A Draft Energy White Paper 2011: Strengthening the Foundation for Australia's Energy Future was published for public consultation in December 2011. The paper fulfils the Australian government's commitment to publish a Draft Energy White Paper (EWP) by the end of 2011. Following the completion of the consultation process, the government anticipates that a final Energy White Paper (EWP) will be released late in 2012.

The Draft EWP recognises the major role fossil fuels will play in meeting global and Australia's energy needs. It notes that coal is an integral part of Australia's economy and will remain so for many decades to come. Conversely, hard coal production is likely to remain strong while brown coal production faces a long-term decline unless an alternative to its use in electricity-generation can be found. The long-term sustainability of the coal industry is likely to depend on the successful commercialisation of carbon capture and storage technologies and low-emissions technologies in Australia and elsewhere as the world moves to constrain greenhouse gas emissions. New technologies may also offer the opportunity for unconventional use of stranded coal assets through synthetic fuels such as coal-to-liquids or coal-to-gas fuels.

CRITIQUE

Australian coal reserves are abundant, available in most states, but particularly plentiful and suited for export in New South Wales and Queensland. In 2009, Australia produced 451.44 Mt of raw hard coal, most of which was exported to nearby Asian markets.

Australian coal exports have important implications for steam coal trade but are crucial to the coking coal market. Australia is a major player in the steam coal trade with exports of 136.5 Mt or almost 20% of global trade. In the case of coking coal, Australian supplies to global markets are also significant and in 2009 it exported approximately 125 Mt, which represented more than half of global coking coal trade. While steam coal production is concentrated in both New South Wales and Queensland, coking coal production and exports are mainly from Queensland (around 90% of exports). The Port of Newcastle in New South Wales is the largest seaborne coal-export facility with further capacity expansions under way over the next five years.

In 2009, exports of coking coal were valued at AUD 24.9 billion and those of steam coal at AUD 14.4 billion. Although only preliminary data exist for 2010, it is worth noting that exports are expected to increase by approximately 10%, with final figures close to 300 Mt or AUD 50 billion.

In general, the environmental and consenting system for the mining sector works efficiently. Mining is generally developed in an environmentally sustainable way although problems have been noted in relation to land access in some places. Nonetheless, more often than not land access and compatibility with other land uses has not been a concern in Australia.

There are plans for new mines and for expanding some of the existing ones. Australia has proved its capacity to develop infrastructure at the right pace in the past. However, the current developments are challenging, especially those in the Galilee Basin in central Queensland, a new producing basin the size of the United Kingdom, but poorly served with infrastructure. These investments will require the development of transport infrastructure (rails and ports), and trained personnel, if they are to be completed in a timely manner.

Australian exports are generally high-quality coal, while much of the coal consumed at home tends to be lower-quality, with high ash content; over 20% in the case of bituminous coal, and moisture levels of over 60% in the case of lignite. Generally, Australian coal has low sulphur and low mercury content. For this reason, the levels of sulphur-based emissions from coal-fired plants have not been a major concern.

Coal-fired electricity plants, largely concentrated in the more populous eastern states, account for 54% of electricity generating capacity (29.5 GW) and produce over 80% of electricity. A large portion of this capacity, approximately 22.5 GW, is older than 20 years. Capacity additions in the past decade (2.9 GW) tend to be supercritical. In general, the efficiency of the coal-fired plants is lower than the OECD average values, largely reflecting the use of lower-quality coal, often priced at the cost of extraction from nearby captive mines plus the use of low-quality lignite.

Australia is currently experiencing what is generally considered a resources boom, a recurring cyclical phenomenon in Australian mining. This boom, more widespread and long-lasting than those in the past, will have a great impact on many aspects of the Australian economy. The government has considered that a part of the profits that investors will obtain should return in the form of additional taxes. The proposal for a new resource super profit tax was refused and now a mineral resource rent tax has been advanced to apply to some iron ore and coal projects with profits of over AUD 50 million.

RECOMMENDATIONS

The government of Australia should:

- ☐ *Determine a clear and stable policy on mineral resource taxation, avoiding uncertainty that may damage the favourable investment environment that Australia presents.*
- ☐ *Along with state and territory authorities, monitor the development of infrastructure in order to avoid infrastructure bottlenecks and workforce shortages in the future expansion of the coal industry.*
- ☐ *Co-ordinate with state and territory authorities to continue to guarantee that mining activity is performed under high-quality environmental conditions, compatible with other land uses, especially agricultural use.*

8. NATURAL GAS

Key data (2010)

Production: 49.1 bcm (+10% compared to 2009)

Share of natural gas: 21.2% of TPES and 15.0% of electricity generation

Exports: 50% of production, 24.3 bcm

Inland consumption: 33.4 bcm (power generation 32%, industry 32%, residential 12%)

OVERVIEW

Australia is endowed with significant natural gas resources and has been exporting liquefied natural gas (LNG) since 1989, although gas itself plays a less important role in domestic primary energy demand with 23% in 2009/10 compared with coal (37%) and oil (35%). Gas production has increased by around 50% over the past decade with three new LNG trains commenced operations and a further single train commenced production in May 2012. Another seven projects comprising an additional 13 trains have reached final investment decision (FID) since October 2009 and are planned to come on line between 2014 and 2017. This will potentially make Australia the second-largest LNG exporter with capacity of just over 80 Mt per year based on projects currently approved. One of the biggest challenges is nevertheless to manage this surge and prevent increasing costs due to potential workforce shortages and infrastructure bottlenecks.

SUPPLY AND DEMAND

SUPPLY

Australia benefits from large natural gas resources; proven gas reserves amounted to 3.67 trillion cubic metres (tcm) at end 2011 according to BP's *Statistical Review 2012*. This represents more than 80 times current gas production, albeit only 1.8% of the world's gas reserves. Australia is the second-largest holder of proven gas reserves among OECD countries, behind the United States. Over the past decade, its proven gas reserves have increased by one-third. In recent years, closer attention has been given to unconventional resources, in particular coal seam gas (CSG, also called coal-bed methane or CBM). Geoscience Australia and the Bureau of Resources and Energy Economics (BREE, 2012) estimate that CSG economic demonstrated resources amount to approximately 0.9 billion cubic metres (bcm) or 33 trillion cubic feet (tcf) with sub-economic and inferred resources adding 171 tcf (4.8 tcm). Australia is also believed to hold significant shale gas resources; the United States Energy Information Administration (EIA) estimates that technically recoverable shale gas resources from a limited number of basins amount to over 11 tcm (396 tcf) with significant additional potential in basins not included in the EIA study. Around 92% of Australia's conventional gas resources are located in the Carnarvon, Browse and Bonaparte Basins off the north-west coast. Smaller resources are also located off the south-east coast in the Gippsland, Bass and Otway Basins. While crude oil production is expected to decline, the gas industry faces an unprecedented boom, driven mostly by

new LNG-export projects. LNG exports bring significant revenues: in 2010/11, the value of LNG exports amounted to AUD 10.5 billion, up 34% from the previous year owing to a small increase in export volumes and significantly higher gas market prices.³⁹

In 2010, Australia produced 49 bcm of gas, imported 5.6 bcm from the Joint Petroleum Development Area (JPDA) with Timor Leste, and exported 24.3 bcm as LNG.⁴⁰ Most of the production has been traditionally sourced from three petroleum basins: offshore Carnarvon (north-western Australia) representing around three quarters of total gas production, offshore Gippsland (south-eastern Australia) and onshore Cooper/Eromanga (central Australia). Australia's western market conventional domestic gas is predominantly sourced from the offshore Carnarvon Basin. In contrast, Australia's eastern markets conventional domestic gas is predominantly supplied from the Gippsland and Otway Basins, and the Cooper Basin while increasing volumes of coal seam gas comes from Queensland with smaller amounts from New South Wales coal basins. The small northern market is supplied from the offshore Bonaparte and onshore Amadeus Basins.

In 2010, a further 5.6 bcm of LNG was produced in the Joint Petroleum Development Area and transported to the onshore Darwin LNG export plant for processing. Under the 2003 Timor Sea Treaty (TST), Australia and Timor Leste jointly oversee the development in the TST-established JPDA. In 2010, Bayu-Undan was the only project currently producing in the JPDA. Upstream petroleum revenues in the JPDA are split 90:10 in favour of Timor Leste.

The Bureau of Resources and Energy Economics (BREE) expects natural gas production in the western market (including LNG) to grow at an average annual rate of 5.5% in the period to 2034/35. Production in the eastern market is projected to grow at 5% a year to 2 492 petajoules in 2034/35. This means that Australian gas production would be multiplied by a factor of five by 2034/35.⁴¹ This underlines the importance of growth in the gas industry and the necessary investments to reach such levels. Future north-western Australian gas supplies will contribute to around two-thirds of the additional production to 2030, with supplies being developed in association with new major LNG export projects in the Carnarvon Basin such as the Pluto, Gorgon and Wheatstone LNG projects.

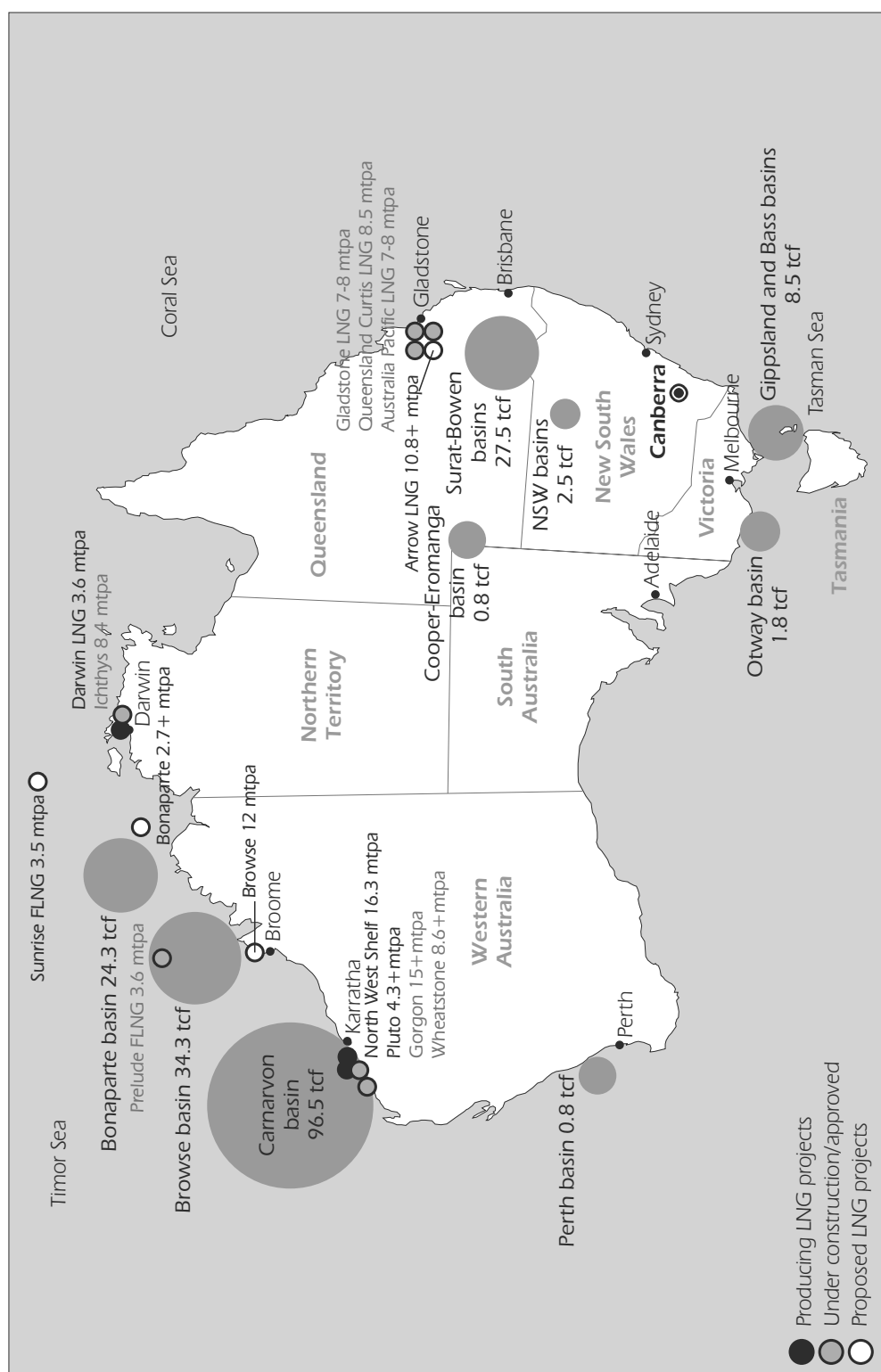
While Australia's gas production has been traditionally offshore, conventional and concentrated in three basins (Carnarvon, Gippsland and onshore Cooper/Eromanga), this is bound to change with the rise of coal seam gas. CSG reserves and production have grown substantially in recent years, particularly in Queensland where the bulk of known resources is located. CSG's share of total Australian gas production has already increased from 3% in 2004 to 10% in 2010, with 97% sourced from Queensland and 3% from the Sydney Basin in New South Wales. From 2015, Australian LNG production will partially shift to onshore and to the east (Queensland). CSG production is expected to increase significantly during the current decade on the back of three committed CSG-to-LNG export projects located near Gladstone with further projects likely.

39. Australian government *Draft Energy White Paper 2011: Strengthening the Foundation for Australia's Energy Future*, Department of Resources, Energy and Tourism, Commonwealth of Australia, 2011.

40. The fiscal year in Australia starts in July. Data given in this chapter refer therefore to the fiscal year, for example 2010 data are for the period 1 July 2009-30 June 2010.

41. *Australian energy projections to 2034/35*, Bureau of Resources and Energy Economics, Commonwealth of Australia, 2011.

Figure 20. LNG projects in Australia



This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Source: Department of Resources, Energy and Tourism.

LNG exports are expected to grow steadily from around 24.3 bcm (18 Mt/yr) as of 2010. There are currently seven operating LNG trains, which started operating between 1989 and 2012: five from the North West Shelf (Western Australia), one from the Pluto Project in the Carnarvon Basin (Western Australia) and the one in Darwin (Northern Territory) which processes gas imported from the JPDA. Total capacity amounts to 33.2 bcm (24.2 Mt/yr). Based on committed projects, LNG export capacity will reach over 100 bcm (80.8 Mt/yr) by 2017. LNG export capacity could reach 150 bcm by 2030, based on planned projects: either expansions of existing plants or new projects such as Ichthys, Bonaparte and Browse LNG.

Box 8. Committed LNG projects (as of June 2012)

Australia expects to see its LNG capacity increase threefold between 2011 and 2017, on the back of recent investment decisions. This reflects the growing appetite of neighbouring Asian markets, notably Japan, China and Korea. More final investment decisions (FIDs) are expected to take place in the coming years. The total capital expenditure committed on new Australian LNG projects exceeds AUD 167 billion.

Gorgon will consist of an initial three trains of 6.8 bcm (5 Mt/yr) each. Located on Barrow Island in the Carnarvon Basin, it is planned to start in a sequenced way between end-2014 and end-2015. Chevron, Shell and ExxonMobil are the main partners, who took FID in late 2009. A fourth train is now under consideration.

Queensland Curtis is a CSG-to-LNG project based on two trains of 5.8 bcm (4.25 Mt/yr) each. Like all current CSG-to-LNG projects, it is located near Gladstone, and is earmarked for a 2014 start-up. BG, the main sponsor, took FID in October 2010.

Gladstone LNG is the second CSG-to-LNG project based on two trains of 5.3 bcm each and is expected to start in 2015. Sponsored by Santos, Petronas, Total and KOGAS, the project reached FID in January 2011.

Prelude LNG, sponsored by Shell, will be the world's first floating LNG liquefaction terminal. Located offshore north-west Australia in the Browse Basin, it consists in a single 4.9 bcm (3.6 Mt/yr) train. After a FID in May 2011, first gas from the plant is planned for 2017. Such a development will be followed with great interest by other companies as this technology could later encourage the development of stranded assets.

FID for the first train (6.1 bcm or 4.5 Mt/yr) of the *Australia Pacific LNG* project was taken in July 2011. This will be the third CSG-to-LNG project near Gladstone with a planned start of operations in 2015. ConocoPhillips and Origin are the main partners; China's Sinopec has 15%.

The *Wheatstone LNG* project, sponsored by Chevron with partners Apache, Kufpec, Shell and Kyushu, took FID in September 2011 for an initial two-train (12.3 bcm or 8.9 Mt/yr) project. The onshore plant in the Carnarvon Basin will be at Onslow, 200 km south-west of the existing North West Shelf and Pluto projects.

The *Ichthys LNG* project based in Darwin in the Northern Territory is the latest project to take a FID. The initial two-train (11.6 bcm or 8.4 Mt/yr) project is based on gas resources in the Browse Basin and an 890 km pipeline to the LNG processing plant in Darwin.

There are other projects under development, such as the *Hess Equus* project and the *Shell/PetroChina joint CSG-to-LNG* project.

Source: IEA.

There are currently seven LNG export projects representing 56.6 Mt/yr (77.5 bcm) under construction or committed (see Box 8). All projects took final investment decision over the period October 2009-December 2011. These LNG projects represent 70% of the committed worldwide LNG export capacity due to come on line over 2011-17. Only Qatar so far has experienced such a capacity growth in such a short period of time.

Given the concentration of projects under construction in the same place over a short period of time, there is a risk of bottlenecks in infrastructure, workforce shortages, as well as a risk for Australia to exacerbate a patchwork economy. This situation is not specific to the gas industry but is part of a wider general boom in the resources industry.

Petroleum taxes form an important part of policy when it comes to encouraging the development of oil and gas fields. There are a number of different taxes: the petroleum resource rent tax (PRRT), and the forthcoming mineral resource rent tax (MRRT), which will replace the resources super profits tax proposed by the previous government. The PRRT is a profit-based tax, levied on petroleum projects in Commonwealth offshore waters. PRRT is applied to the recovery of all petroleum products, including natural gas among others. Under the PRRT, when products undergo additional refinement, the additional refinement value-adding processes are not taxed. The PRRT includes incentives for offshore exploration and petroleum development, and has been extended to onshore oil and gas operations, including coal seam gas following the agreement on the MRRT in July 2010.

Specific programmes have also been developed in order to foster exploration on frontier areas. A designated frontier area (DFA) tax incentive was applied to select acreage released for petroleum exploration between 2004 and 2009, in order to encourage exploration in offshore frontier areas by allowing for the value of exploration expenditure in such areas to be deducted at a rate of 150% for petroleum-producing assets subject to PRRT. Meanwhile, the Australian government's Offshore Energy Security Program has been seeking to improve data on offshore frontier basins through the acquisition of pre-competitive geophysical and geological data. This has resulted in increased exploration within previously unexplored or under-explored areas.

DEMAND

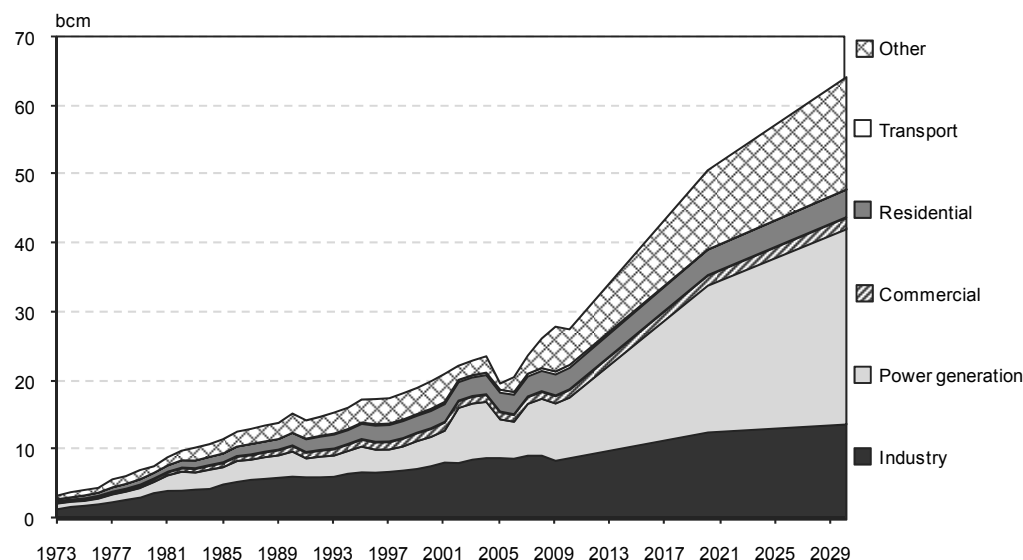
The Australian domestic market is divided into three separate gas markets: Eastern Australia (Queensland, New South Wales, the Australian Capital Territory, South Australia and Tasmania), Western Australia and the small Northern Territory market. There is no interconnection between these markets because of the large distances between them, so that gas production is either consumed within each market or exported as LNG.

Australian natural gas demand reached 33.4 bcm in 2010, a 7.2% increase over 2009. Gas ranks third in terms of share in the primary energy mix with 21%, behind coal (41%) and oil (32%). One-third of total gas demand is used by electricity generators and another third by industry. The energy industry uses roughly 18% for oil and gas extraction and liquefaction (energy industry's own use), while residential/commercial accounts for the remainder. Gas demand has increased by 4.2 bcm or 3.6% per year over the past decade, faster than coal and petroleum products. The sharpest increases were in energy industry's own use, notably because of the new LNG plants coming on line in 2004, 2006 and 2008 and because of the corresponding gas production increase. By contrast, after a sharp increase in 2002, gas demand in the electricity sector has remained relatively flat over 2002-09. Most gas-fired plants are open-cycle gas turbines (OCGT) used for peaking purposes, particularly in times of high wind power production. Industrial gas use gained 16% and residential/commercial gas demand gained 13% over 2000-09.

Natural gas demand is projected to grow at approximately 3% per year between 2008/09 and 2034/35, reaching around 2 611 PJ by 2034/35, according to BREE.⁴² The power sector is seen as the main driver behind growth in gas demand, and consumption is expected to increase threefold between 2009 and 2030. BREE estimates that gas's share in electricity generation will grow from an estimated 16% in 2008/09 to 36% in 2034/35, representing more than three-quarters of additional power generation needs over the period. A 630 MW CSG-fired power plant was commissioned in 2010 and a number of advanced gas-fired projects totalling approximately 1 000 MW of capacity (including 59 MW of CSG-fired capacity) are under construction.⁴³ As a consequence, natural gas demand will double over the two coming decades. It remains to be seen whether new gas-fired plants will be open-cycle or combined-cycle gas turbines, as the outcome in terms of CO₂ emissions is quite different as OCGTs emit more CO₂ per kWh of electricity produced. Energy industry's own use would also increase threefold on the back of rapidly increasing production and exports. Industrial gas use would only increase by half.

In terms of regional demand, the eastern market is by far the largest gas consumer, representing around 64% of Australia's gas demand. In this region, the power and the residential/commercial sectors together are the largest gas users. The western gas market consumes around 35% of Australia's total gas demand. The Northern Territory is the smallest consumer of gas, accounting for merely 1% of domestic gas consumption in 2010.

Figure 21. Natural gas demand by sector*, 1973-2030



* TPES by consuming sector. *Other* includes other transformation and energy sector consumption. *Industry* includes non-energy use. *Commercial* includes commercial, public services, agriculture/ forestry, fishing and other final consumption.

Note: this graph shows historical data until 2009 and the government's projections from 2010 to 2030.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2010 and country submission.

In terms of seasonality, Victorian gas demand is more seasonal than other parts of Australia because of a higher share of residential consumption for heating purposes. Additional daily winter demand is usually covered by storage, but during peak days, it requires linepack balancing and/or injection of gas from the gas storage facility located

42. Australian energy projections to 2034/35.

43. *Major Electricity Generation Projects*, Bureau of Resources and Energy Economics, Commonwealth of Australia, 2011.

near Melbourne. By contrast, South Australian gas demand is higher during the summer because of air conditioning resulting in higher electricity use and therefore gas use in power plants. There is less seasonal variation in other states and territories.

INDUSTRY STRUCTURE

The Australian gas industry comprises around 150 gas companies active in the different parts of the gas value chain. After the 1990s, large parts of the gas industry were privatised. While some state and territory governments still have interests in gas retail companies, there is no local, state or Australian government ownership or shareholdings in the upstream sector.

Upstream

The upstream part of the gas value chain is relatively concentrated and currently dominated by international oil companies (IOCs) such as Chevron, ConocoPhillips, Shell, ExxonMobil, BP and Apache, as well as Australian majors such as Woodside, BHP Billiton, Santos, and Origin Energy. As new LNG projects are developed, new players are also entering Australia, including BG Group, INPEX, Total, Hess and the three major Chinese national oil companies (NOCs) CNOOC, Sinopec and PetroChina. There are also many smaller gas companies.

Many companies work in joint-ventures, with overlapping ownership interests. Chevron, Shell and ExxonMobil have the highest market shares in proved and probable gas reserves with 21%, 14.2% and 11.8% respectively, as of 2010. These companies have notably high shares in the Carnarvon Basin, which is Australia's largest producing basin. Woodside, Origin Energy, Santos, BHP Billiton and ConocoPhillips follow with shares in reserves ranging from 7.4% to 4.9%. Mergers and acquisitions since 2006 have mostly focused on CSG and the associated LNG projects, in particular Shell and PetroChina acquired Arrow Energy in 2010.

Six major companies accounted for 70% of the supply to the domestic market in 2009/10 (72% in 2008/09). BHP Billiton and Santos were the largest players with 19% and 18% respectively followed by ExxonMobil (14%), Woodside (12%), Apache Energy (10%) and Origin Energy (6%). There are significant regional variations – Woodside and Apache represent half of the production in the Carnarvon Basin supplying the domestic market, while Santos has a 64% market share in the Cooper Basin. Origin Energy, BG, ConocoPhillips and Santos dominate the Bowen-Surat Basin with shares around 16% to 19%. Gas producers sell directly to big gas users such as major industrial, mining customers and power generators as well as to energy retailers, which then sell the gas to small gas users.

In terms of LNG exports, the North West Shelf joint venture providing over 20 bcm/yr to the LNG markets is led by Woodside, BHP Billiton, Chevron, BP, MIMI, and Shell while the 4.5 bcm/yr Darwin LNG is led by ConocoPhillips, Santos, Inpex, Eni, Tepco and Tokyo Gas, and the 4.3 bcm/yr Pluto LNG is led by Woodside, Tokyo Gas and Kansai Electric. Japanese energy and utility companies continue to take limited shareholdings in existing LNG ventures. With the new LNG export projects, IOCs are reinforcing their positions, while Chinese NOCs such as CNOOC, PetroChina and Sinopec, Japanese energy companies such as Tokyo Gas as well as Korean gas companies (Kogas) are becoming involved with the objective of obtaining equity gas to supply their domestic markets.

Transmission

Before 1990, Australia's transmission pipelines were a series of individual pipelines, each supplying a demand centre from a specific gas field or basin. The majority of these

pipelines were government-owned and there was little interconnection. Privatisation of the pipelines took place two decades ago and now transmission pipelines are mostly in the hands of private companies, while the network has expanded. Additionally, Australia's local gas distribution networks have been fully privatised in all states and territories, with the exception of New South Wales, which has one government-owned distribution network.

Since the early 1990s, Australia's transmission pipeline network has almost trebled in length and the Eastern states have become interconnected, with Adelaide, Canberra, Melbourne and Sydney each now being supplied by two separate pipelines. There are more than 33 000 km of high-pressure steel pipelines, of which more than 25 000 km are used for natural gas transmission.

If transmission pipelines are determined to be anti-competitive, they are regulated under the National Gas Law and National Gas Rules. Major transmission pipeline companies include APA Group, Jemena, Prime Infrastructure and Hastings Diversified Utilities Fund. Jemena owns and operates the Eastern gas pipeline, VicHub and the Queensland Gas pipeline. The APA Group owns pipelines in New South Wales, Western Australia, and has a 25.99% share in Hastings Diversified Utilities Fund. This Fund acquired assets from Epic Energy, and owns pipeline assets such as the Moomba to Adelaide pipeline. The major gas distribution systems in Australia are privately owned, but regulated by the Australian Energy Regulator (AER) to ensure gas can be transported on reasonable terms by third parties. There is some duplication between companies owning transmission and distribution networks, including Jemena, the APA Group and Prime Infrastructure, as well as Envestra in which the APA Group has 32%.

Retail

In terms of gas retailers, South Australia (in 1993), Victoria (late 1990s), Western Australia (in 2000) and Queensland (in 2007) have privatised their state-owned retailers. The New South Wales government owns EnergyAustralia and Country Energy, and in Tasmania, one of the two active retailers is state-owned, but otherwise the Australian gas retail sector is mainly in private hands. Many retailers are active in both the electricity and gas sectors and often offer dual products. In particular, AGL Energy and Origin Energy have substantial interests in both electricity generation and gas production.

Victoria is the state with the largest number of gas users and consequently the largest number of retailers (eight), followed by New South Wales (six). At the other end of the spectrum is Tasmania with some 5 000 users and two retailers. The largest retailers are AGL Energy, Origin Energy and TRUenergy, active in four different jurisdictions. New players are nevertheless active and their market share has been increasing, notably in Victoria and New South Wales. The number of customers switching supplier is the highest in Victoria.

REGULATION

Considerable changes have taken place since the last in-depth review in 2005. In April 2004, the Ministerial Council on Energy (MCE) agreed to expand the gas market element of the energy market reform programme to accelerate the development of reliable, competitive and secure natural gas markets, and to encourage the penetration of natural gas in the energy mix. Such changes are a continuation of the reforms started in the early 1990s, whereby public gas utilities were disaggregated and retail competition introduced. The three-year market reform programme announced by the MCE in December 2003 had

planned the creation of an energy regulator, a market commission and the enhancement of regulatory consistency across Australia. As a result, new regulations have been developed, including the National Gas Law (NGL) and National Gas Rules (NGR) in 2008 and new national bodies such as the **Australian Energy Regulator**, the **Australian Energy Market Commission** and the **Australian Energy Market Operator** have been established.

The National Gas Law and National Gas Rules commenced on 1 July 2008 in all jurisdictions except Western Australia, which enacted complementary legislation on 1 January 2010. The National Gas Law reforms gas regulations on access to pipelines and replaces the Gas Pipelines Access (South Australia) Act 1997. It brings pipeline regulation under the national energy framework. Its application under each state or territory constitutes an individual state/territory access regime which applies to the provision of pipeline services. Under the NGL, the National Competition Council classifies pipelines (transmission or distribution), recommends to the relevant minister whether a pipeline should be or remain covered by the legislation, whether “light regulation” or “full regulation” should apply, and makes recommendations on exemptions for new pipeline projects. Indeed, not all covered pipelines are to be subject to “full regulation” under the NGL. Pipeline operators can apply for a “light regulation determination” to avoid in particular the upfront setting of reference tariffs (price regulation) under the full regulation regime. Additionally, greenfield pipeline projects can apply for incentives (a 15-year no-coverage determination).

The **Australian Energy Regulator (AER)** is responsible for the regulation of gas transmission and distribution networks and for enforcing the NGL and NGR in all jurisdictions except Western Australia. The AER performs its regulatory role at arm’s length from the Australian government. The AER is part of the Australian Competition and Consumer Commission (ACCC) and was established under Part IIIA of the Competition and Consumer Act 2010. It operates as a separate legal entity. From July 2008, the AER became the economic regulator for covered gas transmission and distribution pipelines in all states and territories (except Western Australia).

The **Australian Energy Market Commission (AEMC)** was established in 2005 and its role has expanded since then. For the gas sector, it has responsibility for reviewing the effectiveness of competition in the retail market. In July 2008, the role of AEMC was expanded to include the power to make rules regarding the regulation of pipelines; then in July 2009, its role was expanded again to include the power to make rules regarding gas retail in some jurisdictions. Finally, its role was expanded to include Western Australia in January 2010, when it became a participating jurisdiction in the National Gas Law, to the extent set out in the National Gas Access (WA) Act 2009.

On 1 July 2009, the **Australian Energy Market Operator (AEMO)** took over as operator of the Victorian wholesale gas market and the gas retail markets of New South Wales, the Australian Capital Territory, Victoria, Queensland and South Australia. Western Australia and the Northern Territory will continue with their current regulators and can opt in at a later stage. Tasmania’s retail gas market is not regulated.

Finally, changes have been made to improve the transparency of the market. A short-term trading market (STTM) for gas, a gas market Bulletin Board (BB) and a *Gas Statement of Opportunities* (GSOO) were created. The **STTM** gas started at the Sydney and Adelaide hubs on 1 September 2010 and Brisbane on 1 December 2011. This market is relatively similar to European or North American markets in the sense that gas users and suppliers can trade natural gas at the wholesale level and gain some supply or demand flexibility.

The **BB** and the **GSOO** both aim at increasing transparency on gas markets. The BB publishes daily market information, such as pipeline capacities and daily gas deliveries of the Eastern gas market on its website. It covers major producing sites, storage, demand centres and transmission pipelines in this region. Facilities in other jurisdictions could participate in the future. The GSOO is an annual supply/demand outlook publication of the Eastern gas market which assists participants and other interested parties in their planning and identification of potential investment opportunities. Western Australia intends to develop similar tools for its market.

State and territory governments are currently responsible for the regulation of retail energy markets. They have introduced full retail contestability (FRC) for gas customers, implying that users can choose their supplier. The last state to do so was Queensland in 2007.

Western Australia enacted the NGL and the NGR through complementary legislation on 1 January 2010, instead of enacting an application act. The Economic Regulation Authority (ERA) is the independent economic regulator for Western Australia, in charge of monopoly aspects of the electricity and gas industry. It also has the responsibility of overseeing the gas retail market. The Retail Market Company (REMC) is the operator for Western Australia's contestable gas markets.

The **petroleum resource rent tax (PRRT)** has applied to the operation of offshore oil and gas industry since 1987. The regime has remained relatively unchanged since its inception, and provides a stable and predictable tax environment to the industry. From 1 July 2012, the PRRT was extended to onshore oil and gas projects.

GOVERNMENT POLICIES

DRAFT ENERGY WHITE PAPER

A Draft Energy White Paper 2011: Strengthening the Foundation for Australia's Energy Future was published for public consultation in December 2011. The paper fulfils the Australian government's commitment to publish a Draft Energy White Paper (EWP) by the end of 2011. Following the completion of the consultation process, the government anticipates that a final EWP will be released late in 2012. The Draft EWP contains significant proposals in relation to both the electricity and natural gas markets.

The Draft EWP acknowledges that existing market and policy frameworks are facing challenges. The fundamental design of electricity and gas markets remains sound and there is no justification for another "root and branch" review. Long-term supply is adequate and well-functioning markets will continue to ensure that new gas requirements continue to be delivered. Markets in the east and west are changing and there is a strong case for further reforms in these markets to improve transparency and increase opportunities for more flexible trading.

The Australian government has committed to improving the effectiveness of Australia's gas and electricity market frameworks. The Australian government proposes to support the continued development of gas markets to improve transparency and trading opportunities, and lead further work to better monitor market dynamics to assess whether policy settings are delivering the required outcomes given the growing use of gas for electricity generation. The government will also support further reforms to the Western Australian gas market to ensure that it becomes more mature and competitive and to extend national governance arrangements and principles to cover all Australian gas and electricity markets.

EMERGENCY POLICY

The three regional markets depend on their respective sources of supply, all of which are domestic. Gas imported from Timor Leste is re-exported as LNG. As noted earlier, Australia is a net exporter and is projected to have rapidly increasing gas production. However, gas consumption is also expected to grow significantly, in particular in the power sector, reinforcing the interaction between the electricity and gas markets. This will require careful attention so that infrastructure capacities and emergency response policies are developed accordingly.

Unlike many other IEA countries, the share of gas consumption in the residential/commercial sector is relatively small (15%) and concentrated in the Eastern regional market. To meet these variations, there are four operating storage facilities (all depleted fields) and one LNG peak-shaving plant, representing a working storage capacity of 1.3 bcm.

Over 1.1 bcm is located in the eastern market – the most prone to seasonal variations owing to higher heating demand during winter. Conventional gas storage facilities are located in Victoria, Western Australia and the Cooper Basin. In Victoria, the largest facility is the Iona Gas plant, owned by TRUenergy, which has 22 PJ of storage capacity and can deliver 570 TJ of gas per day. AGL Energy is currently developing a coal seam gas storage facility in Queensland at Silver Springs. Dandenong storage facility in Victoria is Australia's only LNG storage facility with 0.7 PJ of capacity. In Western Australia, a scheduled expansion of the Mondarra storage facility will increase storage capacity to 15 PJ and will allow injection and withdrawals to be made on both the Dampier to Bunbury natural gas pipeline and the Parmelia pipeline.⁴⁴

Access to storage facilities is not regulated, but negotiated between storage operators and their customers. A new storage facility, Silver Springs, is currently being developed by AGL; first gas injection started in 2011 and the project aims completion by end-2015. AGL also plans to develop an LNG storage facility in New South Wales by 2014 to improve security of supply.

Table 9. Underground storage facilities

Facility	Basin	Working capacity	Withdrawal rate	Company	Online date
Mondarra	Perth	127	5	APA Group	n.a.*
Moomba	Cooper	623	4	Santos	1981
Newstead	Surat	234	5.2	Origin	1997
Iona	Otway	308	6	TXU	1999
Silver Springs	Surat	n.a.*	n.a.*	AGL	2011-15

* not available.

Source: IEA.

The management of temporary gas shortfalls is primarily undertaken by gas market participants and jurisdictional governments, depending on the nature and size of the event. By and large, the gas industry has good arrangements, such as load shedding, in

44. *State of the Energy Market 2011*, Australian Energy Regulator, Commonwealth of Australia, 2011.

place to manage a range of issues that can temporarily impact on gas supplies. For larger issues, each state and territory has legislation which confers emergency powers which may be exercised in natural gas emergency situations affecting only one jurisdiction.

Several options can be used in the event of a gas shortage, including fuel switching in the power and industry sectors. Contingency gas (CG) may be used at the short-term trading market hubs in Sydney, Adelaide and Brisbane. CG may be offered by shippers who can increase supply to the hub and users who can reduce withdrawals from the hub in cases of shortage. In such a case, the shipper and the user will be paid a price higher than the *ex ante* market price for additional gas they make available.

In the case of a major gas crisis affecting more than one jurisdiction, the National Gas Emergency Response Advisory Committee (NGERAC), created in 2005, will advise energy ministers across jurisdictions. The NGERAC is currently chaired by the Commonwealth, and includes government representatives from each jurisdiction as well as industry representatives.

PRICES

Most gas production in Australia is contracted on a long-term basis and pricing information is treated by the industry as commercial-in-confidence and is thus not publicly available. Gas is traditionally sold under long-term contracts of up to 20 years. Recently, the duration of these contracts tends to be shorter, five years or less, owing to price uncertainties. Contracts underpinning new projects can still have duration of 20 years.

The IEA does not have information about industry or residential gas prices, but gets a wholesale as well as a retail price index. Indeed, average daily wholesale gas price data have been available in Victoria since the introduction of the Victorian wholesale spot market in 1999 in order to increase the flexibility of market participants in buying and selling gas. Overall, gas traded at the spot price accounts for around 10% to 20% of wholesale volumes in Victoria, with the balance sourced through bilateral contracts or vertical ownership arrangements between producers and retailers. The new spot markets in Sydney, Adelaide and Brisbane are expected to provide additional wholesale gas price references and improve transparency, competition and efficiency within the gas sector.

Retail gas prices are regulated in Australia only for residential and small business customers (consuming less than 1.0 TJ/yr) in New South Wales, South Australia and Western Australia; all other jurisdictions have removed retail gas price regulation. However, all jurisdictions have agreed under the Australian Energy Market Agreement (AEMA) to phase out retail price regulation where effective competition can be demonstrated. The AEMC is the commission responsible for monitoring competition.

- The New South Wales government plans to phase out retail gas price regulation when effective competition can be demonstrated, but not before 2013.
- The South Australian government has not set a timetable for the removal of regulated prices for small gas customers.

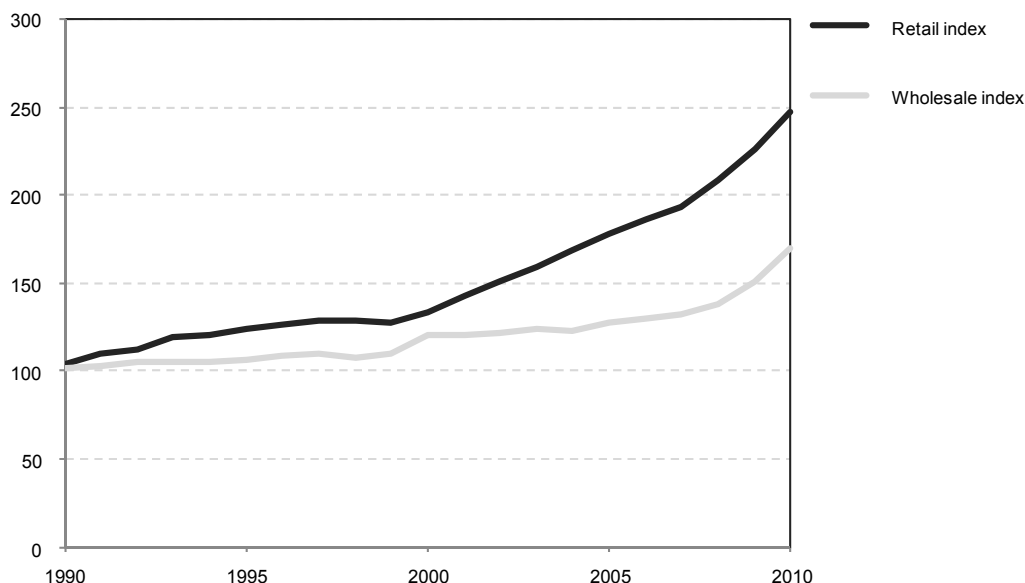
In New South Wales and South Australia, the retail gas markets are open to competition and gas users can choose whether or not to keep regulated gas tariff set by the Independent Pricing and Regulatory Tribunal in New South Wales and by the Essential Services Commission of South Australia.

In Western Australia, tariff regulations set price caps for small residential users and non-residential customers. Tariffs are set by the Western Australian Office of Energy. The Office of Energy is undertaking an ongoing review of regulated gas tariffs.

Both wholesale and retail indices have been increasing over the last two decades, but more rapidly during the last decade, and even more during the last three years. Additionally, the retail index increased much faster than the wholesale index: the retail index increased from 130 in 2000 (1990 = 100) to 250 in 2010, while the wholesale index increased from 120 to 170.

According to data from the Australian Competition and Consumer Commission (ACCC), there are some wide differences between regional gas prices. Retail prices have risen over the past 15 years in all states except Victoria. Prices in Queensland were relatively stable from 2001 to 2005, but have increased significantly over the past few years. They are also comparatively higher, reflecting fewer consumers and lower individual consumption owing to the warm climate (therefore a higher cost per energy unit). By contrast, Victoria has the largest number of users located near major gas fields. Western Australia traditionally has relatively low wholesale gas prices but high transport costs due to long distances.

Figure 22. **Natural gas price indices (1990 = 100)**



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2011.

The *National Energy Assessment 2011* found that gas prices in Australia are projected to increase as a result of higher gas production costs and the impact of the LNG export market on the domestic market. This change may be more evident in the eastern market owing to the rapid growth of the coal seam gas industry in Queensland that has occurred sooner than was expected in the 2009 *National Energy Security Assessment*. Although the expected trend for gas prices is still upwards, the significant levels of global gas supplies that have emerged since the 2009 NESA will introduce greater competition in the LNG industry and constrain price increases. As witnessed in the United States, market dynamics can be difficult to predict.⁴⁵

45. *National Energy Security Assessment December 2011*, Department of Resources, Energy and Tourism, Commonwealth of Australia, 2011.

CRITIQUE

Given the concentration of LNG export projects currently under construction or committed over a short period of time (eight projects as of February 2012, including three near Gladstone and three in Western Australia's Pilbara, one floating and one in Darwin), there is a perceived risk of bottlenecks in infrastructure, workforce shortages, as well as a risk for Australia to create a patchwork economy. This situation is not specific to the gas industry but is aggravated by the general boom in the resources industry. Better co-ordination between the states and within the states, possibly involving industry, to have sequenced construction of such projects and co-ordinated use of infrastructure could be desirable. Furthermore, federal and state governments should take a proactive approach in order to address workforce shortages in terms of education, training and attracting overseas workforce.

A clear, stable regulatory and fiscal framework is essential for investors to be able to take final investment decisions on these large-scale long lead-time investments without fearing major changes to regulation that could threaten the economics of their investment. For example, Australia's first LNG project, the North West Shelf, benefited from fiscal stability over its thirty-year life (to date), that enabled massive long-term pioneering investments to proceed, and additional investments and expansions to be made with confidence. Where possible, such a fiscal framework should not discriminate against smaller companies because of a potentially heavy regulatory burden. When possible, a clear and streamlined regulatory framework avoiding duplication from the states and the federal government should also be created. This has already taken place for environmental approvals under the Environment Protection and Biodiversity Conservation Act, for example, the new LNG plants in Queensland.

Gas is expected to represent a growing share of electricity generation. Over the past ten years, in common with many IEA countries, most new electricity generating capacity was gas or wind. The majority of the gas-fired plants are open-cycle gas turbines used for peaking purposes, in particular in times of low wind power production. Such plants are more rarely used for baseload purposes. While gas-fired plants generally emit substantially less greenhouse gas emissions than coal-fired plants, the use of open-cycle gas turbines undermines these benefits. Meanwhile, the use of more efficient generating technologies, such as combined-cycle gas turbines to replace aged coal-fired plants should be encouraged by appropriate measures to be determined within the climate change discussion. Such plants can produce emissions nearly one-third lower than those of certain older coal-fired plants. As gas-fired plants will remain the main source of system flexibility, adequate investments in the transmission system as well as in other flexibility tools (linepack, storage, and demand-side responses) will be necessary.

The progress made by Australia to improve gas markets should be commended. Since the last in depth review, a National Gas Law and Natural Gas Rules have been passed; the energy regulator is now responsible for gas as well as for electricity; the Australian Energy Market Operator (AEMO) became the operator of the Victorian wholesale and retail markets of New South Wales, the Capital Territory, Victoria, Queensland, and South Australia, providing greater consistency between the states. A short-term trading market (STTM) has also been established. There is still some progress to be made in order to harmonise regulations and regulatory entities between the States. The STTM is so far relatively limited in terms of size and geographic coverage; its growth and a diversification of products offered should be encouraged. Understanding that end-user prices are a responsibility of the states, removing price caps and regulated gas prices for small users should be encouraged.

Oil and gas data are collected on a voluntary basis. However, in common with other IEA countries, data quality needs to be improved markedly. As Australia will remain a major LNG exporter, clarity, transparency and completeness of data is becoming increasingly important for the global market to understand trading patterns, but also to be able to be better prepared for potential gas disruptions. There are discrepancies between the different submissions of gas-related data: for example, LNG exports in 2010 in the IEA *Natural Gas Information* (NGI) book are either 24.3 bcm or 26.2 bcm, and 22.8 bcm according to the IEA monthly gas statistics.

RECOMMENDATIONS

The government of Australia should:

- ☐ *Improve co-ordination at the states, territories and federal levels to manage the boom of upstream projects in order to avoid infrastructure bottlenecks and workforce shortages.*
- ☐ *Ensure clarity and stability of the taxation regime in order to support sound and timely investment decisions in developing gas resources.*
- ☐ *Take the necessary steps to improve oil and gas data reporting by placing a data reporting obligation on all industry participants.*

9. OIL

Key data (2010)

Crude oil production: 20.4 Mt, -14.4% compared to 2000

Net crude oil imports: 7.7 Mt, +60.7% compared to 2000

Oil products: refinery output 30.1 Mt, imports 15.4 Mt, exports 2.2 Mt

Share of oil: 32% of TPES and 1.3% of electricity generation

Inland consumption: 43 Mt (transport 69%, industry 18%, electricity and heat generation 2%, agriculture 4%, residential and commercial services 2%, other 5%)

Consumption per capita: 1.8 t per capita (OECD average: 1.6)

SUPPLY AND DEMAND

SUPPLY AND PRODUCTION

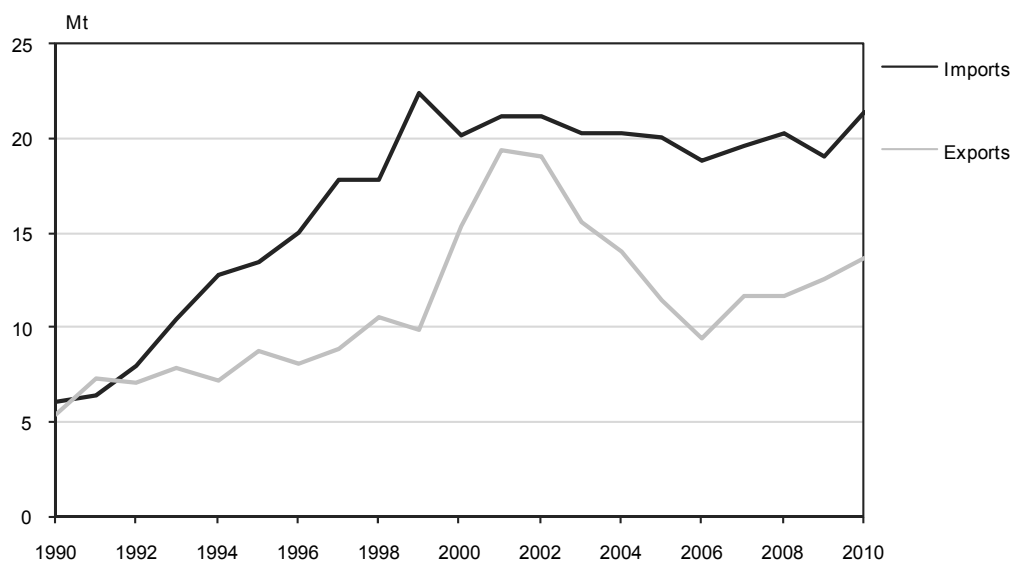
Domestic oil production began in Australia in the 1960s following the discovery of large fields located off the south-east coast of Australia. Approximately 70% of Australia's crude oil and condensate production occurs off the north-west coast. While there are over 300 producing fields at present, the bulk of production comes from seven major fields located in the mature oil provinces of the Carnarvon Basin in the north-west of Australia and the Gippsland Basin in the south-eastern Bass Strait. Production from the Carnarvon Basin, which accounted for around 66% of total production in 2010, is mostly exported. Production from the Gippsland Basin, predominantly used in domestic refining, has declined steadily since its peak in the mid-1980s and accounted for less than 15% of total production in 2010.

Most of Australia's crude oils are of a high quality, light-sweet grade, such as its main crude streams (Gippsland, Bayu-Undan and Cossack). These are similar in quality to the condensates produced primarily in association with the country's giant offshore gas fields. In addition to crude oil and condensate production, Australia produces natural gas liquids (NGLs) in the form of naturally occurring liquid petroleum gas (LPG). Total crude oil and condensate production reached a height in 2000/01 at 687 thousand barrels per day (kb/d). Production has since declined and averaged 441 kb/d in 2010 (an additional 70 kb/d of LPG was also produced in 2010).

Over the past five years, a number of new projects have been developed; six fields in the Carnarvon Basin and one in each of the Perth and Bonaparte Basins. These eight fields have a production capacity in excess of 350 kb/d and the Australian government's 2010 projections expect total crude production to increase to 521 kb/d in 2012/13. Beyond this period, production is expected to decline as older fields mature and slowly decline. By 2015, crude production is expected to average 464 kb/d, with LPG likely adding an additional 70 kb/d to total indigenous production.

Condensate is expected to outstrip crude oil production by 2015 and new discoveries within established basins could add to production in the latter half of the period to 2030. Nonetheless, over the longer term, combined crude oil, condensate and LPG production is projected to fall gradually, by 3.7% per year to 376 PJ by 2034/35. Over the same period, total domestic oil demand is expected to grow, resulting in total net imports (including both crude and refined products) rising by 3.1% per year.

Figure 23. **Crude oil imports and exports, 1990-2010**



Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011.

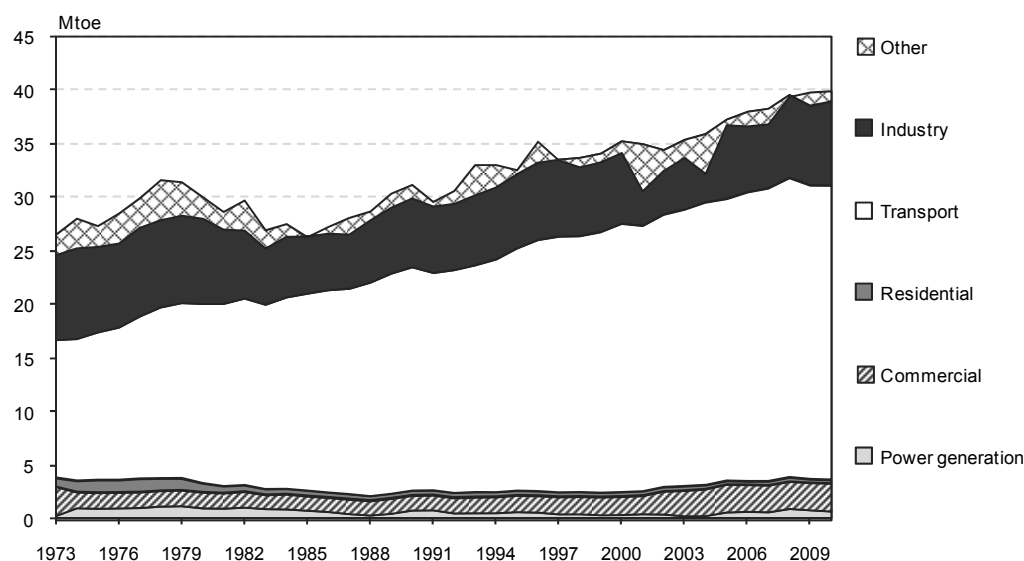
DEMAND

Oil product demand in Australia averaged 960 kb/d in 2010. Total oil use has grown at an annual average rate of 1% since 2000. The transport sector, which accounts for two-thirds of all oil used in Australia, has been the primary factor leading oil demand growth. At the same time the mining sector, where diesel is the primary fuel used, has continued to expand and contributed to growth in the fuel's use. Demand for diesel grew by an average of 4.2% over the period, and in 2010 overtook gasoline as the largest component of the country's overall oil demand.

Total oil demand is expected to continue to grow in the coming years at an annual average rate of 1.1%. This rate would infer oil demand reaching just over 1 million barrels per day (mb/d) in 2015 and nearly 1.1 mb/d by 2020. The mining sector is expected to make the most significant contribution to oil demand growth, where the sector's energy consumption is expected to grow at a rate of 3.3% annually to 2030. Air transport is also expected to drive oil demand growth, with a long-term growth rate of 2.3% per year.

The breakdown by product of projected growth in oil demand is likely to continue the trends of the previous decade, with demand for diesel and jet kerosene growing at the greatest pace and demand for gasoline remaining flat or increasing at only a modest rate.

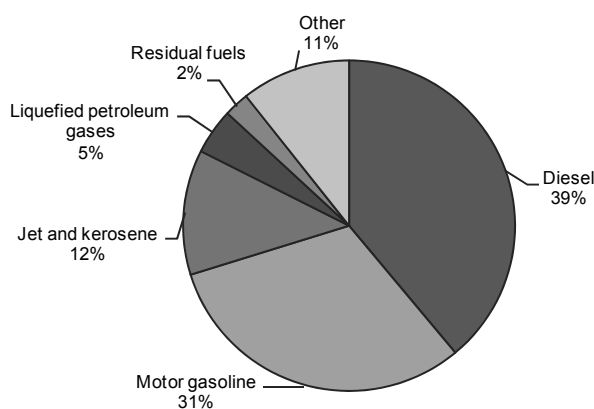
Figure 24. Final oil consumption by sector, 1973-2010



* TPES by consuming sector. *Other* includes other transformation and energy sector consumption. *Industry* includes non-energy use. *Commercial* includes commercial, public services, agriculture/ forestry, fishing and other final consumption.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2011.

Figure 25. Oil consumption by product, 2010



Source: *Oil information*, IEA/OECD Paris, 2011.

TRADE

Until 2000, the year in which its domestic crude production peaked, Australia was either a net oil exporter or relied only marginally on oil imports to meet domestic demand. Since then, as domestic production has declined and domestic oil demand grown, Australia has become a growing net oil importer. In 2010, total oil net imports, including both crude and refined products, amounted to 393 kb/d.

A large portion of Australia's domestic crude oil production is exported, as oil's quality and the geographic location of production (coming primarily from the north-west coast) makes it attractive for Asian refineries. In 2010, nearly 330 kb/d of domestic production was exported, primarily to Korea, Thailand and China. At the same time, the majority of domestic refinery capacity is located close to the major demand centres on the east coast, where refiners process primarily domestic crudes coming from the south-eastern

fields and lower-quality imports from South-East Asian producers. In 2010, total imports of crude oil amounted to some 480 kb/d, primarily sourced from Malaysia, Indonesia and Vietnam.

Imports of refined products have steadily increased in recent years, rising from just under 200 kb/d in 2004 to a high of over 330 kb/d in 2009. Total imports of refined products in 2010 were just under 300 kb/d, including 115 kb/d of middle-distillate (diesel and kerosene) imports from Singapore. At the same time, product exports averaged 56 kb/d.

Continued growth in domestic oil demand and declining domestic oil production are expected to result in an increase in Australia's oil imports over the next twenty years. In the shorter term, domestic production is expected to increase to 2012/13, with a significant proportion of this production growth concentrated in north-western Australia. As this production will likely be largely exported to Asian refineries, the ability of domestic production to meet domestic demand is likely to be lower than implied by the simple comparison of production and consumption.

At the same time, Australia's refining capacity is not expected to expand given increasing competitive pressures from larger refineries in India and South-East Asia in particular. In addition to the outlook for domestic production and consumption, the outlook for domestic refining capacity may result in lower crude oil imports and, simultaneously, higher imports of refined products. Projections of declining oil production and constraints around petroleum refining suggest that Australia's net trade position for crude oil and refined petroleum products will weaken over the period to 2034/35, with net imports projected to increase at an average rate of 3.1% a year.⁴⁶

RESERVES

Australia has more than 50 sedimentary basins. Of these, only twelve are producing oil and gas and only four are known to have non-commercial reserves. There has been very little exploration of the remaining 34 basins.

Australia has limited reserves of crude oil and most of its known remaining oil resources tend to be condensate and liquefied petroleum gas (LPG). Shale oil deposits are known to contain a large, unconventional resource.

Crude oil reserves, classified as economic demonstrated resources (EDR), which include remaining proven and probable commercial reserves, were estimated at 966 million barrels (mb), approximately ten years of remaining reserves based on the reserves to production ratio, as of 1 January 2011. Condensates represent more than half of the country's total petroleum resources, with EDR estimated at some 2.11 billion barrels (roughly 45 years of production). Economic demonstrated resources of naturally occurring LPG are estimated at 964 million barrels.⁴⁷

Most (72%) of the remaining identified crude oil resource is located in the Carnarvon and Bonaparte Basins. There are further resources in the Gippsland Basin and smaller volumes in a number of onshore (Cooper-Eromanga, Bowen-Surat and Amadeus) and offshore (Browse, Perth and Bass) Basins.

46. *Australian Energy Projections to 2034/35*, Bureau of Resources and Energy Economics, Commonwealth of Australia, 2011.

47. Geoscience Australia, *Oil and Gas Resources of Australia*, Reserves Table 2, McKelvey Classification Estimates by Basin, as at 1 January 2011.

There are additional, but uncertain, resources in the form of crude oil that could be extracted from existing fields using enhanced oil recovery (EOR) technologies. Furthermore, Australia has a large unconventional and currently non-producing identified oil shale resource of 22 390 mb which could potentially make a contribution to oil supply in the future if economic and environmental challenges can be overcome.

There have been a number of assessments of potential undiscovered resources and Geoscience Australia estimates that risked-mean undiscovered resources in currently producing basins are around 1700 mb (9 996 PJ) of crude oil and 700 mb (4 116 PJ) of condensate.

GOVERNMENT POLICIES

DRAFT ENERGY WHITE PAPER 2011

A Draft Energy White Paper 2011: Strengthening the Foundation for Australia's Energy Future was published for public consultation in December 2011. The paper fulfils the Australian government's commitment to publish a Draft Energy White Paper (EWP) by the end of 2011. Following the completion of the consultation process, the government anticipates that a final EWP will be released late in 2012. The Draft EWP makes a number of policy proposals relevant to the petroleum sector, most notably in relation to energy security and resource development.

The Draft EWP notes that, in the absence of major new discoveries, Australian oil production is expected to decline, with a corresponding increase in imported petroleum products.

Furthermore, the Draft EWP makes clear that maintaining Australia's energy security is a paramount goal for the Australian government and identifies a range of challenges for improving or at least maintaining Australia's energy security. The government proposes to pursue improved energy security and to address key challenges by implementing the integrated energy policy framework defined in the Draft EWP and gives a commitment to a biennial National Energy Security Assessment from 2014.

The Draft EWP suggests that Australia remains relatively unexplored for oil and there is potential for significant new oil resources to be found in deep-water frontier basins (such as in the Great Australian Bight), and the development of onshore shale gas may unlock unconventional liquid hydrocarbons as well.

Accordingly, and to improve the effectiveness of Australia's resource development framework, the Australian government has proposed a large number of actions. These actions include a commitment to review the efficiency and effectiveness of Australia's offshore exploration policy while at the same time continuing to implement current offshore regulatory reforms.

INDUSTRY STRUCTURE

UPSTREAM

There are many oil companies active in the upstream sector but four companies account for the vast majority of Australia's domestic oil production: Woodside, ExxonMobil, BHP Billiton and Apache. In 2010, the combined output of these four producers accounted for 85% of Australian crude-oil production and 92% of condensate production.⁴⁸

48. APPEA, 2010 Production Statistics.

DOWNSTREAM AND REFINING

Refining

There are four companies operating Australia's seven refineries; BP, Caltex, ExxonMobil and Shell. The refineries share a total crude distillation capacity of 762 kb/d. While mostly constructed in the 1950s and 1960s, these have undergone extensive upgrading, in particular in 2005/06. Australia's refineries are relatively small by global standards, with the largest, the Kwinana refinery (south of Perth), at just over 142 kb/d, representing roughly 19% of the country's total distillation capacity.

Table 10. **Australian oil refining capacity, 2009**

	Location	ML per year
BP PLC	Bulwer Island, QLD	5 910
BP PLC	Kwinana, WA	8 280
Caltex Refineries (NSW) Ltd.	Kurnell, NSW	7 810
Caltex Refineries (QLD) Ltd.	Lytton, QLD	6 300
ExxonMobil Refining & Supply Co.	Altona, VIC	4 640
Shell Refining (Australia) Pty. Ltd.	Clyde, NSW	4 740
Shell Refining (Australia) Pty. Ltd.	Geelong, VIC	6 530
Total		44 210

Source: Department of Resources, Energy and Tourism.

Australian refineries face considerable competition from mega-refineries in Asia, with Singapore product prices largely determining their profitability. In 2003, Port Stanvac (75 kb/d) in Adelaide, once Australia's eighth refinery, was mothballed for economic reasons. Its owner, Mobil, decided in 2009 to demolish the refinery and remediate the site. In July 2011, Shell announced that it will stop refining oil at its Clyde refinery (82 kb/d) near Sydney and convert the plant into a fuel import terminal before mid-2013. Australia's total crude distillation capacity will be reduced to 680 kb/d across six operating refineries following the conversion of the Clyde refinery.

Australian refineries use both domestic and imported crude, primarily from the country's Bass Strait production in the south and from South-East Asian producers. Total refinery intake of the country's seven refineries averaged 666 kb/d (605 kb/d of which was crude and condensates) in 2010. Over two-thirds of Australia's refinery input requirements came from imports.

Refiners produce mostly gasoline and middle distillates, as well as smaller volumes of bitumen and LPG. In 2010, motor gasoline accounted for 43% of refinery output, diesel for 31% and kerosene for 14%.

In 2006, Australia enacted higher fuel quality standards that have required refineries to upgrade facilities. The fuel quality changes required automotive diesel oil (ADO) to contain 10 parts per million (ppm) sulphur by January 2009 (reduced in steps from 500 ppm and 50 ppm), all grades of gasoline to contain 150 ppm sulphur by January 2005 and premium gasoline to contain 50 ppm sulphur by January 2008 (reduced from 150 ppm).

Retail

There has been ongoing structural change in Australia's oil retailing over the past few decades, with approximately 6 000 retail petroleum sites around Australia in 2010 compared to some 12 500 sites in the 1990s. The shares of volume of retail sales by brand in 2010/11 were: Woolworths/Caltex (23%), Coles Express/Shell (22%), BP (19%), Caltex (18%) and Shell (2%), with other smaller retail chains accounting for the remaining 17%. ExxonMobil sold its fuel retailing business to 7-Eleven Australia during 2010/11.

The retail fuel market is increasingly populated with independent operators, independently branded chains and supermarket chains. The refiner-marketers continue to reduce their involvement in retail operations. In May 2010, ExxonMobil signed an agreement for the sale of its retail-fuels business, comprising 295 company-owned or leased service stations, primarily located in the metropolitan areas of eastern Australia, to 7-Eleven Australia.

The Oilcode

As part of its Downstream Petroleum Reform Package, the Australian government introduced the *Trade Practices (Industry Codes – Oilcode) Regulations 2006* (the Oilcode). The Oilcode is a mandatory industry code under the Competition and Consumer Act 2010 (formerly known as the Trade Practices Act 1974), which repealed previous petroleum retailing regulations.

The Oilcode applies to all downstream petroleum industry participants and was designed to remove restrictions on competition, promote industry certainty about the future, promote cultural change and improve sustainability. Its intention was to create a more effective regulatory regime, giving all industry players the freedom to respond to changing conditions in the retail petroleum market without reducing levels of competition. Section 3(2) of the Oilcode required the Australian government to conduct a review of the Oilcode after it has been in operation for 12 months. The outcome of the last review, published in 2009, found the Oilcode regulations have met the objectives set out in the Oilcode's explanatory statement.⁴⁹

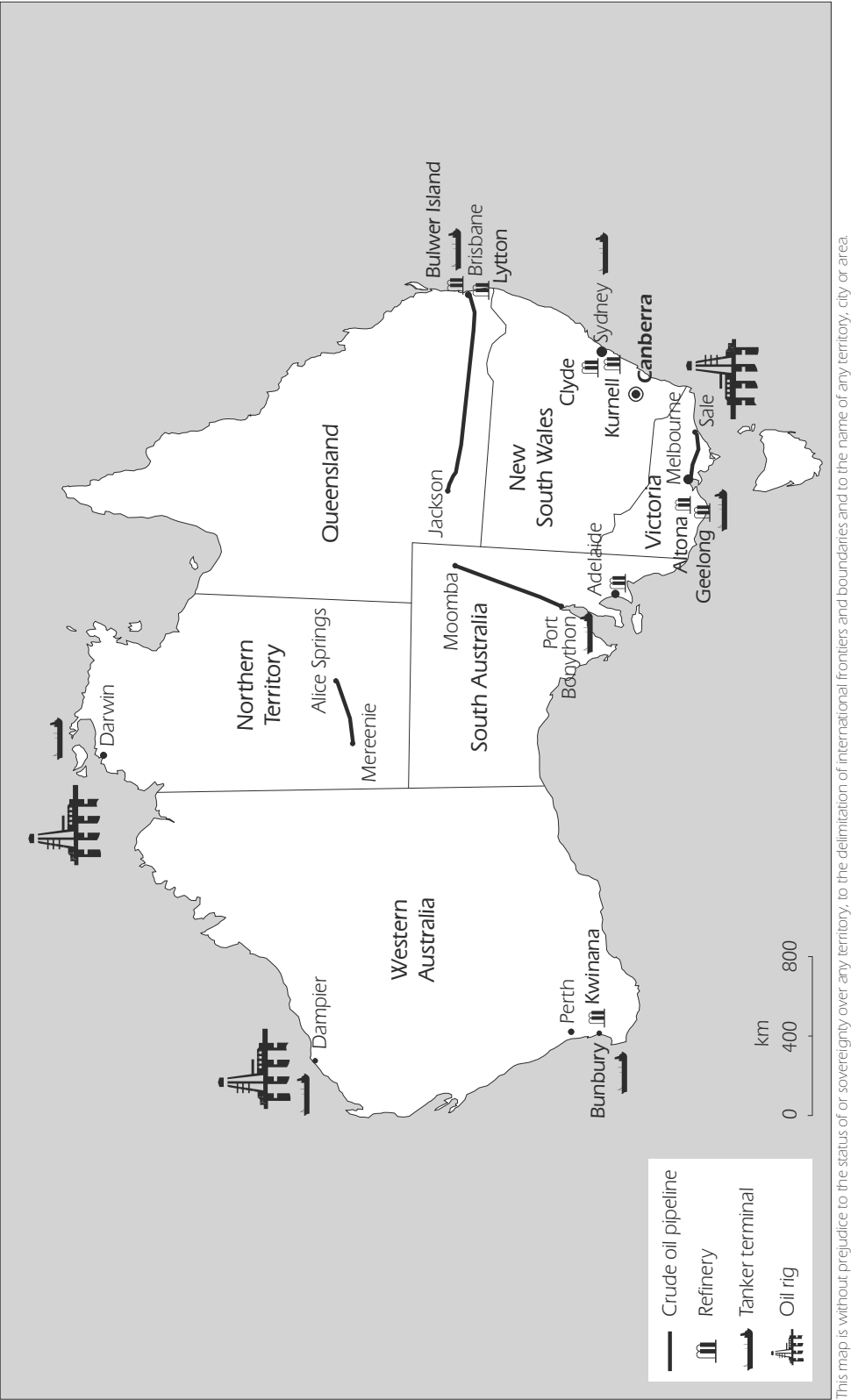
OIL SUPPLY INFRASTRUCTURE

PORTS AND PIPELINES

Australia has four main trunk lines for transporting oil and oil products by pipeline. The company Epic Energy operates a pipeline carrying crude oil and a mixture of NGLs 659 km (409 miles) from Moomba to Port Bonython. Santos operates a significant part of the oil pipeline network, including the Jackson to Brisbane line that spans nearly 797 km (500 miles), and the Mereenie to Alice Springs line that covers 270 km (168 miles). In addition, ExxonMobil operates the Longford to Long Island Point pipeline (south-east of Melbourne), which runs 190 km (118 miles).

49. *Oilcode Review, Statutory Review of the Trade Practices (Industry Codes – Oilcode) Regulations 2006*, Department of Resources, Energy and Tourism, May 2009.

Figure 26. Oil infrastructure in Australia



Source: IEA

Australian exports of crude oil and condensate are increasingly sourced from the west coast, while exports of refined product are largely sourced from the east coast. In addition to the seven refineries which have port facilities for importing crude oil and exporting refined products, Australia has 64 refined product import terminals. Of these, there are 11 major deepwater ports which also have facilities to export petroleum liquids. The port at Fremantle in Western Australia, near Perth, is the country's largest oil-exporting centre.

STORAGE CAPACITY

All storage capacity in Australia is held commercially within the supply chain, with no capacity used for emergency reserves in the form of government-held or compulsory industry stocks.

Storage capacity at the main storage facilities across Australia was just over 42 mb (6.7 million cubic metres) in 2009, according to an independent study commissioned by Australian authorities.⁵⁰ However, while this represents the latest available data, it does not include all storage capacity in the country, as information from smaller industry participants and independent importers was not included in the study.

Storage capacity is likely to have expanded substantially since the 2009 study. The study itself noted that investments were under way at that time which would expand Australia's total storage capacity by 1.7 mb (270 ML), with independent terminal operators accounting for 64% of this capacity expansion. In early 2011, Australia's major oil companies were reportedly expanding their storage capacity by a total of 1.0 mb (including capacity either recently brought into service or under construction) and projects for an additional 1.6 mb of storage capacity expansion were under consideration.

Nonetheless, there appears no lack of willingness to invest in new storage capacity for refined petroleum products; however, concerns have been raised in regard to a number of impediments to further investment, such as lengthy and complicated regulatory approval processes, compliance with competition law requirements and land constraints at port locations around the country.⁵¹

INDUSTRY REGULATION

INSTITUTIONS

A number of agencies have been assigned specific responsibility for regulation within the upstream petroleum sector.

The Department of Resources, Energy and Tourism (RET) provides policy advice to the Commonwealth Minister for Resources. In cooperation with the States and the Northern Territory, RET is the regulator of offshore petroleum activities. Each State and the Northern Territory also has a department responsible for upstream petroleum regulation. These departments provide advice to the State Minister and act as the Designated Authority (DA) for the regulation of Commonwealth waters.

50. *Petroleum Import Infrastructure in Australia*, prepared for the Department of Resources, Energy and Tourism by ACIL Tasman, August 2009.

51. *Liquid fuels vulnerability assessment -A review of liquid fuels vulnerability*, prepared for the Department of Resources, Energy and Tourism by ACIL Tasman, October 2011.

The Ministerial Council on Mineral (MCE) and Petroleum Resources (MCMPR), established by COAG in June 2001, consists of the Commonwealth Minister for Resources, Energy and Tourism, and state and territory ministers with responsibility for minerals and petroleum.⁵² The ministers responsible for petroleum in New Zealand and Papua New Guinea have observer status. Geoscience Australia conducts research and advises government and industry on Australia's petroleum prospects, reserves and potential. It provides preliminary geoscience information to attract petroleum exploration investment to offshore basins.

UPSTREAM REGULATIONS

The regulatory arrangements for the upstream petroleum sector derive from Australia's federal system of government. Rights to petroleum are owned, or held, by governments but they may be assigned to the private sector under arrangements set out in legislation.

The Offshore Constitutional Settlement (OCS), completed in 1979, is an agreement between the Australian government (Commonwealth), the states and the Northern Territory regarding jurisdiction over the territorial sea. The OCS includes arrangements for managing oil, gas and other seabed minerals and established the states' rights over coastal waters, which were then enshrined in Commonwealth law. The OCS also included agreements on offshore petroleum arrangements in both coastal and Commonwealth waters. These agreements formed the foundation of the existing regulatory framework:

- State and territory petroleum legislation applies in coastal waters and is administered by state and territory authorities.
- Commonwealth legislation alone applies in Commonwealth waters. However, the Australian government shares joint regulatory authority with the relevant state or territory in the adjacent areas of Commonwealth waters.
- The joint regulatory authority for each adjacent area consists of a designated authority (DA) and a joint authority (JA). The DA is the relevant state or territory minister and the JA comprises the state or territory minister and the responsible Commonwealth minister.
- Acreage in the Joint Petroleum Development Area (JPDA) is managed by the designated authority, within the Timor-Leste national petroleum authority and is governed by a 2003 treaty.

RESOURCE TAXATION ARRANGEMENTS

Petroleum production projects operating in Australia are subject to a resource charge, a profit-based petroleum resource rent tax (PRRT), introduced in 1987 to replace royalties and crude oil excise tax in most areas of Commonwealth waters and to provide a stable and internationally competitive petroleum taxation regime. At present, the PRRT applies to all petroleum projects located in Commonwealth waters with the exception of the North West Shelf production licence areas and the Joint Petroleum Development Area.

PRRT is a profit-based tax applied at a rate of 40% to a project's taxable profit (project income less project expenditure, project exploration expenditure and exploration expenditure transferred in from other related PRRT projects). Payments of PRRT are

52. The Ministerial Council was officially replaced by the Standing Council on Energy and Resources (SCER) on 15 November 2011.

deductible for company tax purposes in the year assessed and paid to avoid double taxation. Company tax is levied at the rate of 30%. PRRT and company tax instalments are payable quarterly in the year of tax liability.

In response to the recommendations of *Australia's Future Tax System Review*, the government announced in July 2010 that the petroleum resource rent tax (PRRT) would be extended to all onshore and offshore oil and gas projects, including the North West Shelf.⁵³ The purpose of this change was to provide certainty for oil and gas projects and ensure all oil and gas projects are treated equitably.

Where the PRRT does not apply, such as onshore and in state/territory waters or the North West Shelf project, crude oil excise and royalties are payable. Royalties are levied at a rate of between 10% and 12.5% of net well-head value of all petroleum produced.

The rate of crude oil excise depends on the annual rate of production of crude oil, the date of discovery of the petroleum reservoir and the date on which production commenced. The first 30 million barrels per field are exempt.

PRODUCTION INCENTIVES

The annual Offshore Petroleum Exploration Acreage Release forms a major part of the Australian government's strategy to encourage petroleum exploration in its offshore waters. The purpose of the Acreage Release is to enable industry to undertake long-term planning, to provide certainty in the release process, to ensure access to comprehensive pre-competitive geological and geophysical data and analysis, and to ensure the provision of quality information about issues that may impact on successful applicants.

Petroleum exploration in Australia is also supported by access to substantial pre-competitive geoscientific data sets. These include government-generated geoscientific maps and data sets; company reports of previous exploration; open-file exploration databases; geographic information system (GIS) data; and access to a designated data room and data packages in support of the annual acreage release.

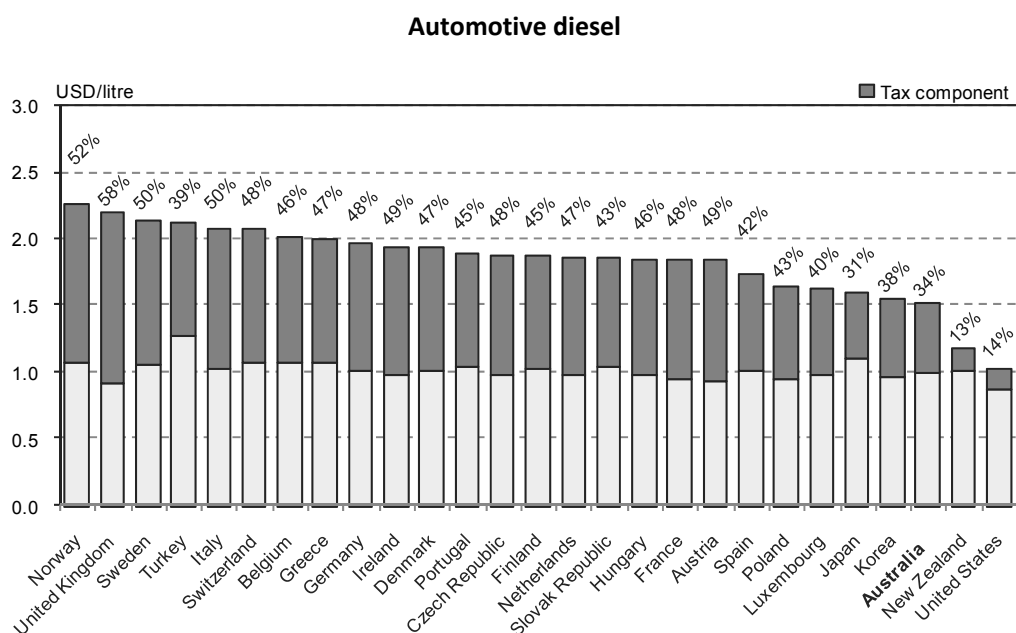
In addition to these data sets, Geoscience Australia undertakes major studies over Australia's vast offshore areas, with a particular focus on new frontier offshore areas. This work is designed to reduce exploration risk and promotes the petroleum prospectivity of Australia's under-explored sedimentary basins.

PRICING

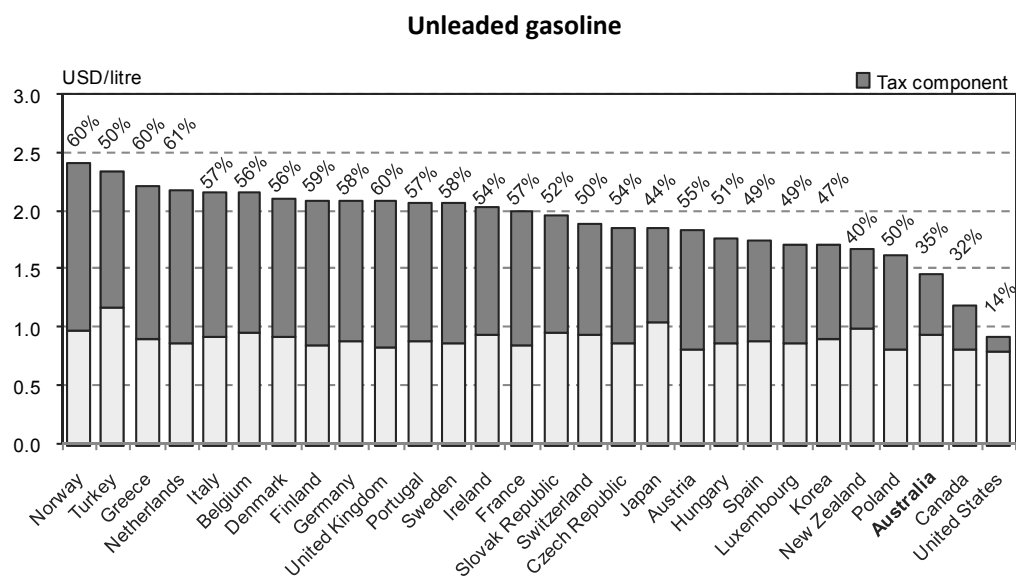
Australian downstream petroleum prices are based on the regionally benchmarked fuel (not oil) prices for the Asia-Pacific region – that is, the Singapore prices for petrol (e.g. MOPS95) and diesel (Gasol 10 ppm sulphur). The Mogas 95 Unleaded Mean of Platts Singapore (MOPS) spot price, which is a daily market price for unleaded petrol traded in Singapore.

53. *The Future Tax System Review* was established in 2008 to examine Australia's tax and transfer system, including state taxes, and make recommendations to position Australia to deal with the demographic, social, economic and environmental challenges of the 21st century.

Figure 27. Fuel prices and taxes in IEA member countries, fourth quarter 2011



Note: Data missing for Canada.



Source: *Energy Prices and Taxes*, IEA/OECD Paris, 2011 fourth quarter.

EMERGENCY PREPAREDNESS AND PLANNING

OVERVIEW

The Minister for Resources and Energy is responsible for co-ordinating a national emergency response in the event that an oil supply disruption triggers the Liquid Fuel Emergency (LFE) Act. Within the ministry, the Department of Resources, Energy and Tourism functions as the permanent core of the National Emergency Sharing Organisation (NESO) for IEA purposes. In a disruption, this would expand to include the National Oil Supplies Emergency Committee (NOSEC), which is composed of representatives from

Australian state and territory governments (which have constitutional authority for energy emergencies within their jurisdictions), as well as from industry and the Australian Institute of Petroleum. The NOSEC manages the National Liquid Fuel Emergency Response Plan (NLFERP) which details how Australian governments would respond to a fuel disruption with national implications.

A national emergency can only be declared if the Governor-General is satisfied that the situation meets the following criteria: the use of emergency powers is in the public interest; there is no real prospect of averting the shortage through voluntary augmentation of supplies by oil companies; and the minister has provided the opportunity for prior consultation with the relevant energy ministers in all Australian states and territories.

STOCKS

Australia does not maintain public stocks, nor is there a minimum stockholding requirement imposed on oil companies operating in the country. The Australian government relies on the normal stockholding practices of the domestic oil industry to meet its 90-day net import stockholding obligation as a member of the IEA. As imports have been increasingly necessary to meet Australia's domestic oil demand, there has been a steady rise in the amount of oil stocks necessary to meet Australia's 90-day IEA oil stockholding obligation.

The Australian government has statutory powers over industry stocks in a declared state of emergency under the LFE Act. The Act also empowers the Minister for Resources and Energy to impose specific reporting and to establish stockholding requirements on industry, including in the planning stages prior to a declared state of emergency.

Total oil stocks held by industry in Australia at end-2010 totalled 38.1 million barrels (mb), 45% of which in the form of unrefined oil. The level of industry stockholding fluctuates monthly, ranging between 35 mb and 45 mb over the previous five years.

Companies report stock levels to the Australian government on a monthly basis through the Australian petroleum statistics collection. If necessary, more frequent reporting of stock levels could be implemented to monitor compliance with a direction issued under the LFE Act. The Act also sets out penalties for failure to comply with reporting directives.

Since 2010, the level of oil stocks in Australia have frequently equated to less than 90 days of net imports. A *National Energy Security Assessment* was conducted by the government in 2011 and evaluated Australia's energy security situation and trends, and assessed the issue of non-compliance. The report finds that structural change towards higher net oil imports is driving non-compliance but does not find evidence of a decline in domestic energy security. This assessment will be part of the information base that informs the Australian government's next steps on options to address non-compliance with the IEA stockholding obligation.

DEMAND RESTRAINT

The Australian emergency policy is to rely on the domestic market to respond to supply shortfalls in the first instance, including consumer response to price signals. Short-term surge production capacity and fuel switching capacity in Australia is limited. In a declared state of emergency, the Australian government has legislative powers to control the storage, transfer, sale and production of liquid fuels. Initial light-handed demand restraint measures and a rationing scheme at the wholesaler level can quickly be escalated to invoke heavier-handed measures, including retail rationing.

Box 9. Security of oil supply: compliance with IEA 90-day stockholding obligation

The Agreement on an International Energy Program, the treaty upon which the IEA was founded in 1974, includes the commitment of IEA member countries to hold oil stocks equivalent to no fewer than 90 days of the previous year's net imports.

The treaty also includes commitments to have an integrated set of emergency response measures for major international oil disruptions, *i.e.* when supplies are reduced by 7% or more to individual member countries or to the IEA member countries as a group. The treaty defines the following emergency response measures: a drawdown of oil stocks, demand restraint measures, fuel-switching out of oil, surge oil production and the sharing of available supplies.

At present, Australia is the only IEA country that relies on commercial stockholding of industry to meet its minimum 90-day stockholding obligation. Australia does not have public stock holdings and does not place a minimum stockholding obligation on its domestic oil industry. Previously, when Australia was a net exporter or only a marginal net importer of oil, this reliance on commercial stocks was considered sufficient to meet its IEA requirements. Recently, as domestic production has declined and domestic oil demand grown, Australia has increasingly become a net oil importer. By the end of 2009, eligible commercial stockholdings were no longer sufficient to address the 90-day obligation, and oil stocks have since ranged between 80 and 90 days. The year 2012 has seen a severe worsening in Australia's compliance level, as higher 2011 net imports become the basis for measuring stockholding. The IEA estimates that compliance will likely be around 70 days throughout 2012. While the situation could improve slightly in 2013, owing to a short-term increase in domestic production in 2012, it will not be sufficient to bring Australia into sustainable compliance.

2011 Emergency Response Review of Australia

The IEA Emergency Response Review, also conducted in 2011, strongly recommended that the Australian government take action to become fully and systematically compliant with its IEP stockholding commitment. The Emergency Response Review noted that the establishment of emergency stockholding to meet the minimum IEP commitment would also create the means for Australia to contribute to an IEA collective action with the use of emergency stocks.

Australia's state and territory governments have constitutional powers for planning and co-ordinating emergency response within their territorial boundaries (note that in a national emergency, the LFE Act can override state and territory arrangements, but that the Act is invoked in full consultation with states and territories). In the case of a major oil crisis, affecting more than one jurisdiction, ministers have agreed that the National Oil Supplies Emergency Committee (NOSEC), which includes the fuel industry, will advise on appropriate actions. In an IEA collective action, NOSEC would likely recommend participation with the use of demand restraint measures.

CRITIQUE

Australia benefits from its large petroleum resources; by end-2008 economic-demonstrated resources of crude oil were estimated to be 6 950 PJ, condensate 12 560 PJ and LPG 4 610 PJ. While the gas industry faces an unprecedented boom, oil (including condensates)

production is expected to continue to decline, though the 100 000 barrels per day (b/d) of condensate expected at peak production from the Ichthys Project will partly reverse this trend.⁵⁴

Australia has become a net importer of oil (418 000 b/d in 2009) and refined products (218 000 b/d); this trend is expected to continue over the 2010-30 period. IEA experience in countries with declining oil production shows that measures such as enhanced oil recovery (EOR) can help to improve oil production and lessen imports. In addition, the use of proven secondary recovery methods, such as horizontal wells and water injection, can increase the average recovery factor up to almost 30%. Therefore, the duration of existing production activities will depend on how the overall average recovery factor develops.

The government should examine initiatives to support enhanced oil recovery, for example an independent assessment of existing worldwide experience with different methods to recover greater volumes of oil from remaining fields. The IEA welcomes the Australian government proposals to amend legislation in light of the Montara and Macondo offshore drilling accidents. The IEA commends efforts to encourage upstream exploration and development while at the same time taking steps to ensure greater regulatory and safety standards.

Since joining the IEA in 1979, Australia has successfully relied solely on commercial industry stocks to meet its stockholding obligation. However, annual net imports have risen significantly over the last decade as a result of both an increase in imports of crude oil and petroleum products (largely driven by rising consumption), and a decrease in the exports of crude oil (driven by a decline in domestic oil production).

At present, Australia is the only IEA country that fully relies on commercial stockholding of industry to meet its minimum 90-day stockholding obligation. Australia does not have public stock holdings and does not place a minimum stockholding obligation on its domestic oil industry. Previously, when Australia was a net exporter or only a marginal net importer of oil, this reliance on commercial stocks was considered sufficient to meet its IEA requirements. However, this is no longer the case, as Australia becomes an ever larger net importing country, like many other IEA countries.

The IEA Emergency Response Review of Australia made several strong recommendations regarding actions to be taken which would bring Australia into compliance again and would allow the country to contribute to future collective actions. For example, the establishment of emergency stockholding to meet the minimum IEP commitment would also create the means for Australia to contribute to an IEA collective action in a situation of emergency.

Oil and gas data are collected on a voluntary basis. However, in common with other IEA countries, data quality needs to be improved markedly. Australia is to become a growing oil importer; therefore, better data collection should be encouraged so that market participants are able to take informed decisions and so as to provide a sound platform for public policy development and implementation.

Rising oil net imports, primarily in the form of refined product, will necessitate increases in domestic storage capacity and berthing capacity at ports, and in the oil industry's current expansion plans. Adequate and sufficient investment in terminal infrastructure will be an important contributor to Australia's reliability over the medium term.

⁵⁴ Ichthys Project Project Overview, <http://www.inpex.com.au/projects/ichthys-project/project-overview.aspx>, last accessed at 16:47 on 9 May 2011.

The government should continue to monitor infrastructure capacity needs and to facilitate timely and sufficient capacity additions by ensuring that the planning and development approvals process does not unduly hinder development.

RECOMMENDATIONS

The government of Australia should:

- ☐ *Improve co-ordination at the states, territories and federal levels to manage the boom of upstream oil and natural gas projects in order to avoid infrastructure bottlenecks and workforce shortages.*
- ☐ *Maintain and develop policies favourable to investments in new technologies and new recovery methods to prolong the life of existing oilfields and strengthen security of oil supply.*
- ☐ *Take the necessary steps to improve oil (and gas) data reporting. This may include placing a data-reporting obligation on all industry participants.*
- ☐ *Take action to address its 90-day oil stockholding obligation and examine available options to meet this commitment.*
- ☐ *Actively monitor infrastructure capacity needs and facilitate timely and sufficient capacity additions; ensure that inefficient planning and development approvals processing do not unduly hinder development.*

PART III

ENERGY TECHNOLOGY

10. ENERGY TECHNOLOGY RESEARCH, DEVELOPMENT AND DEPLOYMENT

Key data (2010)

Government energy RD&D spending: 485 million (NC, nominal), USD 328 million (2011 prices and PPP), +5.6% from 2009

Share in GDP: 0.36 per 1 000 units of GDP (IEA average: 0.43)

R&D per capita: 14.6 USD (2011 prices and PPP, IEA average: 14.0)

INSTITUTIONAL FRAMEWORK

The **Department of Resources, Energy and Tourism** (RET) is responsible for technology policy and programmes specific to energy and has a focus in clean energy and industrial energy efficiency. The RET portfolio also includes Geoscience Australia, the Bureau of Resources and Energy Economics (BREE) and the Australian Solar Institute (ASI). The Department of Climate Change and Energy Efficiency (DCCEE) supports research relating to climate change and other energy efficiency matters.

The **Australian Centre for Renewable Energy** (ACRE) was established to promote the development, commercialisation and deployment of renewable energy and enabling technologies and improve their competitiveness. As part of the Clean Energy Future package, ACRE and the ASI, along with a range of other existing renewable energy measures, will be incorporated into the **Australian Renewable Energy Agency** (ARENA) that commenced operations on 1 July 2012.

In December 2011, the government established the **Department of Industry, Innovation, Science, Research and Tertiary Education** (DIISRTE) to replace the Department of Innovation, Industry, Science and Research (DIISR). The department is the ministry responsible for supporting the competitive national innovation system and for administering some programmes that form part of the Australian Government's Clean Energy Future Plan including the Clean Technology Programs, the Clean Technology Focus for Supply Chains, the Clean Energy and Other Skills Package, and the Steel Transformation Plan.

The **Cooperative Research Centres** (CRCs), supported by the Department of Industry, Innovation, Science, Research and Tertiary Education, provide funding to build a critical mass in research ventures between end-users and researchers. During the period since 2005, there have been seven CRCs funded to undertake research in the energy sector.

The **Commonwealth Scientific and Industrial Research Organisation** (CSIRO) is Australia's national science agency and is responsible for the National Research Flagships. These are large-scale multidisciplinary research partnerships focused on national priorities, including climate change, minerals and clean energy, and transport technologies. The CSIRO's facilities are located in all capital cities and also in some regional centres, including in Newcastle, New South Wales.

The **Australian Research Council** (ARC), a statutory authority under the DIISRTE portfolio, is a major provider of funding for research and development. The ARC provides advice to

the government on research matters; it manages the National Competitive Grants Program (NCGP) and administers the Excellence in Research for Australia (ERA) evaluations.

State governments also provide policy and programme support for energy technology development, for example Victoria's Energy Technology Innovation Strategy and Western Australia's Low-Emissions Energy Development Fund.

Launched in April 2009, the **Global Carbon Capture and Storage Institute** (GCCSI) is an international initiative based in Australia, with the objective to accelerate the commercial deployment of carbon capture and storage projects. Australian universities are major providers of energy technology research and development.

POLICIES AND PROGRAMMES

The Australian government takes a strategic approach to its research and development (R&D) investment, taking into account identified national research and innovation priorities and needs in research skills. The following is a short list of some of the programmes the Australian government supports at present or will be supporting in the immediate future.

DRAFT ENERGY WHITE PAPER

The Draft Energy White Paper (EWP), published in 2011, presents a review of Australia's future energy needs to 2030 (and in some cases beyond) and defines a comprehensive and strategic policy framework to guide the further development of Australia's energy sector. The Draft EWP proposes four priority action areas for national energy policy including the acceleration of clean energy outcomes.

It identifies the challenges the Australian energy sector faces over the coming decades and acknowledges the need for energy policy to balance the sometimes conflicting requirements of delivering energy security, facilitating economic development and meeting clean energy goals.

The Draft EWP identifies the need to address a number of important market reform concerns but also the need for policy makers to engage in a number of supporting actions, for example:

- to engage with industry and education sectors to develop a skilled workforce and infrastructure to meet Australia's future energy needs and export opportunities;
- to continue to actively work with industry and the research community given the critical role technology will have in the transformation of the energy sector ; this will involve public and private collaboration domestically and internationally to achieve the technological breakthroughs required to meet Australia's goals. The government, through its publicly funded activities, can play an important role in deepening understanding around new technologies and in promoting the sharing of non-proprietary knowledge;
- to promote the deepening of knowledge and understanding of the energy resource base, energy resource sector developments and technology developments to improve policy-making and leverage private-sector activity.

The Draft EWP acknowledges the important role that research, development, adoption, demonstration and commercialisation of clean-energy technologies will play in the future. Accordingly, initiatives such as the ARENA, the CCS Flagships Program and the Clean Energy Finance Corporation will become significant pillars of energy policy.

CLEAN ENERGY FUTURE

The Clean Energy Future is a comprehensive plan developed by the government to help Australia make a transition to a low-carbon economy. The plan and supporting legislation, enacted in November 2011, contain a number of proposals relating to the research, development and deployment of new energy technologies.

The newly established ARENA (incorporating the ACRE and the ASI) will administer the existing AUD 3.2 billion government support for research, development, demonstration and commercialisation of renewable energy technologies

An AUD 1.2 billion Clean Technology Program will help directly improve energy efficiency in manufacturing industries and support R&D in low-pollution technologies across industry. The programme contains three elements:

- The Clean Technology Investment Program (AUD 800 million over seven years from 2011/12) awards competitive grants (minimum grant size of AUD 25 000) for manufacturing businesses to invest in energy-efficient capital equipment and low-emissions technologies, processes and products. Eligible manufacturers must have an annual electricity consumption of at least 300 MWh or 5 terajoules (TJ) of natural gas, or be directly liable under the carbon-pricing mechanism in the year before application. Co-investment of a dollar from grant recipients for every dollar of grant will be required for companies of under AUD 100 million turnover seeking less than AUD 500 000 in grant. Other companies seeking above AUD 500 000 co-invest two dollars for each dollar of grant. Manufacturers seeking grants for over AUD 10 million will be expected to co-invest three dollars for every dollar of Australian government grant funding.
- The Clean Technology Food and Foundries Investment Program (AUD 200 million over six years from 2011/12) awards competitive grants (minimum grant size of AUD 25 000) for food and foundry manufacturers to invest in energy-efficient capital equipment and low-emissions technologies, processes and products. This programme is the same as the Clean Technology Investment Program, except that there is no minimum energy use requirement and applicants must be manufacturers in the food and beverage manufacturing or metal forging and foundries industry sectors.
- The Clean Technology Innovation Program (AUD 200 million over five years from 2012/13) will assist Australian industry to maintain competitiveness in a carbon-constrained economy. The programme will award competitive grants to support R&D, proof of concept and early-stage commercialisation activities that lead to the development of new clean technologies and associated services, including low-emission and energy-efficient solutions that reduce greenhouse gas emissions. The programme will offer grants from AUD 50 000 up to AUD 5 million. These grants will be awarded on a matched (50:50) co-investment basis.

The existing funding for the Carbon Capture and Storage (CCS) Flagships Program which supports the construction and demonstration of large-scale integrated CCS projects in Australia will continue. Complementing this programme is the National Low Emissions Coal Initiative (NLECI) and National CO₂ Infrastructure Plan (NCIP), which aim to accelerate the development and deployment of capture and storage technologies that will reduce emissions from coal use.

ENTERPRISE CONNECT

Enterprise Connect helps small and medium-sized enterprises (SMEs) drive innovation with Researcher in Business grants to facilitate stronger research linkages between SMEs and research institutions. Support is also provided to improve business capability through Tailored Advisory Service grants.

Enterprise Connect supports the development of clean technology business through its Clean Technology Innovation Centre, while assisting other eligible SMEs identify and take up clean technologies in their business. The Clean21 Technology Innovation Network is an element of Clean21: The Future of Manufacturing, announced as an election commitment on 29 July 2010. The network, based in the Enterprise Connect Clean Technology Innovation Centre, works through expert business advisers to assist eligible businesses adopt new technologies, plan for change and reduce environmental impact.

The Australian government's Clean Energy Future initiative included the announcement on 10 July 2011 of the Clean Technology Focus for Clean Supply Chains. Enterprise Connect is assisting small and medium-sized businesses in clean technology industries to enhance the clean technology focus of industry supply chains. The programme enhances the role of supplier advocates for the clean technologies, water, and built environment sectors. The programme also enhances Australian industry involvement in the supply of goods and services for energy efficiency solutions.

ACRE-SUPPORTED ACTIVITIES

ACRE currently supports renewable energy and enabling technology development through the following programmes:

- Advanced Electricity Storage Technologies Program
- Emerging Renewables Program
- Geothermal Drilling Program
- Renewable Energy Demonstration Program
- Renewable Energy Venture Capital Fund
- Second Generation Biofuels Research and Development Program
- Solar Projects

CARBON CAPTURE AND STORAGE (CCS) FLAGSHIPS PROGRAM

The CCS Flagships Program is designed to accelerate the development and demonstration of CCS technologies. The programme promotes the wider dissemination of CCS technologies by supporting a small number of demonstration projects that capture CO₂ emissions from coal-fired power plants and industrial processes, and safely storing CO₂ underground in stable geological formations to mitigate global warming.

The programme supports the construction of two to four commercial scale CCS projects with an electricity generating capacity of 1 000 MW or equivalent size for other industrial processes. The programme also includes an AUD 100 million research component from the Education Investment Fund to finance major CCS research projects associated with each successful CCS flagship. The objectives support the G8 Summit's call for the launch of 20 demonstration CCS projects worldwide by 2010, to be operational from 2015 and

for commercial deployment by 2020. The government will fund up to one-third of the non-commercial costs of CCS Flagship projects which are ultimately selected. The Flagships Program is expected to generate equal funding from responsible states and industry. To date the government has selected two projects under the CCS Flagships Program: the South-West Hub project in Western Australia and the CarbonNet project in Victoria

AUSTRALIA-CHINA JOINT COORDINATION GROUP ON CLEAN COAL TECHNOLOGY

Australia and China have established a close and productive relationship in addressing the challenge of reducing greenhouse gas emissions from the combustion of fossil fuels. The Australia-China Joint Coordination Group (JCG) was established in 2007 and is supported by up to AUD 20 million in funding. Under the JCG the Department of Resources, Energy and Tourism is working closely with China's National Energy Administration (NEA). The JCG meets annually with the 6th meeting scheduled for late 2012 in Hangzhou, China.

China's NEA has signed a Memorandum of Understanding with the Department to collaborate on a feasibility study for a commercial-scale (600 MW) Post Combustion Capture (PCC) project with CCS in China. The feasibility study will draw on AUD 12 million committed under the JCG. Work on the project is under way with a scoping study report produced by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and China's Clean Energy Research Institute (CERI) now finalised. The report recommended three options for the location of the PCC project.

Work to establish the Australia-China JCG Partnership Fund has commenced with the aim of finalising arrangements in the first half of 2012. At the 5th JCG meeting it was agreed to extend the work of three highly successful bilateral projects conducted between Australia and China under the Asia-Pacific Partnership (APP) by providing up to AUD 5.0 million. Under the JCG, the Department is also funding six collaborative research projects that are being supported by approximately AUD 2.9 million over two financial years.

NATIONAL RESEARCH FLAGSHIPS

National Research Flagships are large-scale multidisciplinary research partnerships that pair technical expertise with national priorities. Initiated by CSIRO in 2003, the National Research Flagships programme is one of the largest scientific research endeavours ever undertaken in Australia, with the total investment to 2010/11, in ten Flagships programmes, expected to be close to AUD 1.5 billion. The Flagships are focused on the delivery and adoption of research outputs to maximise impact for Australia.

Examples of energy-related Flagships include the Energy Transformed Flagship, which aims to demonstrate and ensure deployment of integrated low-carbon pathways for Australia and alternative stationary and transport energy solutions that reduce Australia's greenhouse gas emissions. This Flagship focuses on three main research areas:

- to identify possible transition pathways for Australia through techno-economic modelling and social science analysis;
- to provide alternative energy supply-side solutions for the stationary and transport energy sectors;
- to increase the energy efficiency and reduce peak demand impacts from residential and commercial buildings.

Other CSIRO National Research Flagships also undertake clean energy research, including the Wealth from Oceans Flagship which supports research related to oceans and energy such as pipeline research and ocean renewable energy, and the Future Manufacturing Flagship which supports research in organic photovoltaics and clean manufacturing.

NATIONAL RESEARCH PRIORITIES: BASIC SCIENCE FOR ENERGY

The CSIRO conducts significant research programmes in fossil energy resources, such as the exploration and extraction of coal, gas and petroleum, as well as the conversion of these resources to electricity, including developing technologies for carbon capture and storage and converting gas or coal to liquid fuels. The CSIRO also has basic science research programmes in nanotechnologies, advanced materials, computing and biotechnology, all of which have elements relevant to future energy. Examples include enzymes for bioenergy, advanced materials for organic photovoltaics and gas capture and separation, and analysis of large data sets. Basic research of relevance to the development of energy technologies is also conducted in Australian universities, notably research on photovoltaics at the University of New South Wales and the Australian National University, research on harnessing geothermal energy at the University of Queensland, and biofuels research at Curtin University and the University of Queensland.

FISCAL INCENTIVES

The Australian government has introduced an R&D tax incentive, which applies to R&D activities and expenditure in income years commencing on or after 1 July 2011. The R&D tax incentive provides a targeted tax offset designed to encourage more companies to engage in R&D in Australia. The R&D tax incentive has two core components:

- a 45% refundable tax offset (equivalent to a 150% deduction) to eligible entities with an aggregated turnover of less than AUD 20 million per year;
- a non-refundable 40% tax offset (equivalent to 133% deduction) to all other eligible entities.

STRATEGY AND PROGRAMME EVALUATION

Review and evaluation processes are an integral part of government funding activities. The policies and principles for funding activities are established by the Commonwealth Grant Guidelines, which establish the grants policy and reporting framework for all departments and agencies subject to the Financial Management and Accountability Act 1997.

These requirements are reflected in agencies' internal procedures. For example, in the Department of Resources, Energy and Tourism, post-project evaluations are required to judge whether a project achieved its objectives and delivered quality outcomes. A Program Management Committee within the department also ensures ongoing performance management of funded projects.

The department conducts internal departmental reviews of programmes, and is also being subjected to external evaluations by the Australian National Audit Office (ANAO). The Auditor-General is responsible, under the Auditor-General Act 1997 (the Act), for providing auditing services to the Australian Parliament and public-sector entities. The ANAO supports the Auditor-General, who is an independent officer of the Parliament.

The ANAO's primary client is the Australian Parliament. Its purpose is to provide the Parliament with an independent assessment of selected areas of public administration,

and assurance about public-sector financial reporting, administration, and accountability. The ANAO achieves this primarily by conducting performance audits, financial statement audits, and assurance reviews.

The performance of the various Cooperative Research Centres (CRCs) is closely monitored through quarterly and annual reporting processes and periodic reviews. CRCs submit an annual report every financial year, which includes reporting progress against agreed milestones.

CRCs also periodically undergo “Performance Reviews”, which involve a rigorous examination of the CRC’s operations, including research quality, student issues, research outputs, end-user engagement, financial scrutiny, adequacy of governance arrangements, etc.

There are several CRCs conducting energy-related research, including the CRC for Greenhouse Gas Technologies (CO₂CRC) and the Energy Pipelines CRC.

PROGRAMME PRIORITISATION

In the Draft EWP, the Australian Government puts forward a prioritisation mechanism for R&D of new technologies. The mechanism (illustrated in Figure 28) will consider the level of a technology’s development (in Australia and elsewhere) and if government support addresses identified market failures, and if this would make a material difference to the progress of the technology. The technology will also be required to deliver a net benefit in return for the investment provided.

By applying this analytical framework, the Australian government has identified three key technologies for prioritisation; large-scale solar, geothermal, and carbon capture and storage (gas and black or brown coal). Other possible priority technologies include next-generation biofuels, energy storage technologies, electricity system control and management systems, hybrid energy systems and ocean energy.

FUNDING MECHANISMS AND LEVELS

Table 11 outlines all clean energy programmes announced or currently being delivered across Australia. These programmes are in addition to general research sector funding. State and territory governments, industry and tertiary institutions also provide a range of support for clean energy technology development and commercialisation.

Figure 28. **Proposed clean energy technology prioritisation framework**

		Economic benefit: does the technology have the potential to generate genuine spillover benefits for Australia?	
		Low	High
Abatement potential: Does the technology have potential, if successfully commercialised, to make a significant contribution to Australia’s carbon pollution goals (this can include enabling technologies such as energy storage)?	High	Ongoing support Focus mainly on technology cost and risk reduction and removing barriers	Provide proactive support Consider technology specific development strategies
	Low	Lowest priority Assess on case-by-case basis	Support if compelling Must meet clear public benefit interest test

Source: *Draft Energy White Paper 2011: Strengthening the Foundation for Australia’s Energy Future.*

Table 11. **Australian energy-related support programmes (as at 1 July 2012)**

Department of Resources, Energy and Tourism	
Australian Renewable Energy Agency	AUD 3.2 billion
Carbon Capture and Storage Flagships Program	AUD 1.68 billion
Low Emissions Technology Demonstration Fund (non-solar)	AUD 160 million
National Low-Emissions Coal Initiative	AUD 370 million
National CO ₂ Infrastructure Plan	AUD 61 million
Global Carbon Capture and Storage Institute	AUD 315 million
Smart Grid, Smart City	AUD 100 million
Energy Grants (Cleaner Fuels) Scheme	
Department of Climate Change and Energy Efficiency (DCCEE) and Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA)	
Solar Cities	AUD 94 million
National Solar Schools Program	AUD 50 million
Renewable Energy Bonus Scheme – Solar Hot Water Rebate	
Low Carbon Communities Program	AUD 330 million
Household advice line/website program	AUD 6 million
Remote Indigenous Energy Program	AUD 40 million
Department of Innovation, Industry, Science, Research and Tertiary Education and its portfolio agencies	
Australian Research Council Discovery Program	
Australian Research Council Linkage Program	
Cooperative Research Centres Program	
R&D Tax Incentive	
Venture Capital	
Enterprise Connect (including the Clean Technology Innovation Centre)	AUD 50 million
Commercialisation Australia	
Department of the Treasury	
Clean Energy Finance Corporation	AUD 10 billion
Indicative total	AUD 17.5 billion

Source: *Draft Energy White Paper 2011: Strengthening the Foundation for Australia's Energy Future*, Appendix D, "Australian Government funding support for clean energy technology development and commercialization".

INTERNATIONAL COLLABORATION

Australia is a strong supporter of international engagement as a means to access technologies developed internationally, and for promoting domestic expertise and technologies in international markets. It is actively engaged the IEA's Low-Carbon Energy Technology

Platform and 19 Implementing Agreements, but also in a wide range of international energy technology initiatives, including:

- Global Carbon Capture and Storage Institute;
- Carbon Sequestration Leadership Forum;
- International Partnership for the Hydrogen Economy;
- Global Methane Initiative;
- Renewable Energy and Energy Efficiency Partnership;
- International Renewable Energy Agency;
- Clean Energy Ministerial;
- APEC Energy Working Group;
- Asia Pacific Partnership for Sustainable Development;
- United Nations Framework Convention on Climate Change; and
- International Partnership for Geothermal Technology.

Research agencies and universities pursue international collaboration in support of their research programmes. For example, in 2009/10 the CSIRO participated in over 800 international activities with a value of AUD 77.6 million. These interactions were at various levels, from scientists to governments and companies. Such international relationships provide benefit to CSIRO at a number of levels, such as access to global networks, research infrastructure, knowledge and intellectual property, import of international science and technology into Australia, benchmarking of CSIRO research to ensure it is of international quality, international alignment of research projects that support national and regional needs, and development opportunities for scientists.

The Cooperative Research Centres are also encouraged to engage globally. By 1 July 2011, the 44 current CRCs operating across all sectors have 600 alliances with at least 40 nations. International engagement can include research collaboration, education or training partnerships, commercial licensing, conferences, consultancies and other activities.

PRIVATE SECTOR ACTIVITIES

Private-sector participation is fundamental to innovation and investment programmes that support energy technology and investment administered by the Australian government. Most of the programmes in the current portfolio require co-investments by applicants, usually on 1:1 or 2:1 terms for private and public investment. The ratio can depend on the risk profile. The Australian government argues that risk-sharing through co-investment contributions is appropriate given the likely benefits of the project to the grant recipient. Furthermore, a matching funding requirement allows limited programme funds to be distributed to a greater number of businesses.

Private-sector engagement is also important in R&D activities. CRC participants include publicly funded researchers and end users, often from the private sector. CRC participants make a substantial contribution to the resources of a CRC. They provide resources, which are either cash or in-kind contributions (*e.g.* staff, equipment, facilities, etc.) for use by the CRC. Private-sector participation is vital to many of the CRCs, with CRC research being end-user-driven and often involving commercial paths to utilisation.

The private sector is also closely engaged in the work of the CSIRO. This includes commissioned CSIRO work for private-sector clients, and engagement with industry to define research activities within the CSIRO Flagship Programs and other related research activities.

The government also works with private sector partners in defining R&D needs in specific industries. For example, industry participants were closely engaged in developing roadmaps for geothermal and hydrogen technologies (available at www.ret.gov.au) and in the development of ACRE's Strategic Directions (www.acre.gov.au).

Box 10. Southern Cross Renewable Energy Fund

The Southern Cross Renewable Energy Fund is an AUD 200 million, 13-year co-investment arrangement by the Australian government, Southern Cross Venture Partners (SXVP) and Softbank China Venture Capital (SBCVC).

The Australian government's commitment of AUD 100 million has been matched one for one with private-sector investment from SBCVC, an Asian venture-capital firm. The fund is expected to commence in early 2012 and will be based in Sydney.

The aim of the Southern Cross Renewable Energy Fund is to realise significant financial returns for its investors by making selected investments in Australian renewable energy companies, providing the capital and management skills they need to commercialise their technologies and succeed in domestic and overseas markets. The Fund's investment approach is founded on the conviction that Australian entrepreneurs need to be internationally aware and connected to be truly competitive.

Source: Southern Cross Venture Partners.

CRITIQUE

The 2011 Draft EWP correctly recognises the huge challenges Australia faces in coming decades if it is to meet its clean energy goals.

The Draft EWP also recognises that if Australia is to be successful, it will have to scale up its activities in research, development, adoption, demonstration and commercialisation of clean energy technologies, which will require a concerted collaborative effort from business, government and the research community. Fortunately, the country starts from a strong position and a good proportion of its national R&D budget is invested in the energy sector. Likewise, private-sector investment in energy-related R&D is also strong.

Recently published information indicates that total expenditure on R&D in the energy sector by all sectors of the economy was close to AUD 3 billion in 2008/09 (later data not available).⁵⁵ Notably, much of this activity is undertaken by the private sector and the contribution of this sector increased at an average rate of 28% a year from 2000/01 to 2009/10; reaching AUD 2.7 billion in 2009/10 or approximately 16% of total business R&D expenditure in 2009/10 largely in the mining and extraction of energy resources (57% of spending). Australia also compares reasonably to its OECD peers in terms of investment in energy-related R&D.

Traditionally, the larger portion of investment in energy-related R&D tended towards the oil and gas extraction industry and the coal-mining industry, both engines of Australia's

55. *Energy in Australia 2012*, Bureau of Resources and Energy Economics, Canberra, 2012.

economic growth. With the publication of *Securing a Clean Energy Future – The Australian Government’s Climate Change Plan*, the government sent a very strong signal that investment patterns will change and it committed to significant levels of financial support for innovation in clean energy technologies. Two significant institutions will be established: a Clean Energy Finance Corporation to invest in renewable energy, low-pollution and energy-efficient technologies and an Australian Renewable Energy Agency (ARENA) to provide support for research and development, demonstration and commercialisation of renewable energy. Commendably, the Australian government quickly put in place legislation implementing ARENA and is developing legislation for the Clean Energy Finance Corporation. As indicated, RD&D on carbon capture and storage will continue through existing funding arrangements.

Energy-related R&D is an important policy instrument to meet national energy policy objectives. Given the present global economic climate a coherent energy R&D strategy with clear prioritisation in line with national energy policy goals is essential. Transparency and involvement of major stakeholders in defining a national energy R&D strategy is of key importance. It appears that much of the historic investment in Australia was aligned with those sectors – the mining and extraction of energy resources – that delivered the greatest benefit to the economy. The publication of *Securing a Clean Energy Future* and the Draft EWP signal a realignment of priorities and greater recognition of the need to invest in a low-carbon future. Accordingly, the approach to investment in R&D is being recalibrated towards newer priorities explicit in the Draft EWP.

The Draft EWP proposes four priority action areas for national energy policy. Directly linked to these priorities is the need for investment in energy-related research and development. In addition to the need to develop the necessary skilled workforce, the Draft EWP emphasises the requirement to actively work with industry and the research community to achieve the technological breakthroughs required to meet its goals. The Draft EWP also recognises the strong role that government has to play, by means of its publicly funded activities, in deepening understanding of new technologies, promotion of the sharing of non-proprietary knowledge and leveraging private-sector activity.

The Draft EWP proposes direct funding mechanisms across a range of sectors, including for coal-seam gas, the development and deployment of alternative transport fuels, improved energy-use productivity, research, development and demonstration of energy-efficient technologies, renewable energy, low-emissions technologies and carbon capture and storage. The Australian government is committing up to AUD 17.5 billion in the next decade for clean energy technology development, demonstration and commercialisation. The IEA applauds the scale of the investment proposed by the Australian government and notes the recognition granted to the need for increased programme flexibility balanced with appropriate financial and administrative safeguards, including greater monitoring and evaluation mechanisms.

Furthermore, an energy R&D strategy is not about picking a winner – a portfolio of technologies will be needed. Australia correctly assumes that no single technology will solve its search for a clean, clever and competitive future and has chosen to invest in a basket of technologies. Nonetheless, the sheer scale of the investment proposed will require careful monitoring and evaluation to ensure that investment is delivering an appropriate return and that the Australian taxpayer is getting a fair return. New programmes must regularly demonstrate consistency with national priorities and a strong likelihood of success. Existing programmes also need to be re-evaluated, modified, redirected or terminated, in keeping with energy policy needs and priorities.

A notable feature of existing Australian R&D activities, as well as those under way at present, is the high level of collaboration among various institutions active in the sector. This collaboration can only be strengthened by the rationalisation of agencies proposed in the Clean Energy Package. This strength is also reinforced by the high level of multilateral and bilateral international co-operation that the Australian government is engaged in throughout the sector.

RECOMMENDATION

The government of Australia should:

- ☐ *Maintain its already high level of international collaboration, on both a multilateral and a bilateral basis, as a means to maximise the benefit of energy-related research and development.*

PART IV ANNEXES

ANNEX A: ORGANISATION OF THE REVIEW

REVIEW CRITERIA

The *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 presented in Annex C.

REVIEW PROCESS

The in-depth review team visited Canberra from 28 February to 4 March 2011. During the week-long visit, the review team met with government officials, representatives from ministries and government agencies, energy producers and suppliers, interest groups and various other organisations and stakeholders. This report was drafted on the basis of these meetings and the government response to the IEA energy policy questionnaire and other information. The team is grateful for the co-operation and hospitality of the many people it met during the visit. Thanks to their openness and candour, the review visit was highly productive.

In particular, the team wishes to express its gratitude to Mr. Drew Clarke, Secretary of the Commonwealth Department of Resources, Energy and Tourism for his personal engagement with the team and to his staff for providing detailed briefing on energy policy in Australia. Their willingness to share information and gracious hospitality contributed in no small way to a successful and productive visit. The author is particularly thankful to Mr. Gino Grassia, General Manager, Energy Security Branch, Energy and Environment Division, Department of Resources, Energy and Tourism, Ms Cindy Olsen, Principal Project Officer, Energy Security Branch, Department of Resources, Energy and Tourism and Mr. Ian Cronshaw, Energy Advisor, Department of Resources Energy and Tourism for co-ordinating the team visit and their ongoing support throughout the drafting process.

The members of the review team were:

Mr. Hans Jorgen Koch, Deputy State Secretary, Danish Energy Agency Denmark, team leader

Dr. Anette Rothberg, Programme Manager, Swedish Energy Agency

Dr. Richard Hawke, Energy and the Environment Group, Energy and Communications Branch of the Ministry of Economic Development of New Zealand

Mr. Patrick Specht, Coordination Unit for EU Energy Policy, Federal Ministry of Economics and Technology, Germany

Mr. Ulrich Benterbusch, Director of the Global Energy Dialogue Directorate, IEA

Mr. Rick Bradley, Head of the Energy Efficiency & Environment Division, IEA

Mr. Carlos Fernández Alvarez, Senior Coal Analyst, IEA

Ms Anne-Sophie Corbeau, Senior Natural Gas Analyst, IEA

Mr. Kieran McNamara, Country Studies Division, IEA

Special Observer – Mr. Rajeev KR Pahwa, Central Electricity Authority, Ministry of Power, India

Kieran McNamara managed the review and is the author of the report with the exception of Chapter 7 on Coal which was drafted by Carlos Fernández Álvarez and Chapter 8 on Natural Gas, which was drafted by Anne-Sophie Corbeau. Jason Elliot made a substantial contribution to the drafting of Chapter 9 on Oil. Ulrich Benterbusch, Rebecca Gaghen, Shinji Fujino, Douglas Cooke, Richard Bradley, Robert Tromop, Vida Rozite, Michael Cohen, Justine Garret and Georg Bussmann contributed helpful comments throughout.

Georg Bussmann, Yuichiro Tanaka and Bertrand Sadin prepared the figures. Karen Treanton provided support on statistics. Muriel Custodio, Astrid Dumond, Jane Barbière and Angela Gosmann managed the production process. Viviane Consoli provided editorial assistance and Marilyn Ferris helped in the final stages of preparation.

**ANNEX B:
ENERGY BALANCES
AND KEY STATISTICAL DATA**

Australia

Energy Balances and Key Statistical Data

		Unit: Mtoe						
SUPPLY		1973	1990	2009	2010	2020	2030	2035
TOTAL PRODUCTION		68.0	157.5	297.1	310.6	554.0	630.4	678.3
Coal		40.3	106.1	225.7	237.3	378.1	430.6	452.8
Peat		-	-	-	-	-	-	-
Oil		19.8	29.0	25.0	23.8	22.1	14.7	12.2
Natural Gas		3.4	17.1	39.3	42.5	140.7	170.8	197.6
Biofuels & Waste ¹		3.5	4.0	5.6	5.3	7.9	8.5	8.7
Nuclear		-	-	-	-	-	-	-
Hydro		1.0	1.2	0.9	1.1	1.1	1.1	1.1
Wind		-	-	0.3	0.4	3.1	3.3	4.2
Geothermal		-	-	-	-	0.4	0.8	1.1
Solar		-	0.1	0.2	0.3	0.5	0.6	0.6
TOTAL NET IMPORTS		-10.9	-66.6	-166.5	-189.7	-393.2	-460.6	-506.2
Coal	Exports	17.6	67.2	169.0	190.1	327.8	384.2	416.0
	Imports	-	-	0.0	0.0	-	-	-
	Net Imports	-17.6	-67.2	-169.0	-190.1	-327.8	-384.2	-416.0
Oil	Exports	3.4	9.3	16.5	17.6
	Imports	12.6	14.4	35.4	38.1	36.1	46.7	51.6
	Int'l Marine and Aviation Bunkers	-2.4	-2.1	-4.0	-4.1	-5.9	-6.1	-6.5
Natural Gas	Net Imports	6.8	3.0	15.0	16.4	30.3	40.6	45.0
	Exports	-	2.3	18.0	20.9	95.7	117.0	135.3
	Imports	-	-	5.6	4.9
Electricity	Net Imports	-	-2.3	-12.5	-16.0	-95.7	-117.0	-135.3
	Exports	-	-	-	-	-	-	-
	Imports	-	-	-	-	-	-	-
TOTAL STOCK CHANGES		-0.1	-4.7	-4.6	3.9	-	-	-
TOTAL SUPPLY (TPES)²		57.1	86.2	126.0	124.7	160.8	169.8	172.2
Coal		22.6	35.0	52.3	51.4	50.3	46.3	36.8
Peat		-	-	-	-	-	-	-
Oil		26.6	31.2	39.8	39.9	52.4	55.3	57.2
Natural Gas		3.4	14.8	26.9	26.5	45.0	53.9	62.4
Biofuels & Waste ¹		3.5	4.0	5.6	5.3	7.9	8.5	8.7
Nuclear		-	-	-	-	-	-	-
Hydro		1.0	1.2	0.9	1.1	1.1	1.1	1.1
Wind		-	-	0.3	0.4	3.1	3.3	4.2
Geothermal		-	-	-	-	0.4	0.8	1.1
Solar		-	0.1	0.2	0.3	0.5	0.6	0.6
Electricity Trade		-	-	-	-	-	-	-
Shares (%)								
Coal		39.6	40.6	41.5	41.2	31.3	27.3	21.4
Peat		-	-	-	-	-	-	-
Oil		46.6	36.2	31.6	32.0	32.6	32.5	33.2
Natural Gas		5.9	17.1	21.3	21.2	28.0	31.7	36.2
Biofuels & Waste		6.2	4.6	4.4	4.2	4.9	5.0	5.1
Nuclear		-	-	-	-	-	-	-
Hydro		1.7	1.4	0.8	0.9	0.7	0.7	0.7
Wind		-	-	0.3	0.3	1.9	2.0	2.4
Geothermal		-	-	-	-	0.3	0.5	0.7
Solar		-	0.1	0.2	0.2	0.3	0.4	0.4
Electricity Trade		-	-	-	-	-	-	-

0 is negligible, - is nil, .. is not available

All data except GDP and population refer to the fiscal year July to June.

Unit: Mtoe							
DEMAND							
FINAL CONSUMPTION	1973	1990	2009	2010	2020	2030	2035
TFC	39.6	56.5	74.7	75.3	108.4	115.4	120.3
Coal	5.2	4.5	3.4	3.0	3.6	3.5	3.5
Peat	-	-	-	-	-	-	-
Oil	24.3	29.0	37.6	38.1	52.6	55.5	57.8
Natural Gas	2.1	8.6	12.7	13.1	21.7	23.8	24.5
Biofuels & Waste ¹	3.5	3.3	3.4	3.5	5.3	5.9	6.1
Geothermal	-	-	-	-	-	-	-
Solar	-	0.1	0.2	0.2	0.2	0.2	0.2
Electricity	4.5	11.1	17.5	17.3	24.9	26.5	28.2
Heat	-	-	-	-	-	-	-
Shares (%)							
Coal	13.1	7.9	4.5	4.0	3.3	3.0	2.9
Peat	-	-	-	-	-	-	-
Oil	61.3	51.3	50.3	50.6	48.5	48.1	48.0
Natural Gas	5.3	15.3	17.0	17.5	20.0	20.6	20.4
Biofuels & Waste	8.8	5.8	4.5	4.6	4.9	5.1	5.1
Geothermal	-	-	-	-	-	-	-
Solar	-	0.1	0.3	0.3	0.2	0.2	0.2
Electricity	11.4	19.7	23.4	23.0	23.0	22.9	23.5
Heat	-	-	-	-	-	-	-
TOTAL INDUSTRY⁵	17.8	23.2	27.1	27.5	38.9	41.5	42.7
Coal	4.9	4.2	3.2	2.9	3.5	3.4	3.4
Peat	-	-	-	-	-	-	-
Oil	7.9	6.4	7.4	7.8	6.9	7.2	7.5
Natural Gas	1.5	6.0	8.2	8.6	13.8	15.4	15.3
Biofuels & Waste ¹	1.5	1.5	1.7	1.8	3.9	4.4	4.6
Geothermal	-	-	-	-	-	-	-
Solar	-	-	-	-	-	-	-
Electricity	2.0	5.1	6.6	6.4	10.9	11.1	11.9
Heat	-	-	-	-	-	-	-
Shares (%)							
Coal	27.5	18.1	11.8	10.5	9.0	8.2	8.0
Peat	-	-	-	-	-	-	-
Oil	44.6	27.6	27.2	28.3	17.7	17.4	17.6
Natural Gas	8.4	26.0	30.3	31.2	35.4	37.0	35.8
Biofuels & Waste	8.4	6.4	6.4	6.5	9.9	10.6	10.7
Geothermal	-	-	-	-	-	-	-
Solar	-	-	-	-	-	-	-
Electricity	11.2	22.0	24.2	23.5	27.9	26.8	27.9
Heat	-	-	-	-	-	-	-
TRANSPORT²	12.9	21.1	28.5	28.6	42.5	44.9	47.1
OTHER⁴	8.8	12.3	19.1	19.2	26.9	28.9	30.5
Coal	0.3	0.2	0.0	0.0	0.0	0.0	0.0
Peat	-	-	-	-	-	-	-
Oil	3.5	1.7	2.8	2.9	6.3	6.9	7.3
Natural Gas	0.6	2.6	4.0	4.1	5.1	5.2	5.4
Biofuels & Waste ¹	2.0	1.8	1.4	1.4	1.5	1.5	1.5
Geothermal	-	-	-	-	-	-	-
Solar	-	0.1	0.2	0.2	0.2	0.2	0.2
Electricity	2.5	5.9	10.5	10.5	13.8	15.1	16.0
Heat	-	-	-	-	-	-	-
Shares (%)							
Coal	3.2	1.7	0.2	0.2	0.1	-	0.1
Peat	-	-	-	-	-	-	-
Oil	39.3	14.1	14.7	14.9	23.5	24.0	23.8
Natural Gas	7.0	21.3	21.2	21.6	19.1	17.9	17.8
Biofuels & Waste	22.6	14.4	7.4	7.3	5.4	5.2	5.1
Geothermal	-	-	-	-	-	-	-
Solar	-	0.7	1.0	1.3	0.8	0.8	0.7
Electricity	27.9	47.8	55.3	54.9	51.1	52.0	52.5
Heat	-	-	-	-	-	-	-

	Unit: Mtoe						
DEMAND							
ENERGY TRANSFORMATION AND LOSSES	1973	1990	2009	2010	2020	2030	2035
ELECTRICITY GENERATION⁶							
INPUT (Mtoe)	16.0	35.2	58.9	57.6	67.5	69.2	66.9
OUTPUT (Mtoe)	5.5	13.3	21.0	20.8	26.7	29.0	30.0
(TWh gross)	64.4	154.3	244.4	241.5	310.0	337.5	348.4
Output Shares (%)							
<i>Coal</i>	74.9	78.7	76.1	74.8	57.4	50.2	38.5
<i>Peat</i>	-	-	-	-	-	-	-
<i>Oil</i>	2.6	2.3	1.5	1.3	1.7	1.6	1.5
<i>Natural Gas</i>	4.3	9.3	14.7	15.0	20.7	27.7	36.0
<i>Biofuels & Waste</i>	0.5	0.5	1.6	1.6	1.4	1.2	1.2
<i>Nuclear</i>	-	-	-	-	-	-	-
<i>Hydro</i>	17.7	9.2	4.5	5.2	4.2	3.9	3.7
<i>Wind</i>	-	-	1.6	2.0	11.7	11.4	13.9
<i>Geothermal</i>	-	-	-	-	1.7	2.7	3.8
<i>Solar</i>	-	-	0.1	0.1	1.2	1.3	1.3
TOTAL LOSSES	17.7	29.2	49.6	50.4	52.6	53.7	53.6
of which:							
Electricity and Heat Generation ⁶	10.5	21.9	37.9	36.8	40.9	40.1	37.0
Other Transformation	5.4	0.3	-2.0	-0.7	-2.0	-2.3	-0.9
Own Use and Losses ⁷	1.8	7.0	13.7	14.3	13.7	15.8	17.5
Statistical Differences	-0.2	0.5	1.8	-1.0	-0.1	0.8	-1.7
INDICATORS	1973	1990	2009	2010	2020	2030	2035
GDP (billion 2005 USD)	277.41	451.43	853.27	874.48	1141.44	1475.46	1677.51
Population (millions)	13.61	17.17	22.16	22.55	25.83	29.46	31.19
TPES/GDP ⁸	0.21	0.19	0.15	0.14	0.14	0.12	0.10
Energy Production/TPES	1.19	1.83	2.36	2.49	3.45	3.71	3.94
Per Capita TPES ⁹	4.19	5.02	5.68	5.53	6.23	5.77	5.52
Oil Supply/GDP ⁸	0.10	0.07	0.05	0.05	0.05	0.04	0.03
TFC/GDP ⁸	0.14	0.13	0.09	0.09	0.10	0.08	0.07
Per Capita TFC ⁹	2.91	3.29	3.37	3.34	4.20	3.92	3.86
Energy-related CO ₂ Emissions (Mt CO ₂) ¹⁰	158.5	260.0	384.1	383.5	456.2	469.6	457.4
CO ₂ Emissions from Bunkers (Mt CO ₂)	7.6	6.4	12.0	12.3	17.6	18.3	19.6
GROWTH RATES (% per year)	73-90	90-00	00-09	09-10	10-20	20-30	30-35
TPES	2.5	2.3	1.7	-1.0	2.6	0.5	0.3
Coal	2.6	3.2	0.9	-1.8	-0.2	-0.8	-4.5
Peat	-	-	-	-	-	-	-
Oil	0.9	0.9	1.7	0.3	2.8	0.5	0.7
Natural Gas	9.1	2.7	3.8	-1.4	5.4	1.8	3.0
Biofuels & Waste	0.7	2.4	1.1	-5.5	4.1	0.8	0.5
Nuclear	-	-	-	-	-	-	-
Hydro	1.3	1.5	-4.3	13.4	0.4	-	-
Wind	-	-	59.1	26.3	22.4	0.6	4.7
Geothermal	-	-	-	-	-	6.1	7.4
Solar	-	0.5	10.6	26.1	7.3	1.1	0.6
TFC	2.1	2.1	0.8	0.8	3.7	0.6	0.8
Electricity Consumption	5.4	2.9	1.8	-0.9	3.7	0.6	1.3
Energy Production	5.1	4.0	2.7	4.6	6.0	1.3	1.5
Net Oil Imports	-4.7	-23.3	60.6	9.6	6.3	3.0	2.1
GDP	2.9	3.6	3.2	2.5	2.7	2.6	2.6
Growth in the TPES/GDP Ratio	-0.4	-1.3	-1.4	-3.4	-0.1	-2.0	-2.2
Growth in the TFC/GDP Ratio	-0.8	-1.5	-2.4	-1.1	1.0	-2.0	-1.6

Please note: Rounding may cause totals to differ from the sum of the elements.

Footnotes to energy balances and key statistical data

1. Biofuels and waste comprises solid biofuels, liquid biofuels, biogases and industrial waste. Data are often based on partial surveys and may not be comparable between countries.
2. Excludes international marine bunkers and international aviation bunkers.
3. Industry includes non-energy use.
4. Other includes residential, commercial, public services, agriculture, forestry, fishing and other non-specified.
5. Inputs to electricity generation include inputs to electricity and CHP plants. Output refers only to electricity generation.
6. Losses arising in the production of electricity and heat at main activity producer utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of 100% for hydro, wind and photovoltaic.
7. 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.
8. Toe per thousand US dollars at 2005 prices and exchange rates.
9. Toe per person.
10. “Energy-related CO₂ emissions” have been estimated using the IPCC Tier I Sectoral Approach from the *Revised 1996 IPCC Guidelines*. 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 2010 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.

ANNEX C: INTERNATIONAL ENERGY AGENCY “SHARED GOALS”

The member countries* of the International Energy Agency (IEA) seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to 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, member countries 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** are 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 respect the Polluter Pays Principle where practicable.
- 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 member countries wish to retain and improve the nuclear 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 encourages 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 the meeting of 4 June 1993 Paris, France.)

*Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

ANNEX D: FURTHER NOTES TO CHAPTER 5 ON RENEWABLE ENERGY

Northern Territory: For new connections, the Northern Territory feed in tariff is one-for-one – whatever the customer's consumption tariff is. Residential customers: 21.77 c/kWh, which is offered by the Power Water Corporation. As of 1 July 2012, Power and Water increased the maximum size of domestic PV systems which can be connected to the power network without undertaking extensive investigations to 4.5kW.

New South Wales: The Independent Pricing and Regulatory Tribunal (IPART) was asked to determine a 'fair and reasonable' feed-in tariff to apply to new solar PV customers who are not part of the Solar Bonus Scheme. IPART was directed that the recommendations should be subsidy free; it should not result in increased electricity prices and should not require government funding. In March 2012, IPART released a report that found a "fair and reasonable" tariff to be 5.2c/kWh – 10.3c/kWh in 2011/12. This is considered the direct financial benefit retailers gain from exported PV. This value would increase in the future as a result of carbon pricing.

Table 12. **NSW fair and reasonable feed-in tariff for new solar PV customers**

Scheme	Time-frame	Tariff
Original Solar Bonus Scheme announced November 2009	1 January 2010 – 31 December 2016	60 c/kWh
Revised Solar Bonus Scheme announced October 2010	1 January 2010 – 31 December 2016	20 c/kWh
Two month hold on applications to the Solar Bonus Scheme	April 2011	n.a.
Closure of Solar Bonus Scheme	July 2011	n.a.
IPART Fair and Reasonable Tariff	2011/12	Benchmark range of 5.2 c to 10.3 c/kWh Retailers will be able to set their own tariffs.
IPART Fair and Reasonable Tariff	2012/13	Benchmark range of 7.7 c to 12.9 c/kWh Retailers will be able to set their own tariffs.

Source: Department of Resources, Energy and Tourism.

IPART recommended that retailers pay the recommended new fair and reasonable tariff, and that they also contribute 6.5 c/kWh towards the Solar Bonus Scheme from June 2012. This rate should be reviewed annually.

In June 2012, IPART recommended a "fair and reasonable" feed-in tariff for 2012/13 (commencing 1 July 2012) is from 7.7c/kWh to 12.9 c/kWh. IPART also determined that retailers must contribute 7.7 c/kWh in 2012/13 for each eligible kWh under the Solar Bonus Scheme.

South Australia: The Essential Services Commission of South Australia (ESCOSA) recently reviewed the feed-in tariffs regime. The final outcome of the review was published in 2012.⁵⁶

Victoria: The Victorian Competition and Efficiency Commission (VCEC) is currently conducting an inquiry into feed-in tariff (FiT) arrangements and barriers to distributed generation. The terms of reference ask the VCEC to assess the design, efficiency and effectiveness of feed-in tariffs, recommend whether existing feed-in tariffs should be continued, phased out or amended and identify barriers to the development of a network of distributed renewable and low-emission generation in Victoria. An issues paper was released on 16 February 2012. A draft report was released for consultation on 18 May 2012 with public comments due by 15 June 2012. A final report is due mid-July 2012. The report contains draft recommendations to change existing FiT schemes to:

- end the Transitional FiT Scheme by either 31 December 2013, or once the previously announced 75 MW of capacity is reached, whichever comes sooner;
- change the Standard FiT, which now applies to generators of less than 100 kW other than small solar PV, to:
- include all low-emissions and renewable technologies;
- require retailers to offer a “fair and reasonable” price. Indicative “fair and reasonable” prices would be published, updated and monitored by the Essential Services Commission; and
- require retailers to publish their FiT prices;
- move to a competitively determined FiT by December 2015.

VCEC found that medium-scale generators have the most potential to assist with network shortfalls and supply substantial amounts of low-emissions power. However, significant barriers exist to deter medium-scale entrants, such as no automatic right of connection to the network and slow, costly approval processes. The draft report proposes that these barriers be removed, with the addition of appropriate safeguards to protect the integrity of the network and better communication and engagement with electricity distributors.

56. 2012 Final *Determination of Solar Feed-in Tariff* Premium, Essential Services Commission of South Australia, 2012

ANNEX E: CARBON CAPTURE AND STORAGE IN AUSTRALIA

OVERVIEW

Carbon capture and storage, or CCS, is a family of technologies and techniques that enable the capture of CO₂ from fuel combustion or industrial processes, the transport of CO₂ via ships or pipelines, and its storage underground, in depleted oil and gas fields and deep saline formations.

The IEA analysis suggests that CCS will play a vital role in worldwide, least-cost efforts to limit global warming, contributing around one-fifth of required emissions reductions in 2050. For CCS to reach this potential, around 100 CCS projects would need to be implemented by 2020 and over 3 000 by 2050 across power generation and industry. The development and demonstration of CCS technologies is a priority for the Australian government, which forecasts that fossil fuel-fired plants with CCS could provide between 26% and 32% of total generation, or 90 and 125 terawatt-hours (TWh) a year, by 2050.

POLICY FRAMEWORK AND FUNDING

The Australian government, in partnership with stakeholders from the private sector, the research community and state governments, has implemented a development strategy covering the CCS innovation chain:

- The strategy includes substantial (AUD 2 billion) support of large-scale and small- to medium-scale projects via a number of national programmes such as CCS Flagships, National Low-Emissions Coal Initiative projects and Low-Emissions Technology Demonstration Fund projects.
- The Australian government also supports R&D and pilot testing of low-emissions coal and CCS technologies through the Cooperative Research Centre for Greenhouse Gas Technologies (CO₂CRC) and AUD 75 million for Australian National Low-Emissions Coal Research and Development Limited (ANLECR&D), which is matched by funding from the coal industry.
- AUD 61 million has been made available to accelerate the identification and development of suitable CO₂ geological storage sites through the National CO₂ Infrastructure Plan.
- The government also supports international R&D and collaboration through the Global Carbon Capture and Storage Institute (GCCSI), the Australia-China Joint Coordination Group on Clean Coal Technology, the Clean Energy Ministerial Carbon Capture Use and Storage (CCUS) Action Group, and the Carbon Sequestration Leadership Forum (CSLF).
- The government has established the National Carbon Capture and Storage Council comprising industry, researchers and several state governments to advise on the accelerated development and deployment of CCS.

CCS REGULATORY FRAMEWORK

Under Australia's federal system of government, the Australian government has jurisdiction over Commonwealth waters (extending from three nautical miles offshore to the edge of Australia's Continental Shelf) and the states and territories have jurisdiction over onshore areas and coastal waters (up to three nautical miles). The development of legislative and regulatory systems in each jurisdiction is a matter for the jurisdiction concerned.

CCS legislation and supporting regulations are in place at federal level (for injection and storage in Commonwealth waters) under the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGs Act) and also for CCS activities onshore in a number of states (Queensland, South Australia and Victoria).

In addition, Western Australia has drafted a bill amending the state's Petroleum and Geothermal Energy Resources Act 1967 to include provisions dealing with greenhouse-gas storage formation property rights, acreage release, exploration, retention and injection licences and long-term liability issues. The bill has reached the initial consultation phase and will be introduced into Parliament some time in 2012. This follows enactment of project-specific legislation for the Gorgon Gas Processing and Infrastructure Project on Barrow Island (the Barrow Island Act) in 2003. The government of New South Wales introduced CCS legislation into Parliament in November 2010; however, it failed to pass as a result of a delay to the legislative process caused by the subsequent state elections. The proposed legislation provided a full permitting and licensing regime for the permanent storage of CO₂, including provisions for the post-closure transfer of liabilities to the Crown. The NSW government is currently developing options for a new legislation programme in 2013.

CCS INITIATIVES

GLOBAL CARBON CAPTURE AND STORAGE INSTITUTE

The government-funded GCCSI was established in 2009 to accelerate commercial CCS deployment. The Institute has attracted a collaborative international membership, made up of 344 government, industry, non-government and research organisations from around the world. The Institute has a number of active partnerships in place with key players in the CCS arena, including the International Energy Agency, the Asian Development Bank, the World Bank, the Climate Group, the Clinton Climate Initiative, and the CSLF.

CARBON CAPTURE AND STORAGE FLAGSHIPS PROGRAM

The Carbon Capture and Storage (CCS) Flagships Program supports the construction and demonstration of large-scale integrated CCS projects in Australia. It promotes the wider dissemination of CCS technologies by supporting a select number of demonstration projects that capture CO₂ emissions from industrial processes and safely storing them underground in stable geological formations. The government has allocated funding of AUD 1.68 billion dollars to the programme.

The first stage of the CCS Flagships evaluation examined a number of projects nominated by state governments to arrive at a short list. In December 2009, four projects were short-listed for consideration under the programme:

- The Wandoan power project, an integrated gasification combined cycle (IGCC) coal-fired power project located north-west of Brisbane, Queensland.
- The ZeroGen project, another IGCC project located west of Gladstone in Queensland,
- The Collie South West Hub based around an integrated multi-user capture, transport and storage infrastructure project and located south of Perth in Western Australia in close proximity to the industrial centres of Kwinana and Collie.
- CarbonNet located in LaTrobe Valley, Victoria, is another integrated multi-user capture, transport and storage infrastructure project, which sources CO₂ from electricity generating plants in the area.

Western Australian South West Hub project

On June 2011, the government announced its decision to select the Western Australian Collie South West Hub project under the CCS Flagships Program based on the recommendations of an independent assessment panel. The project will progress under a staged and gated approach, with an initial focus on proving availability of sufficient geological storage. The Australian government is to provide up to AUD 52 million to support the studies required to move the project to the next phase of decision making. A detailed storage viability study needs to be completed and initial studies have identified the Lesueur formation in the Southern Perth Basin as the best potential CO₂ storage site.

Work has commenced on the feasibility study for the pipeline network that will support the project's enabling and base cases. Provided the enabling case (test sequestration) demonstrates that the targeted storage site is suitable for the long-term storage of CO₂, the base case will advance. The base case entails the capture of up to 2.5 Mt/yr of CO₂ from a proposed ammonia and urea plant in 2015 and the hub is then planned to further expand its capacity to up to 9 Mt/yr of CO₂ from coal-based industries in the south-west region.

CarbonNet project

In February 2012, the Australian government announced the CarbonNet project as the second project selected for funding through the feasibility stage. Joint funding of up to AUD 100 million (AUD 70 million from the Australian government and AUD 30 million from the Victorian government) will be available for the feasibility stage work which will largely focus on the modelling and testing of potential CO₂ storage sites.

The CarbonNet project will capture carbon emissions from power plants, industrial processes and new coal-based industries in Victoria's Latrobe Valley and store it in nearby geological basins. The project, which is being led by the Victorian state government, is planning to integrate multiple CCS projects and proponents across the entire CCS value chain within the next ten years, and in doing so progressively lower barriers to entry for new participants. Initially sized to capture and store 1.2 Mt/yr of CO₂ emissions before 2018, the network will have the potential to scale up to support over 20 Mt/yr thereafter and potentially with further growth to service Australia's eastern seaboard.

Queensland project

The government has also agreed to reconsider Queensland's Wandoan project subject to conditions predominantly related to progressing prefeasibility studies and the availability of programme funding.

NATIONAL CO₂ INFRASTRUCTURE PLAN

The AUD 60.9 million National CO₂ Infrastructure Plan (NCI Plan) was developed to accelerate the identification and development of sites suitable for the long-term storage of CO₂ that are within reasonable distances of major energy and industrial CO₂ emission sources. The plan promotes pre-competitive storage exploration and provides a basis for the development of transport and storage infrastructure. The plan includes the development of a national CO₂ drilling rig deployment strategy and an assessment of infrastructure needs. The plan complements the pre-competitive exploration already under way through the National Carbon Mapping and Infrastructure Plan.

The NCI Plan is made up of four components:

- a multi-basin CO₂ storage exploration and appraisal programme – designed to facilitate long-term CO₂ storage hubs through initiatives, such as the CCS Flagships Program;
- the acquisition of additional pre-competitive offshore and onshore CO₂ storage data – in basins in New South Wales, Victoria and Western Australia;
- a National CO₂ Drilling Rig Deployment Strategy – which will develop best practice for obtaining data from CO₂ exploration drilling programmes in Australia;
- a National CO₂ Storage and Transport Infrastructure Assessment – which will investigate future CO₂ infrastructure needs and provide the foundations for safe and secure transport, injection, and storage of CO₂.

The plan assists the development and deployment of integrated CCS projects, particularly those projects supported by the Australian government's CCS Flagships Program and the National Low Emissions Coal Initiative. Geoscience Australia will provide strategic advice in delivering the plan and will lead in the acquisition of pre-competitive data.

NATIONAL LOW EMISSIONS COAL INITIATIVE (NLECI)

The Australian government established the National Low Emissions Coal Initiative (NLECI) to accelerate the development and deployment of technologies to reduce emissions from coal use. These technologies will enable coal to make a major contribution to reducing Australia's greenhouse gas emissions by 80% of 2000 levels by 2050. The focus of NLECI is research, demonstration and deployment of low-emission coal technologies involving carbon capture and storage.

The NLECI was established in 2008 and has funding until 2015. Over these eight years, the Australian government will provide funding of AUD 370 million to support the initiative. This includes:

- AUD 75 million for the Australian National Low Emission Coal Research and Development Agency;
- AUD 50 million for the National Carbon Mapping and Infrastructure Plan;
- AUD 50 million for the Callide oxyfuel combustion project;
- AUD 20 million for the Australia-China Joint Coordination Group on Clean Coal Technology;
- AUD 150 million for low-emission coal demonstration projects in Queensland, New South Wales and Victoria.

STATE-LEVEL INITIATIVES⁵⁷

The **New South Wales government** has established a Clean Coal Act to underpin its Clean Coal Fund. CCS activities are also deemed eligible for funding support under its Climate Change Fund.

Victoria has established the Energy Technology Innovation Strategy which provides funding for prospective clean energy technologies to drive down their cost curves and so minimise the economic impact of a cost on carbon. A request for proposals for the second phase closed in September 2010.

In March 2010, the **Western Australian** Environmental Protection Authority released a recommendation that a proposed new coal-fired power station expansion be approved on the basis that it will be CCS-ready. A directions paper supporting the development of WA's new energy vision titled Strategic Energy Initiative 2031 acknowledges that coal will continue to be a significant part of WA's energy mix when used in conjunction with CCS.

57. *The global status of CCS: 2011*, Global CCS Institute, Canberra, Australia.

ANNEX F: GLOSSARY AND LIST OF ABBREVIATIONS

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.

ACT	Australian Capital Territory
AER	Australian Energy Regulator
ARENA	Australian Renewable Energy Agency
AUD	Australian dollar
bcm	billion cubic metres
b/d	barrels per day
CCA	Climate Change Authority
CCGT	combined cycle gas turbine
CCS	carbon capture and storage
CDM	clean development mechanism (under the Kyoto Protocol)
CHP	combined production of heat and power
COAG	Council of Australian Governments
DCCEE	Department of Climate Change and Energy Efficiency
DSO	distribution system operator
ETS	emissions trading scheme
EU	European Union
EWP	Energy White Paper
IPCC	Intergovernmental Panel on Climate Change
JI	joint implementation (projects under the Kyoto Protocol)
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LULUCF	land use, land use change and forestry

mcm	million cubic metres
Mt	million tonnes
Mtoe	million tonnes of oil equivalent
NEM	National Electricity Market
NGL	natural gas liquids
NSW	New South Wales
NT	Northern Territory
OCGT	open-cycle gas turbine
PPP	purchasing power parity: the rate of currency conversion that equates the purchasing power of different currencies, <i>i.e.</i> estimates the differences in price levels between countries
QLD	Queensland
R&D	research and development, especially in energy technology; may include the demonstration and dissemination phases as well
REC	renewable energy certificate
RET	Department of Resources, Energy and Tourism
SA	South Australia
SCER	Standing Council on Energy and Resources
TAS	Tasmania
tcm	trillion cubic metres
TFC	total final consumption of energy
toe	tonne of oil equivalent, defined as 10^7 kcal
TPES	total primary energy supply
UNFCCC	United Nations Framework Convention on Climate Change
WA	Western Australia



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