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Overview of energy production and use in Australia

In this chapter, a brief overview of current energy production and use in Australia is provided, including projections of future energy needs and the likely future mix of energy sources. This is done to establish the context within which to discuss, in later chapters, how the law is responding to the environmental problems created by Australia's energy profile. What emerges is that Australia is, and will likely remain, a country heavily dependent on fossil fuels. Under current regulatory arrangements, renewable sources of energy are likely to make an insignificant contribution to the overall energy mix in future. Although a debate on the role of nuclear energy in Australia has begun, it is too soon to speculate where that debate might lead. The emissions of carbon dioxide from the burning of fossil fuels contribute significantly to the threat of global climate change. Consequently, this book is devoted, in the main, to analysing Australia's regulatory framework for controlling these emissions, and provides a comparative analysis of developments in other jurisdictions against which to compare the efforts of governments in Australia.

1.1 Energy production and trade in Australia

In 2003, the Australian Bureau of Statistics conducted an Energy Survey 2001–02 to collect data on energy use across sectors of the Australian economy, excluding agriculture, forestry, fishery and residential sectors. This information has been used by the Australian Bureau of Agricultural and Resource Economics (ABARE) to undertake its own 2003–04 fuel and electricity survey. The outcome of ABARE's work is the report *Australian Energy Consumption and Production, 1973–74 to*

2001–02. The ABARE survey has reconciled consumption with production where the production data are sourced independently.

Total primary energy production is estimated to have declined in Australia between 2001–02 by 2%, with coal accounting for approximately 49% of total production. Australia remains overwhelmingly an energy exporter with exports in coal increasing by 2%. Coal exports account for 38% of total Australian energy production. However, Australia is a net importer of liquid fuels (including crude oil, natural gas liquids and other refined petroleum products such as gasoline, aviation turbine fuel and diesel). In 2001–02 exports of uranium declined by 24% although this is likely to be reversed given the recent announcement by the Australian government to reinvigorate the development of Australia's uranium resources.

In March 2005, the Federal Minister for Industry, Tourism and Resources established an inquiry into Australia's uranium resources. As a result of global climate change, the global demand for uranium resources has escalated as nuclear energy is a non-fossil fuel source of energy. The House of Representatives Standing Committee on Industry and Resources has been requested to inquire into the strategic importance of Australia's uranium resources. The terms of reference of the inquiry are: global demand for Australia's uranium resources and associated supply issues; any relevant industry developments associated with the strategic importance of Australia's uranium resources; prospects for the further development and export of Australia's uranium resources and their implications for greenhouse emissions reductions; and the current structure and regulatory environment of the uranium mining sector. In addition, on 5 August 2005, the Minister for Resources announced that the Federal government had taken control over the future of the Northern Territory's rich uranium deposits, declaring the Territory open for business on uranium. The Northern Territory government had promised to ban new uranium mines. About a dozen companies are currently exploring for uranium in the Northern Territory, which is home to some $12 billion worth of known uranium deposits.

1.2 How Australia uses energy

One of the most recent analyses of Australia's energy use has been provided in ABARE's August 2004 report entitled *Australian energy: National and state projections to 2019–20*.[1] The report states that since 1973–74, total primary energy use in Australia grew by some 2.6% per annum, compared with an economic growth rate of 3.2% per annum. In 2000–01 Australia's total primary energy consumption was 5037 petajoules (PJ). Primary energy consumption is projected to grow at an average of 2.1% over the period to 2019–20, while gross domestic product is assumed by ABARE to grow by 3.4% per annum. This means that

[1] See M Akmal, S Thorpe, A Dickson, G Burg & N Klijn *Australian energy: National and state projections to 2019–20* (ABARE: 2004) available at <http://abareonlineshop.com/product.asp?prodid=12776> (accessed 20 June 2005).

by 2019–2020 total primary energy consumption would grow by 50% reaching 7515 PJ. The report affirms that fossil fuels are Australia's major energy sources. Australia's energy needs are provided by oil (35%), black coal (28%), natural gas (19%) and brown coal (13%). Uranium is not used currently as an energy source in Australia.

The largest users of stationary energy are the manufacturing and construction sectors. ABARE forecasts an industry demand growth of 50% to 2020, attributed to growth in the iron and steel sector as well as non-ferrous metals such as alumina refining and aluminium smelting. Our focus on greenhouse gas emissions in the energy sector in this book is justified by the fact that energy production and use contributed 68% of Australia's greenhouse gas emissions in 2002, and is expected to be 72% by 2020. Greenhouse gas emissions from the energy sector are expected to grow by more than 30% to 2020. The biggest single source of energy emissions is electricity, accounting for two-thirds of stationary energy emissions. Coal is the major source of base load electricity generation and its combustion accounts for 92% of electricity emissions. However, it seems that electricity emissions will grow somewhat slower than electricity use, as there is a relative shift from brown coal to natural gas in electricity generation. Nevertheless, Australia's fuel mix will continue to be dominated by coal and oil with coal expected to account for more than 70% of the mix.

Growth in domestic use of natural gas is projected to remain strong with total consumption expected to be 1828 PJ by 2019–20. However, energy consumed per dollar of economic output is expected to decline so that 18% less energy will be required by 2019–2020. Australia's reliance on imported liquid fuel is expected to increase by 29% by 2019–20.

1.3 Uptake of renewable energy in Australia[2]

In Chapter 2, an in-depth analysis of sustainable energy technologies is provided. Here a simple analysis of the current uptake of renewable energy in Australia is offered. A mix of renewable energy technologies is expected to be developed to meet the Mandatory Renewable Energy Target of sourcing 2% more electricity from renewable sources by 2010 (the Mandatory Renewable Energy Target (MRET)), as prescribed by the *Renewable Energy (Electricity) Act 2000* (Cth).[3] Prior to the enactment of this legislation, Australia's renewable energy sector generated approximately 16,000GWh of electricity representing 10.5% of Australia's electricity market. This was largely electricity generated from hydro-electric sources from Tasmania and the Snowy Mountains scheme. In order to meet the MRET, renewable energy generation from minor sources of energy,

[2] Most of the information given in this section is sourced from *Renewable Opportunities – A Review of the Operation of the Renewable Energy (Electricity) Act 2000*, especially the section entitled 'Progress Towards MRET Objectives', available at <http://www.mretreview.gov.au/report/index.html< (accessed 23 August 2005).
[3] See Chapter 4.

other than hydro, will need to increase about 60% above 1997 levels to a point where 9500GWh of renewable energy is generated.

The mix of renewable energy technologies, as at 18 August 2003, is the following: hydro – 36%; solar hot water heaters – 26%; wind – 11%; bagasse cogeneration – 10%; landfill gas – 8%; wood waste – 4%; black liquor – 4%; and sewage gas – 1%. These figures demonstrate that a wide range of renewable energy technologies have entered the electricity market since the introduction of the MRET. For example, largely due to the MRET, the solar hot water system has grown by 30% per annum from 19 000 to 30 000 systems. The wind industry reported an annual growth rate of 118% between 1999 and 2002. Wind power is expected to grow 16% a year from a small base over the entire outlook period and to contribute around 36% to the additional renewable energy generated between 2001–02 and 2010–11. Electricity generated from biomass is expected to increase by 10% per year, accounting for 33% of the total growth over the same period.

Sales of renewable electricity, equipment and services for 2002–03 were approximately $1.8 billion, of which 14.5% are expected to be exports, amounting to $226.5 million. These sales are less than half of the Renewable Energy Action Agenda target (discussed below) of $4 billion sales in 2010. Projected employment is 6189 people. Installed capacity for this period was 7616.4MW which, when large hydro generation is removed, amounts to 680MW.

By September 2003, it was suggested that $900 million of investment in renewable energy projects had occurred with another $1 billion committed or planned. However, a number of investors are concerned that investment will cease after 2007 because the capacity to deliver the 2010 MRET target will have already been installed. Also there is no commitment on the part of the Australian government to continue the target beyond 2010. This reduces the payback period for investments, which is typically 15 years.

1.3.1 The Allen Consulting Group's *Sustainable Energy Jobs Report*

A report prepared by the Allen Consulting Group in 2003 gives an excellent overview of the sustainable energy industry (SEI) in Australia. The Group finds that unless there is government intervention in the energy market, the outlook to 2030 for SEI and renewables is limited. This is as a result of market failure and other difficulties that block the development of the industry. Governments around the world are taking action to address this problem, in particular to reduce greenhouse gas emissions and stimulate the renewable energy industry. Many governments are doing this for energy security and to ensure that their economies are familiar with a wide range of energy technology options. They regard support for emerging renewable technologies as an important strategy for ensuring long-term energy competitiveness. The potential for the technologies to grow jobs and export markets, as well as deliver environmental benefits, has also been recognised. In Australia, the SEI export market is likely to be in the Asia-Pacific region as it resumes its rapid development trajectory.

The role of renewables in the Australian energy market mirrors that in the rest of the world, except that the mandatory target (MRET) set by the *Renewable Energy (Electricity) Act 2000* (Cth) has seen a high growth rate in renewables. However, because of the low target set under the legislation, non-hydro renewables are only expected to supply 3.6% of Australia's electricity in 2020. The key message is that unless the negative externalities associated with fossil fuel generation are factored into the price of electricity, renewables will not significantly increase their share of domestic energy supplies.

Renewable energy technologies face considerable competitive challenges as a result of market failure, regulatory failure and the costs of development. This makes renewable energy more expensive than that generated by fossil fuels. In spite of this there is evidence to show that biomass and biogas are close to being competitive with fossil fuel technologies, and wind-powered electricity is moving closer to competitiveness.

While renewable energy technologies are likely to impose a financial cost on society, these can be mitigated through concerted policy action which involves a mixture of renewable energy and demand management approaches and other measures.

The report focuses on seven sustainable energy technologies and makes key observations about their development. They are: commercial–industrial energy efficiency; industry–small cogeneration; dry agricultural wastes; wind power; solar photovoltaic; waste coal mine gas and vent air technology; and biodiesel. The report emphasises the importance of supportive public policies, like the MRET scheme, in the development of these technologies.

The report recommends a combination of approaches to support the development of SEI. These include demand management measures; increasing the MRET scheme to 5%; and establishing a leveraged fund to achieve various SEI initiatives.

More specifically with respect to wind generation, the report notes that worldwide turnover for wind generation equipment is US$1.5 billion per year, while the total industry turnover is between US$5 billion and US$10 billion. It is clear that global growth in wind energy is supported by government policies and cost improvements in association with technology-led productivity gains. There is also a significant regional annual export market to China, the Philippines and New Zealand. Large areas of NSW have been shown to have top wind speeds that are comparable with those in Denmark and Germany, world leaders in wind generation. However, without sufficient policy support the wind market will not reach its potential.

1.4 Renewable Energy Action Agenda

In addition to the measures prescribed by law under the *Renewable Energy (Electricity) Act 2000* (Cth), the Australian government developed a Renewable Energy Action Agenda in 2000 as a joint initiative with industry. The Agenda is to be

implemented by the Renewable Energy Action Agenda Group. In October 2002, the Group released the *Renewable Energy Technology Roadmap* report[4] which reflects the views of industry, research and policy-makers, and participants to provide 'pathways' for the development of Australia's renewable energy industry. The report concluded that five key factors determine renewable energy innovation and technology development: international climate change commitments; government policies and programs; economic and social drivers; renewable energy resources; and research and development capability.

The report suggested that while Australia has acknowledged strength in renewable energy research, greater emphasis is required to complete the innovation cycle to capture commercial benefits from the resulting research breakthroughs. This observation was made in the context of rapid international growth in renewable energy technology following public and academic concern about the impact of global warming.

The report classified the Australian renewable energy sector into 10 technology sectors: biomass energy; cogeneration; enabling technologies; fuel costs and hydrogen fuels; geothermal energy; hydro-electricity, tidal energy and wave energy; photovoltaics (PV); remote area power supply (RAPS); solar thermal energy; and wind energy.

The analysis used in the report assumes that commercially successful technologies must be technically developed, appealing to the market, cost competitive and supported by a significant resource base. In order to promote the Australian renewable energy industry, five technology development strategies are proposed:

- Ongoing development – entails focusing on increasing the technology market uptake and reducing costs to become more competitive with fossil fuels, for example bagasse energy;
- Development and commercialisation – where activity in R&D and market development is required, but the focus is on addressing barriers to commercialisation, for example geothermal energy (hot dry rocks and geothermal heat pumps);
- Import foreign technologies – where for various reasons the best option is for Australia to purchase the necessary technology;
- Monitor international developments – entails monitoring international developments and focusing on ancillary technology and associated services, for example the emerging hydrogen economy; and
- Monitor commercial developments – where Australian resources are limited, the limited resources be adopted for development, for example hydrothermal technologies.

Regarding environment and planning legal issues, the report calls for the development of standards for each renewable energy technology. In particular, the

[4] Available at <http://www.industry.gov.au/assets/documents/itrinternet/RETRSplitVersion2ch4-lesspage.pdf> (accessed 15 August 2005).

report notes that Australia needs to participate in the development of international standards in order to minimise the non-tariff barriers to Australian exports. Further, the report calls for the establishment of a renewable energy technology and innovation network to promote a culture of market-driven innovation in the renewable energy industry.

The targets for the Group in 2005–06 are: to advise the Minister for Industry, Tourism and Resources on the development of the renewable energy industry; to assist with the implementation of the government's Energy White Paper,[5] particularly the Solar Cities and Wind Energy Forecasting initiatives; and to prepare a report to the Ministerial Council on Energy on rule changes that are required in the National Electricity Market[6] to get rid of barriers and maximise the benefits of renewable and distributed generation.

1.5 The role of biofuels

Biofuels, as discussed in Chapter 2, are regarded as environmentally friendly types of fuel. On a fuel cycle basis, greenhouse savings of up to 5% can be gained from the use of E10 (which is petrol blended with 10% ethanol). However, the use of 100% biodiesel made from waste oil can achieve 90% cuts in greenhouse gas emissions compared with diesel. Biofuels currently provide around 50 to 60 ML (or 0.3%) of road transport fuel. Most of this is manufactured from wheat starch produced in New South Wales, although about 5 ML of ethanol is produced from C molasses feedstock in Queensland. A biodiesel plant using waste oil was recently established in New South Wales with a capacity of 14–17 ML. In 2003, a 10% limit on the contribution of ethanol to petrol came into force, while an ethanol fuel labelling standard came into effect in 2004. The legislation, principally the *Fuel Quality Standards Act 2000* (Cth) which regulates the use of biofuels, and the *Energy Grants (Cleaner Fuels) Scheme Act 2003* (Cth) which provides funding to support the development of biofuels, is discussed in greater detail in Chapter 4.

It is interesting to note the September 2005 findings of the Biofuels Taskforce[7] established by the Prime Minister. The Taskforce has found that potentially there may be greater health benefits from ethanol use than previously envisaged; that previous research findings that ethanol may provide greenhouse and regional benefits should be supported; that there are considerable market barriers to the biofuels industry including low consumer confidence and high commercial risk; and that on a business as usual basis Australia is unlikely to meet a target of at least 350 ML of biofuel production by 2010. The Prime Minister has nevertheless reaffirmed the government's intention to reach this target.

[5] See Chapter 7. [6] See Chapter 5.
[7] Available at <http://www.dpmc.gov.au/biofuels/final_report.cfm> (accessed 16 October 2005).

1.6 Is there a place for nuclear energy in Australia's future energy mix?

As discussed in Chapter 2, the possibility of establishing a nuclear fuel industry in Australia has long been dismissed on environmental grounds. However, in March 2005 the Minister for Industry, Tourism and Resources established an inquiry into Australia's uranium resources. As a result of global climate change, the global demand for uranium resources has escalated because nuclear energy is a non-fossil fuel source of energy. It is regarded as being a 'greenhouse friendly' type of fuel, although critics state that the greenhouse intensity of building and operating nuclear power stations is often not factored into the overall calculation of intensity. The Federal Minister for Industry and Resources has indicated that he will be disappointed if uranium exports do not double or triple over the next 10 years, possibly creating a $2 billion export industry.

As mentioned earlier he has requested the Commonwealth House of Representatives Standing Committee on Industry and Resources to inquire into the strategic importance of Australia's uranium resources.

There seems to be considerable support within the current Australian government for reopening the debate about a future nuclear energy industry in Australia. The Prime Minister has welcomed the debate,[8] while Deputy Whip of the Liberal Party, Alan Eggleston, said Australia should consider using nuclear energy to reduce its reliance on coal for electricity. He has stated that with 40% of the world's uranium reserves, Australia could not continue to be so reliant on coal.[9] The Minister for Education, Science and Technology, Brendan Nelson, has meanwhile stated that Australia will need to use nuclear energy within the next 50 years to help drive down the growth in greenhouse gases.[10]

In spite of this support from the government, considerable concerns have been raised with regard to the use of nuclear energy in Australia.[11] First, nuclear power itself generates greenhouse gases because of the significant use of energy required to mine, mill and enrich the uranium for the fuel rods. Even where high-grade uranium ores are used, it takes 7 to 10 years to 'pay back' the energy used in the construction and fuelling of a typical reactor. Secondly, for a large-scale deployment of nuclear power to be sustainable in the long term, breeder reactors would have to be used, which create their own fuel in the form of plutonium. To date, these reactors have not generated sufficient new fuel. Ultimately, this would result in plutonium, a highly hazardous radioactive material, being transported around the world in increasing quantities. The risks associated with nuclear terrorism are clear. Thirdly, despite significant government support for the nuclear energy industry globally, it remains one of the most expensive ways

[8] See 'Howard Welcomes Debate on Nuclear Power', *The Age*, 10 June 2005.
[9] See *Sydney Morning Herald*, 17 August 2005, available at <http://smh.com.au/articles/2005/08/17/1123958110562.html?oneclick=true>.
[10] See *Sydney Morning Herald*, 11 August 2005.
[11] See article by Professor Stuart White in *Sydney Morning Herald*, 13 June 2005.

to reduce greenhouse gas emissions. At no time has the same level of support been forthcoming to support the development and commercialisation of energy efficiency and renewable energy technologies. Finally, with the well-known difficulties of disposing of the waste associated with nuclear energy, the technology may well exacerbate, rather than solve, environmental problems. Perhaps one of the greatest concerns is that a focus on a nuclear energy industry in Australia will detract support and funding for the nascent sustainable energy industry. As we describe in Chapter 2, energy efficiency and renewable energy technologies are proven technologies designed to significantly reduce greenhouse gas emissions.

Not surprisingly on 7 September 2005, Greenpeace, the Australian Conservation Foundation (ACF) and the Australian Greens called on the Australian government to rule out nuclear energy. They released a report challenging claims made by various senior Coalition leaders that nuclear power is clean and a potential solution for curbing greenhouse gas emissions. The report is entitled *Nuclear Power: No Solution to Climate Change*.[12] The report states that a doubling of the nuclear power industry by 2050 would only reduce greenhouse gas emissions by 5% while there is a significant danger that nuclear power plants could be used as nuclear bomb factories. Alternative approaches, such as a greater uptake of energy efficiency measures and renewable energy technologies, offer a clean energy future without the associated dangers. President of the ACF, Professor Ian Lowe, also claims that the real cost of nuclear energy is far higher than for renewable energy technologies. Meanwhile, the Australian Greens Senator for Tasmania, Christine Milne, called on the Prime Minister not to amend the *Australian Radiation Protection and Nuclear Safety Act 1998* (Cth), which currently prevents the licensing of a nuclear power plant, so as to allow such licensing.

[12] Available at <http://archive.greenpeace.org/comms/no.nukes/nenstcc.html> (accessed 16 October 2005).

2

Energy technologies and sustainable development

The Brundtland Report in 1987 described 'sustainable development' as development that 'meets the needs of the present without compromising the ability of future generations to meet their own needs'.[1] In a comprehensive joint study in 2000 of the link between energy use and production and sustainable development, the United Nations Development Programme, the United Nations Department of Economic and Social Affairs and the World Energy Council declared in their report, *World Energy Assessment: Energy and the Challenge of Sustainability* (hereafter referred to as *World Energy Assessment*) that there are two important features of the link between energy production and use and sustainable development:

> One is the importance of adequate energy services for satisfying basic human needs, improving social welfare, and achieving economic development – in short, energy as a source of prosperity. The other is that the production and use of energy should not endanger the quality of life of current and future generations and should not exceed the carrying capacity of ecosystems.[2]

In its chapter on energy resources and technological development, the *World Energy Assessment* went on to consider the appropriate options available for using energy in ways supportive of sustainable development consistent with addressing environmental concerns. The report identified three major options:

- Greater use of energy efficiency, in terms of energy use in buildings, electric appliances, motor vehicles and industrial production processes.
- Increased reliance on renewable energy resources.

[1] World Commission on Environment and Development, *Our Common Future*, OUP, Melbourne, 1987, at 8.
[2] United Nations Development Programme, United Nations Department of Economic and Social Affairs and World Energy Council, *World Energy Assessment: Energy and the Challenge of Sustainability*, United Nations, New York, 2000, at 31.