Ann. Rev. Energy 1986. 11 : 47–75

ENERGY ISSUES AND POLICIES IN AUSTRALIA

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INTRODUCTION

The quadrupling in the world price of oil in 1973–1974—the event that transformed policymakers' concerns about individual fuels into concern about "energy" as a whole—did not at first directly affect Australia. At that time the country was over 60% self-sufficient in oil, and was exporting 28 megatonnes/year of black coal. It was totally self-sufficient in black coal, lignite (brown coal), natural gas, and the "renewables"—wood, hydropower, and bagasse (the crushed, dried stalks of spent sugar cane used in the sugar mills' furnaces). The price of Australian crude oil had been fixed at $A2.06/bbl—just above import parity—in September 1970, and this remained unchanged for five years (at first to the benefit of producers, but after the world oil price rise to the benefit of consumers). As a small, trading economy, Australia soon imported the indirect effects of the oil price rise—inflation, rising unemployment, and recession (1, 2)—but it was not until August 1978 that Australian refineries had to pay the world price for Australian crude oil, which gave gasoline buyers barely six months to adjust before the price at the pump began to rise again, in response to the onset of the second oil shock of 1979–1980. This time the price to refineries of Australian crude oil kept step with the world price, as the government adjusted its crude oil excise tax every six months, to equal the difference between the world price and the acquisition cost of domestic crude, to the great benefit of revenue.

Ten years earlier the lag in the response of the crude oil prices paid by Australian refineries to higher world prices could not have happened; it was only in 1969–1970 that Australia's oil production first exceeded 10% of its oil consumption. The late 1960s also saw the first large-scale pro-

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duction of natural gas, from the offshore Gippsland Basin, Victoria, that has yielded most of the flow of indigenous crude, and from the Cooper Basin, in northeast South Australia. (There was minor crude oil production from fields at Barrow Island, Western Australia, and at Moonie, Queensland, where natural gas was also being produced.) These fields had been discovered during an exploration drive in the 1950s and 1960s, despite the conventional wisdom that held that Australia was so old geologically that any oil and gas had long since dissipated.

OVERVIEW

Past Energy Use

For 40,000 years or more of Aboriginal habitation of the continent the only fuel had been wood, but black coal was discovered north and south of the young settlement of Sydney, New South Wales, less than 20 years after the founding of the British colony in 1788. By 1860 coal was also being mined in Ipswich, Queensland, and the first trickle of exported coal had begun. The railroads were expanding the demand for coal and helping to transport it to gasworks, which were supplying the six state capital cities with town gas. The first petroleum imports occurred in 1865, and the first electricity was generated 20 years later. Despite growing use of the fossil fuels, the renewable fuels of wood and bagasse continued to supply up to a quarter of the country's primary energy until after World War II. (The wood was partly a by-product of land clearance for agriculture.)

With a land area of 7682 km^2 (82% of the area of the United States) and a population of just over 15 million (mid-1983), Australia has an average population density of 2 people/km^2. And yet it is one of the most highly urbanized of countries, with over 42% of its population living in the two largest urban areas, Sydney and Melbourne. These local concentrations allow for less costly reticulation of gas and electricity, but some reserves of primary fuels have been located far from centers of population: most recently the North West Shelf natural gas reserves off the remote northwest coast of Western Australia (WA). The "tyranny of distance," interstate rivalries, and the division of powers embodied in the Australian Constitution at Federation in 1901 have resulted in what have largely been six separate energy economies (or seven, counting the Northern Territory). Lack of economic integration has been exacerbated by state-government ownership or control of electricity generation and gas reticulation in each state.

The relative isolation of the state energy economies is evidenced by the lack of an electricity grid covering more than two states (the Snowy Mountains hydroelectric scheme provides a marginal link between the two

most populous states of New South Wales and Victoria), by the almost complete absence of interstate trade in coal or other fuels for electricity generation, by state-government restrictions on the sale from reserves of natural gas found in the Jackson Basin, Queensland, to consumers in New South Wales (NSW) or South Australia (SA), by interstate rivalries which may keep the price of natural gas at levels well below the world replacement cost, by the great reluctance of the Tasmanians to reduce the island state's reliance on hydropower despite the offer of a Commonwealth subsidy to do so in response to protests against the environmental, archaeological, and ecological damage to be caused by the proposed flooding of the Franklin Valley, and by serious proposals from the Western Australians to generate electricity from nuclear power despite the excess capacity of the NSW and Queensland coal producers and in the face of general public sentiment against nuclear power in Australia.

Private capital plays virtually no part in the generation and distribution of electricity in Australia; the state-owned electric utilities, moreover, are large coal-mine owners. In SA and Victoria almost all coal is mined and used by these utilities, and about a quarter of NSW coal is won from Electricity Commission mines for electricity generation. Natural gas is produced by private firms, but bought at the wellhead or at the city gate by government-owned or -regulated gas utilities. Only crude oil is imported or produced domestically wholly privately, but with Commonwealth control over price and exports.

Energy Consumption

Although a third of the country lies in the tropics, 90% of the population lives in coastal, temperate regions, with no great extremes of temperature. This results in a lower proportion of Total Final Energy (TFE) consumption[1] in residential or commercial heating or cooling than in most other industrialized countries. For instance, in 1982 Australian residential/commercial energy consumption was 18% of TFE consumption, against 29% in the United States overall, and 22% in California.

Figure 1 shows the contributions of the major primary fuels to Australian Total Energy (TE) consumption[2] since 1961.[3] From early days,

[1] Total Final Energy (TFE) consumption is the total amount of energy consumed in non–conversion sector end-use devices.

[2] Total Energy (TE) consumption is the quantity of primary and derived fuels consumed less the quantity of derived fuels produced. Hydroelectricity is valued as the energy equivalent of the fossil fuels necessary to produce an equal amount of thermal electricity.

[3] Because Australian data cover the fiscal year to June 30, all reference to years in this report should be taken to mean the year ending June 30.

the share of black coal in TE consumption had been falling, and the share of oil rising, especially since World War II, until in 1961 their shares were approximately equal, at around 37%. From 1961 to 1972 oil's share rose steadily, to reach a maximum of almost 51% in 1972; since then it has fallen back to 40% in 1984. Natural gas's share of TE consumption has risen from zero in 1967 to 15% in 1984; black coal's share has risen to 29% in 1984 from a low of 25% in 1974; brown coal has remained steady at around 10% (3, 4). Before the first oil shock in 1973–1974 the steady rise in the importance of oil as a primary fuel at the expense of coal (both black and brown) and of renewables (wood, bagasse, and hydropower) was a pattern seen around the world. The onset of significant production of domestic crude oil and natural gas, mainly from the Gippsland Basin in Bass Strait, led to the substitution of domestic for imported crude, and by 1973 natural gas was beginning to make steady inroads into the consumption pattern, most often at the expense of crude oil. For the world, the share of natural gas in TE consumption has been falling, but for Australia it has been rising; Australia's share in 1982, however, was only 14.4%, while the average world share was 19.2% (3).

Tables 1 and 2 present the Australian energy balances for 1974, the

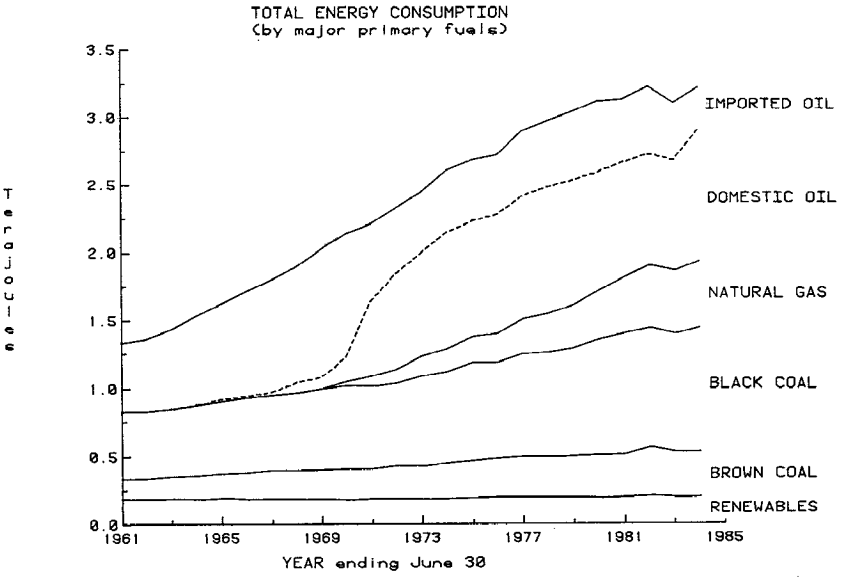

Figure 1 Total Energy consumption—the quantity of primary and derived fuels less the quantity of derived fuels produced—by major primary fuels. Renewables includes wood, bagasse, and hydropower. Source: (3, 4).

earliest year for which national data on detailed end use exist, and for 1984 (preliminary). In 1974, oil was providing 7% of the fuel for electricity generation, 24% of residential/commercial TFE consumption, 34% of manufacturing TFE consumption, and virtually all fuel used for transport; its share in TE consumption was 50.6%. Ten years later oil's importance had fallen to 4% of electricity generation, 8% of residential/commercial TFE consumption, and 19% of manufacturing TFE consumption, with no change in transport; its total share had fallen to 40% of TE consumption. Natural gas doubled its importance during the ten years from 1974 to 1984 (from 7% to 15% of TE consumption), and coal—both black and brown—

Table 1 Australia. Energy balance 1973–1974 (millions of tonnes of oil equivalent)

	Black coal	Brown coal	Oil[a]	Natural gas	Electricity	Other[b]	Total[c]
End use							
Agriculture	—	—	0.9	—	0.1	—	1.0
Mining	—	—	0.7	0.3	0.4	—	1.4
Manufacturing	1.8	—	6.6	2.0	2.1	6.6	19.2
Transport—road	—	0.1	11.3	—	—	—	11.3
—other	0.0	—	5.0	—	0.1	—	5.1
Residential/ commercial	0.2	—	1.8	0.7	2.5	2.3	7.5
Other[d]	—	0.0	1.2	—	—	—	1.2
TFE consumption[e]	2.0	0.1	27.4	3.0	5.1	8.9	46.6
Electricity generation	8.3	5.5	1.2	0.9	−4.6	0.1	11.4
Other conversion	5.5	0.6	0.4	0.0	−0.2	−5.6	0.7
Own fuel use	—	—	2.6	0.2	0.8	—	3.6
TE consumption[f]	15.9	6.3	31.6	4.1	1.2[g]	3.4	62.4
Supply							
Domestic production	35.0	6.3	21.8	4.1	1.2	3.5	71.8
Stock changes	0.9	—	−0.5	—	—	0.0	0.3
Imports	—	—	13.9	—	—	—	13.8
Total supply	35.9	6.3	35.2	4.1	1.2	3.5	85.3
Exports	20.0	—	3.5	—	—	0.1	23.6
Domestic supply	15.9	6.3	31.6	4.1	1.2	3.4	62.4

[a] Crude oil, petroleum fuels, and naturally occurring LPG.
[b] Bagasse, wood, coke, briquettes, and town gas.
[c] No uranium was produced, consumed, or exported.
[d] Lubes, bitumen, and solvents.
[e] Total Final Energy consumption.
[f] Total Energy consumption.
[g] Hydroelectricity.
Source: (3).

increased its share from 36% to 39% of TE consumption, providing an unchanged 81% of fuel for electricity generation over this period. The share of electricity in TFE consumption rose from 10.9% in 1974 to 14.8% in 1984, which moderated growth in TFE consumption because of electricity's high efficiency in consumption (3).

Figure 2 shows real energy prices for the main primary fuels of brown coal, black coal, natural gas, and crude oil, and for the derived fuel of electricity, in Australian dollars per unit of energy content. In the 10 years

Table 2 Australia. Energy balance 1983–1984 (preliminary) (millions of tonnes of oil equivalent)

	Black coal	Brown coal	Oil[a]	Natural gas	Electricity	Other[b]	Total
End use							
Agriculture	—	—	1.6	—	0.1	—	1.8
Mining	0.0	—	0.6	1.0	0.5	0.0	2.1
Manufacturing	2.2	0.1	3.6	4.9	3.1	5.4	19.3
Transport—road	—	—	15.8	—	—	—	15.8
—other	0.1	—	4.2	—	0.1	—	4.3
Residential/ commercial	0.1	—	0.7	2.0	4.4	1.9	9.1
Other[c]	—	—	1.1	—	—	—	1.1
TFE consumption[d]	2.5	0.1	27.7	7.9	8.1	7.3	53.6
Electricity generation	15.7	7.3	1.1	2.9	−8.2	0.2	19.1
Other conversion	3.7	0.4	0.1	0.5	−0.3	−3.9	0.6
Own fuel use	—	—	1.9	0.3	1.5	0.0	3.7
TE consumption[e]	22.0	7.8	30.7	11.7	1.2[f]	3.7	77.0
Supply							
Domestic production	67.7	7.8	25.7	11.7	1.2	3.7	167.5[g]
Stock changes	—	—	0.1	—	—	0.0	−12.4[h]
Imports	—	—	10.3	—	—	—	10.3
Total supply	67.7	7.8	36.1	11.7	1.2	3.7	165.3[i]
Exports	45.7	—	5.4	—	—	0.0	88.3[i]
Domestic supply	22.0	7.8	30.7	11.7	1.2	3.7	77.0

[a] Crude oil, petroleum fuels, and naturally occurring LPG.
[b] Bagasse, wood, coke, briquettes, and town gas.
[c] Lubes, bitumen, and solvents.
[d] Total Final Energy consumption.
[e] Total Energy consumption.
[f] Hydroelectricity.
[g] Uranium production of 49.7 MTOE; no consumption.
[h] Uranium stock buildup of 12.5 MTOE.
[i] Uranium exports of 37.2 MTOE.
Source: (4).

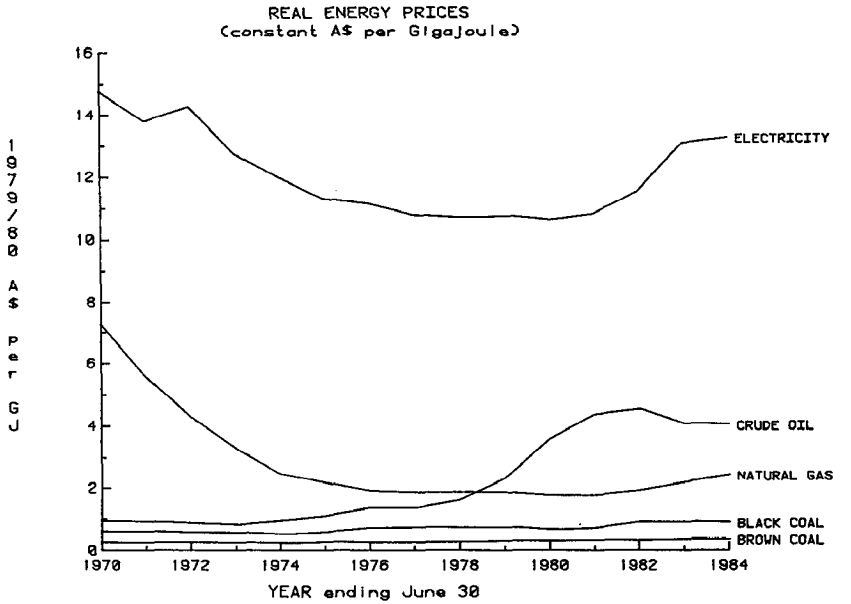

Figure 2 Real energy prices of primary fuels and electricity in 1979–1980 Australian dollars per gigajoule. Coal and electricity prices for 1984 are estimates. Source: (4).

to 1980 there were large reductions in the price of electricity, and its subsequent increase reflects a fundamental adjustment to equate demand with supply: a series of blackouts and brownouts in Victoria and NSW accompanied excess demand for peak electricity in 1978–1981 (5). Electric tariff charges have been well below economic costs, with real rates of return on capital below 2% per annum for most of the 1970s, and sometimes negative (5a, 5b). Meanwhile, the effect of the government's domestic crude-oil pricing policy is clearly shown, with the slight rises in the oil price after 1973 accelerating after 1978, when the price of domestic crude oil bought by Australian refineries was raised to the world level (so-called Import Parity Pricing, IPP).

In 1961, TE consumption was 1336.6 PJ,[4] equivalent to 128.6 GJ per capita. In 1972, TE consumption had risen to 2331.2 PJ, or 178.5 GJ per capita. The preliminary figure for 1984 TE consumption is 3224.2 PJ, or 208 GJ per capita, slightly down from the maximum in 1980 of 215.3 GJ per capita (3–5). Over the period 1961 to 1972 the average rate of growth of TE consumption was 5.2% per annum; for the period 1972 to 1978 it

[4] 1 Petajoule (PJ) = 10^{15} joules = 947.81 × 10^{9} Btu.

was 4.2% per annum; and from 1978 to 1984 it was 1.4% per annum, with a downturn in 1983, reversed in 1984. The Department of Resources and Energy (3) calculates that, had energy prices continued declining at their pre-1974 rate of 0.9% per annum, TFE consumption in 1983 could have been some 12% higher than measured levels, ceteris paribus. The total energy intensity of the Australian economy increased slightly from 1961 to the mid-1970s, but thereafter declined to its earlier levels. The oil intensity increased rapidly from 1961 to 1978 (the date of onset of full Import Parity Pricing of Australian crude oil, then supplying about 60% of total oil consumed), but thereafter declined steadily (3).

Table 3 presents a government projection of the Australian energy balance for 1994 (4). The key assumptions in the projection are: Gross Domestic Product (GDP) to grow by 3.5% per annum from 1984 to 1994; crude oil prices to remain constant at a nominal $US28/bbl from 1985 to 1987, constant in real terms to 1992, and to increase by 4% per annum in real terms to 1994; electricity prices to increase by 2.5% per annum in real terms to 1994; domestic coal prices to remain constant in real terms to 1986 and then to increase by 1.0% per annum to 1994; natural gas prices to increase by 1.5% per annum in real terms to 1994; an exchange rate of $A1.00 = $US0.75; and growth in the Consumer Price Index of 5.25% in 1985, 6.0% in 1986, and 6.6% per annum to 1994. In the 1994 projection, oil will provide 1.3% of the fuel for electricity generation, 5% of residential/commercial TFE consumption, 11% of manufacturing TFE consumption, and virtually all fuel used for transport; its share in TE consumption will be 35%. The shares of black coal (31%), brown coal (12%), and natural gas (17%) in TE consumption will all have risen, as will the share of electricity in TFE (17%). Coal—both black and brown—will provide almost 87% of fuel for electricity generation; the projection includes no domestic consumption of uranium.

The total energy production from renewable sources in 1974 was 197 PJ, comprising wood (47%), bagasse (28%), hydropower (25%), and solar power (negligible). By 1984 the total had risen 4% to 205 PJ, comprising 41%, 34%, 24%, and 0.8%, respectively. Under the projection of Table 3, in 1994 the total will have risen a further 18% to 243 PJ, comprising 39%, 35%, 25%, and 1.8%, respectively. In the projection solar power will grow 2.5 times from 1984 to 1994, although still providing a negligible proportion (0.16%) of Australia's TE consumption. A study of renewable energy resources in Australia (7) did not anticipate a significant role for other renewables (wind, wave, tide, and other biomass) by 1994.

Energy Resources and Trade

RESOURCES In 1985 Australia became the world's largest exporter of coal, with an estimated 82 megatonnes shipped, about 20% up on the previous

financial year's figures (8). With demonstrated economic reserves at June 30, 1984, of 474 kilotonnes of uranium metal (at a cost of less than $US80/kg), and of 73 gigatonnes of black and brown coal, and with 616 teraliters of natural gas and 387 gigaliters of crude oil/condensate and LPG (liquefied petroleum gas) (4), Australia has 23.2%, 6.0%, 0.7%, and 0.4% of the world's proved reserves of these exhaustible energy sources, respectively (6). But relative to annual production Australia is well endowed; at 1984 rates, its demonstrated economic reserves corresponded to 127 years of uranium, 297 years of black coal, 1217 years of brown coal, 49 years of natural gas, 11 years of crude oil, and 27 years of LPG

Table 3 Australia. Energy balance 1993–1994 (projection) (millions of tonnes of oil equivalent)

	Black coal	Brown coal	Oil[a]	Natural gas	Electricity	Other[b]	Total
End use							
Agriculture	—	—	2.5	—	0.2	—	2.7
Mining	0.0	—	0.7	2.3	0.6	—	3.7
Manufacturing	2.8	0.1	2.6	7.4	4.6	6.7	24.2
Transport—road	—	—	18.1	—	—	—	18.1
—other	0.1	—	5.2	—	0.1	—	5.5
Residential/ commercial	0.1	—	0.6	3.0	5.9	1.9	11.5
Other[c]	—	—	1.3	—	—	—	1.3
TFE consumption[d]	3.1	0.1	31.1	12.6	11.5	8.6	67.0
Electricity generation	21.6	11.2	0.5	3.2	−11.5	0.2	25.0
Other conversion	5.4	0.6	0.1	0.3	−0.4	−5.2	0.8
Own fuel use	—	—	2.1	0.4	2.0	0.0	4.5
TE consumption[e]	30.1	11.8	33.7	16.6	1.4[f]	3.6	97.3
Supply							
Domestic production	124.7	11.8	24.7	24.4	1.4	4.3	304.8[g]
Stock changes	—	—	—	—	—	—	—
Imports	—	—	11.9	—	—	—	11.9
Total supplies	124.7	11.8	36.6	24.4	1.4	4.3	316.8[g]
Exports	94.6	—	2.9	7.9	—	0.7	219.5[g]
Domestic supply	30.1	11.8	33.7	16.6	1.4	3.6	97.3

[a] Crude oil, petroleum fuels, and naturally occurring LPG.
[b] Bagasse, wood, coke, briquettes, and town gas.
[c] Lubes, bitumen, and solvents.
[d] Total Final Energy consumption.
[e] Total Energy consumption.
[f] Hydroelectricity.
[g] Production and export of 113.4 MTOE of uranium, no consumption.
Source: (3).

(4). In energy terms black coal (55%) and brown coal (26%) dominate Australia's economically recoverable reserves; uranium constitutes 17%, but oil, LPG, and natural gas less than 3% together. The geographical distribution of the resources is uneven, with coal deposits in NSW, Victoria, and Queensland; crude oil in Victoria; natural gas in WA, Victoria, the Northern Territory (NT), SA, and Queensland; and uranium in the NT and SA.

TRADE Tables 1–3 highlight the growing importance to Australia of international energy trade. In 1974, TFE consumption was 64.9% of domestic energy production; this is projected to fall to 22.0% in 1994, from 32.0% in 1984. However, Australia will be a net importer of oil and petroleum products throughout the period, although exports of black coal, LNG (liquefied natural gas), and uranium may far outweigh the energy content of the petroleum imports. In 1979–1981, projections of world energy demand and supply led to a boom in energy-resource-related investment in Australia, which peaked in 1982 (9), when it became clear that the assumptions on which most of the earlier export projections had been made were no longer valid: the recession had begun, real oil prices were no longer rising, there was greater conservation of oil use and fiercer competition from foreign coal and uranium supplies than expected, and nuclear power was less popular (10). Nonetheless, the International Energy Agency's latest report on Australia (11) urges Australia to keep in mind "the importance to other IEA countries of having reliable and stable imports from Australia." As Hall (12) points out, exports of electricity-intensive aluminum should also be counted in Australia's energy trade.

Since 1971 there has been a positive balance of energy trade, although it fell from $A949.5m (m = million) in 1979 to $A241.9m in 1981 as a consequence of the second oil price rise (6). In energy terms, 1971 was also the year in which the balance became positive, with a boost due to the resumption of uranium exports in 1976 and growth in the exports of steaming coal, until the downturn in 1984 coincided with a fall in the amount of uranium exported (3). In energy terms, the ratio of Australia's energy exports to imports rose from 1.7 in 1974 to 8.6 by 1984, reflecting the country's emergence as a major energy exporter. The projection of Table 3 reveals that by 1994 the ratio may have risen to 18.4. Note that, per unit of energy, crude oil is much more valuable than uranium, which explains a rising energy trade balance in energy terms against a falling energy trade balance in value terms over the period 1979 to 1981.

The energy sector is an important and growing part of the Australian economy. In 1982, total value added, including indirect taxation, in the energy sector was approximately $A22.2bn (bn = billion), or about 15%

of GDP. In June 1982, direct employment in the energy sector accounted for 3% of the Australian workforce. Coal is the nation's most valuable export, and uranium the fifth most valuable. Apart from company tax, the energy sector contributes to both Commonwealth and state revenues through excises levied on certain crude oil, petroleum gas, black coal, and petroleum products; through royalties paid for production of petroleum, coal, and uranium; and through an export duty levied on exports of certain high-quality coking coal. The energy sector is the largest contributor to Commonwealth indirect tax revenues, mainly through the crude oil levy discussed below (6).

In 1983 Australia was the third largest net exporter of energy among OECD countries (after Norway and the United Kingdom), exporting coal, uranium, and petroleum products equivalent to 3870 PJ, or more than 1.23 times the domestic energy consumption. In 1983 the value of Australia's energy exports amounted to $A4.9bn, or about 22% of the value of total exports, resulting in a net surplus of energy exports over imports of $A1.8bn. Exports of black coal (about 65% of which went to Japan) accounted for 63% of the total value of energy exports, and petroleum 30% (nearly half of which was naturally occurring LPG to Japan) (6). Table 3 projects that black coal exports will grow at an average rate of 7.5% per annum until 1994, and that uranium exports will grow at 11.8% per annum.

Australia's third most valuable mineral export in 1983 was alumina, but as new aluminum smelters in Australia are completed this should fall as exports of aluminum rise. Because the process of aluminum production is so energy-intensive, it has been described as a method of converting electricity into metal, and the most energy-intensive stage in the production of aluminum from bauxite is the reduction of alumina to aluminum. Australia has large reserves of bauxite and relatively cheap power based on extensive coal reserves, which have made aluminum smelters in Australia an increasingly attractive proposition. Australia produced 30% of the world's bauxite output in 1982, and Australia's share of primary aluminum production has been forecast to grow from 1.8% of world production in 1979 to 7.4% in 1990, of which over 80% will be available for export as "solid electricity" (13). However, the planning and commencement of the new aluminum smelters have been delayed by environmental concerns and by the economic downturn.

Institutional Actors

Australia is a federation in which the Commonwealth's powers are clearly described, and the powers of the states are the residuum. Minerals in situ are vested in the Crown, which in practice means the state governments,

except for uranium in the Northern Territory, which is vested in the Commonwealth. The offshore Gippsland Basin produces over 90% of Australian crude oil (3). Since 1975, when the High Court confirmed the Commonwealth's control over offshore minerals, there have been no challenges to the power of the Commonwealth to pursue the IPP policy by imposing a tax on all Australian crude oil production equal to the difference between the world price and the acquisition cost of domestic crude.

Until 1960 the most important primary fuel was black coal, which has been mined in Australia since the early days of the colony. During World War II the Commonwealth used its emergency powers to introduce petrol rationing in October 1940, and to take control of the black-coal industry in NSW, which had been experiencing severe labor unrest. (NSW produced 80% of Australia's black coal in 1940.) After the war, with no sign of industrial peace, the Commonwealth joined with the NSW state government to form the Joint Coal Board, which immediately began to coordinate modernization of the underground mines of NSW. Disruptions in the supply of NSW coal had already spurred other state governments to develop alternative sources.

In 1918 the Victoria government had established an electric utility to tap the state's large deposits of brown coal to generate (and distribute) electricity, and to manufacture briquettes. Tasmania had moved to harness its extensive hydropower resources for electricity generation. SA and WA had begun accelerating the development of their coal resources, as had Queensland (14). These moves towards state independence from outside fuel for electricity generation were explicitly recognized in the legislation governing most state electric utilities. Other state-government energy-related activities included the manufacture and supply of town gas and the allocation of exploration and extraction leases for coal, oil, and natural gas. Indirectly, industry policy towards the petroleum industry (in particular towards the siting and construction of refineries) and towards pollution control have ramifications for energy policy, but the states had no consistent policies affecting energy production and consumption overall until after the first oil price rise. In the past eight years, most states have established energy planning agencies, and have belatedly begun to provide public accountability and commercial targets for the real rates of return on capital invested in their statutory energy utilities (5a). Victoria and other states are pursuing energy plans (15), but the Commonwealth is lagging, promising a comprehensive energy policy ("Energy 2000") in 1986.

Apart from the establishment of the Joint Coal Board in 1946, the Commonwealth in peacetime took little part in energy-related policies. In

1920, it joined with the forerunner of British Petroleum (BP) in establishing Commonwealth Oil Refineries (COR), which built a small refinery near Melbourne, and subsequently expanded as a marketing company. But in 1952 COR was sold to BP. From 1926 the Commonwealth began to encourage exploration for oil, but minimally, with small subsidies. In 1946 the Commonwealth Bureau of Mineral Resources (BMR) was established to provide substantial information and assistance to exploration, which led to the first oil discovery in Australia, at Rough Range, WA, in 1953. It was not a commercial well, however (16). Although primarily to divert water from the coastal rivers into the arid interior, the Snowy Mountains scheme (a joint venture among the Commonwealth and the states of NSW and Victoria begun in 1949), provides 3740 MW of hydroelectric capacity (56), 12% of Australia's total generating capacity of 31,115 MW (4). The Australian Atomic Energy Commission, established in 1953, has been involved with exploration for uranium, with building and operating a small nuclear reactor for research purposes, and with joint ownership and management of the Mary Kathleen uranium mine in Queensland (17). In October 1985 the Commonwealth announced that the Commission's functions would be split between two new bodies: the Australian Nuclear Science and Technology Organization (concerned with the use of radioactive isotopes and radiation in science and technology) and the Nuclear Regulatory Bureau (concerned with overseeing the mining of uranium in the Northern Territory).

In 1957 the Commonwealth introduced a formal drilling subsidy scheme, tax concessions, and an expansion of work for the BMR, which was letting contracts to private exploration companies. Australia's oil policy had become one of creating a favorable climate for attracting private exploration companies, and Commonwealth governments continue to provide active encouragement for exploration. However, after 1952, all oil refineries in Australia were privately owned, and the Commonwealth was criticized by the 1976 Royal Commission on Petroleum for its lack of involvement in planning the design and location of refineries in the national interest (18).

The first oil price rise occurred a year after a reformist, Labor government had been elected in Canberra. Philosophically, the new government was predisposed to take a more interventionist role in energy policy, which until then had "been almost untouched by the rational and integrated policy requirement of government" (18). The Department of Minerals and Energy was organized, and the Commonwealth attempted to expedite the utilization of Australian uranium, to examine the structure of the Australian petroleum industry, and to exert national control over the distribution of natural gas, through the newly created Pipeline Authority

and the Petroleum and Minerals Company of Australia [statutory corporations, the establishment of which was later declared invalid by the High Court (14)].

IMPORT PARITY PRICING By 1975 the world price of oil was several times higher than the producer price of Australian crude f.o.b. the refinery, which had been fixed slightly above the world price of October 1968 at $A2.06/bbl. In August the Commonwealth categorized fields discovered before September 14, 1975, as "old," and fields discovered after as "new." New oil was to be priced at import parity and not subject to excise duty. The parity price was set every six months, based on the price of Arabian light crude at the refinery port nearest each producing basin, with an appropriate quality differential. Old oil was subject to excise duty, and the producer prices were allowed to rise, although not to import parity (19). Ten years later, most elements of this scheme to promote exploration, discourage petroleum consumption, and raise revenue survive.

In 1977 a policy of allowing a growing proportion of old oil to be sold at import parity prices was introduced. From 10% in 1978, this proportion was to rise to 50% in 1981, resulting in a rising average price to refineries of Australian crude oil, and a rising return to producers of old oil. To capture for the Commonwealth some of the windfall profits otherwise accruing to the producers, the government proposed an excess profits tax, or resource rent tax (RRT), but later abandoned the proposal, with the explanation that a higher return for old oil would encourage greater production from old wells.

A year later, in 1978, the government imposed an excise duty (the crude oil levy) on the proportion of old oil still fetching the lowest, controlled prices, to bring the price to refineries up to import parity. From now on, all Australian crude oil would be sold to refineries at import parity prices including the crude oil levy. In 1978–1979 the levy yielded $A1189m (4.7% of total Commonwealth receipts); at its height in 1980–1981 the yield was $A3019m (8.6% of total receipts) (20). Before the world oil price slump, the levy was estimated to yield $A4368m in 1985–1986 (6.8% of total receipts). Until 1986 this policy remained the linchpin of Commonwealth energy policy, with but few changes. Since January 1, 1985, prices have been adjusted every two months, and since July 1, 1985, the IPP has been calculated on the basis of a 50:50 weighted average of official and spot prices for Arabian light. To avoid premature abandonment of intermediate fields of old oil, a lower scale of excise was introduced for these fields from July 1, 1985 (21). Despite the IPP policy, in early 1984 Australia's gasoline retail price was the fourth lowest of any OECD country's, because of relatively low taxes on gasoline (6).

The slump in world oil prices in early 1986 presented the government with a difficult problem: passing on the IPP fall would result in a fall in the retail price of gasoline and a welcome reduction in the rate of inflation, but a fall in tax receipts from the crude oil levy. The government decided to pass on the full IPP fall of $US10.90/bbl to Australian refineries but to recoup 75% of the revenue loss by increasing the rate of excise tax on almost all refined petroleum products by 50%. The net result was a fall of $A0.056/liter in the retail price of gasoline, an estimated 1-percentage-point reduction in the rate of inflation directly and indirectly, and a fall of $A420m in annual tax receipts. (Since about 40% of the revenue loss from the fall in IPP is borne not by the government but by local oil producers, tax revenue could be maintained with a net fall of about $A0.034/liter in the retail price of gasoline.) Moreover, the government decided to replace thinly traded Saudi light crude with a basket of mideast crudes as the marker for determining the import parity price. The increased revenue importance of the excise on refined petroleum products provides security for the government against the expected fall in indigenous crude oil production (and hence the crude oil levy) later this decade.

ENERGY POLICY

Evolution of Policy

In November 1977 the Commonwealth announced six general energy policy targets: "to move crude oil prices in the direction of international levels; for the average rate of growth of energy consumption, particularly in liquid fuels, to be restrained; the highest degree of self-sufficiency in liquid fuels consistent with the broadly economic utilization of energy reserves; that economic oil and gas reserves be developed; to encourage individual major energy projects to meet overseas demand for energy minerals where those projects are economical and will provide an adequate return to Australia; and that energy research and development (R&D) be substantially increased" (22). The accompanying statement analyzed the most important problems in energy policy as the needs for general energy conservation, for the substitution of more plentiful fuels for scarce ones, and for a reasonable level of self-sufficiency. In practice the government had allowed Australian crude oil prices to rise somewhat to encourage conservation and substitution, and had reinstated generous mining taxation incentives to encourage further exploration for energy resources.

Earlier in 1977 the government had set up the National Energy Advisory Committee, with members from government, industry, and academia. Until its demise in 1983, this committee produced 21 reports (on such topics as various energy sources, liquid-fuel use, and conservation) which

provided valuable information on Australian energy supply and consumption. Other consultative bodies established included the Minerals and Energy Council of state and Commonwealth Ministers, a council to advise on energy research, development, and demonstration, and a committee to advise on emergency petroleum allocation. In 1979, Australia joined the International Energy Agency and announced further measures to encourage voluntary conservation of liquid fuels and greater use of LPG as a substitute transport fuel.

Seven years later the objectives of the new Labor government are recognizably similar: maintenance of adequate energy supply, pursuit of a high level of liquid-fuel self-sufficiency, the efficient development of Australia's energy resources for domestic and overseas supply, and an equitable sharing of the benefits of energy resource development among the whole community (23). Only the last objective is new. In the meantime, however, the price of oil—and those of other energy sources—had risen to new heights after the rises of 1979–1980, before falling back to levels below those of 1974 in real terms.

The rise in the world price of oil in the mid-1970s led to several attempts to come to grips with an Australian energy policy (18, 22, 24–33). Not surprisingly, given the country's wealth of coal and uranium reserves, a common thread of concern for liquid-fuel adequacy runs through the studies, which consider reductions in the demand for energy use only as a secondary option.

The emphasis on ensuring the adequacy of energy supply—and especially that of liquid fuels—may also betray the supply-side bias of the engineers and physicists who were now attempting to solve the "energy problem." Another explanation, however, lies in the belief that there was a relationship between economic growth and energy usage that was almost one-to-one—a unitary income elasticity of energy demand—and that, in terms of growth forgone, the cost of successful attempts to reduce the demand for energy would be too high. [The implicit assumption—very low elasticities of substitution between energy and other factor inputs (labor and capital) and new technology—has proved invalid in every industrialized country.] As remarked above, Australian total energy intensity has fallen only slightly (by 8.8% from its high in 1978), while total oil intensity has fallen by 23.6% over the same period (3). The falls in intensity probably reflect the effects of the higher prices that followed the adoption of the IPP policy for oil and market pricing for electricity. Higher energy prices encouraged the substitution of other production factors for energy in general and oil in particular, conservation through the adoption of energy- and oil-saving machines and work practices, and changes in energy

end uses. It may be the case, moreover, that policymakers did not have the necessary data on demand responses to model them adequately (34).

In analyzing energy policy, we consider (*a*) demand aspects, (*b*) supply aspects, (*c*) price aspects, and (*d*) aspects external to the principal activities of supply, consumption, and pricing, such as environmental and distributional aspects. In a world in which fuels were produced and traded on completely unregulated markets, price would simply equate supply and demand. But energy markets are not unregulated: governments control the price and availability of petroleum products, electricity, and natural gas; through the use of export controls and the state ownership of coal mines governments may influence the price and availability of brown and black coal, both at home and abroad. Price aspects include the Commonwealth's key policy of Import Parity Pricing for indigenous crude oil and LPG, and the issues of electricity, gas, and coal prices. Demand aspects include measuring the income elasticities and price elasticities of demand for various fuels—both short- and long-term, own-price and cross-price—in order to gain understanding of demand response to changes in price and availability of various fuels. Supply aspects include self-sufficiency, exploration, development, and investment in new wells, mines, dams, power stations, pipelines, and new technologies, such as oil shale production. The environmental aspects of energy production, distribution, and consumption will become more pressing because of growth in energy use, growth in population, increasing incomes and consequent growth in consumption, and increasing scarcity of environmental amenity (35). The doubling and tripling in the price of gasoline after 1978 resulted in some discussion (36, 37) of the distributional impacts of higher transport costs, but there have been no empirical studies of these impacts (38).

Demand Aspects

ECONOMETRIC DEMAND STUDIES Whereas geological and engineering studies may provide an accurate assessment of the prospects for energy supply, detailed econometric analysis of the derived demand for energy is necessary for an adequate understanding of likely responses (use of substitutes, conservation, and change in the structure of industry) to changes in relative prices or energy availability. Donnelly (39) provides a gloomy summary of the difficulties of estimating energy demand elasticities for industry (the iron and steel sector), and for gasoline and electricity demands in Australia. The largest single problem for any researcher or policy analyst is the lack of suitable data and the lack of consistency across different series. Donnelly reports that an attempt to build a simpler, Australian version (40) of the Hudson-Jorgenson (41) computer model of the US energy market had to

be abandoned because of the poor quality of existing data and the limited improvements in energy data collection likely to be made. Moreover, he found that regional gasoline demand elasticities differ from aggregate national ones, and that not only are there regional variations in electricity consumption behavior, but also seasonal variations in demand that must be estimated—impossible with the data currently available. The conference volume (42) is an attempt to clarify future directions for data, estimation, and demand modeling. Since 1980 three National Household Energy Surveys have been made of the stocks of appliances and facilities within Australian households, and their usage over a week. These, together with better price information from energy utilities, may help to provide better demand data in the future.

CONSERVATION PROGRAMS Australian governments have eschewed the use of direct controls over energy consumption. In 1979 the National Energy Conservation Program to increase public awareness was launched, followed by the National Industrial Energy Management Scheme for industrial and commercial energy users. Since 1980, in coordination with automobile manufacturers, the Commonwealth has monitored the national average fuel consumption (NAFC) of new passenger cars under a voluntary program of fuel consumption goals; from an estimated level of 11.2 liters/100 km in 1979, the NAFC had fallen to 9.4 liters/100 km in 1983, slightly behind the goal of 9.0 liters/100 km; the 1987 target is 8.0 liters/100 km (6). In 1983 the Australian Minerals and Energy Council instituted a voluntary energy labeling scheme for refrigerators, freezers, and other appliances. There is mandatory labeling in Victoria, and it is under consideration in NSW.

Supply Aspects

SELF-SUFFICIENCY IN LIQUID FUELS Folie & Ulph (26) examined claims that, in the face of dwindling indigenous crude oil reserves and the risk that overseas supplies could be disrupted, Australia should reduce its supply insecurity by increasing its self-sufficiency in liquid fuels. It has recently been estimated that for each percentage point drop in the level of oil self-sufficiency from its 1984 level of 74%, the country's import bill rises by around $A90m, or 0.5% of exports (43). Apart from the fiscal importance of domestic crude oil production, there is the economic cost that an embargo would impose with a low level of self-sufficiency.

Folie & Ulph concluded that a dwindling level of self-sufficiency might not occur under a wide range of scenarios (of world oil prices, of income paths, and of supply patterns), or not at least until the 1990s (some 15 years after they were writing). A recent industry study (44) asserts that

with no new oil discoveries, self-sufficiency will fall to 65% in 1990, and to under 20% by 2000 (with no new oil discoveries or the production of synthetic fuels after 1995). Folie & Ulph argued that any balance-of-payments problems looming in response to greater oil imports should be tackled by switching resources into all traded-goods sectors, not just the oil import-competing sector. Moreover, to protect against any short-term import uncertainty they advocated stockpiling oil, instead of the more costly strategy of attempting to increase self-sufficiency by subsidizing the price of indigenous crude or such substitutes as shale-oil production or coal liquefaction. Stocks held by the oil corporations fluctuate with supply and industrial conditions. Given the absence of a complete set of competitive future and contingent markets, Folie & Ulph argued that some government provision of stockpiling would be justified. However, since their study was published, as Harris (45) points out in his exhaustive review of social aspects of energy in Australia, there has been scant analysis of the policy of oil stockpiling for Australia (46).

For an exhaustible resource, the concept of self-sufficiency is not as clear-cut as for a nonexhaustible resource, when all relevant quantities are flows: the higher the sustainable domestic flow as a proportion of total production, the greater the degree of self-sufficiency. It is not clear whether self-sufficiency of an exhaustible resource should refer to the domestically produced proportion of today's consumption, or to the husbanding of domestic reserves for drawdown in times of import shortages (47). The adverse effects on exploration and development of attempts to restrict domestic production may neutralize attempts of a small, open country to conserve its reserves, especially if they are small relative to long-run consumption.

RESOURCE RENT TAX Although the previous government had in 1978 abandoned the proposal for a resource rent tax (RRT), in 1983 the newly elected Labor government reintroduced the proposal of replacing the crude oil levy and other resource taxes by an RRT on the production of oil, natural gas, and coal, as well as nonenergy minerals. There is a wide variation in both the type and level of resource taxes across Australian jurisdictions (48), partly as a result of the legal and political struggles of rent-seeking governments to gain or retain the power to tax resource companies, not only directly but also indirectly with, for example, excessive railroad charges (49). Traditional forms of taxation, such as the crude oil levy (a unit excise tax in dollars/bbl) and ad valorem taxes (equal to a percentage of the price), by increasing the cost of production can result in premature abandonment of the well or mine, a dead-weight loss. The RRT is closer to a nondistortionary tax on "economic rent," the return to

owners of the well or mine in excess of the minimum necessary to induce them to continue operating. Under the RRT to be introduced in Australia, the tax rate is to be 40% on net income above a threshold rate of return equal to 15 percentage points above the bond rate, and unsuccessful projects will be denied loss offsets (47). The rationale is that, since such income is virtually pure economic rent, taxing it will not discourage production, given the risk premium of 15 percentage points above the risk-free rate (50, 51). But critics of the RRT (52) fear that the asymmetrical treatment of profits and losses will result in a strong ex ante disincentive for exploration, and argue that its advocates have overlooked the effects of uncertainty. Others (47, 53) argue that the least distortionary method of appropriating rent is a system of cash bonus bidding for exploration leases, perhaps in conjunction with an RRT.

Opposition from the states and the mining corporations, through the Australian Mining Industry Council, stymied the Commonwealth's efforts to replace onshore production taxes with an RRT, and by March 1984 the Commonwealth announced that it would restrict the scope of the proposed RRT to offshore oil projects that had not reached the development stage ("greenfields"). The RRT legislation had not been introduced at time of writing (February 1986), but the tax will take effect from July 1, 1984. In June 1985 it was announced that a version of the RRT would replace existing excises and royalties on Barrow Island, WA, oil production, and that the revenues would be shared between the WA and Commonwealth governments in the ratio 25 : 75 (21). This may provide a model for other onshore agreements. In November 1985 the Commonwealth introduced cash bidding for prospective leases in the Timor Sea, deregulating the lease-allocation process despite the objections of the Australian Petroleum Exploration Association.

ENERGY GRIDS In 1973 the Commonwealth foresaw a network of pipelines across the country, bringing natural gas from remote fields to consumers (54). Completion of pipelines from the Cooper Basin to Sydney and Canberra, and from the North West Shelf to Perth, have brought that realization closer, but a transcontinental pipeline to the southeast from the North West Shelf and the Amadeus Basin in central Australia remains uneconomic, as does a link from Victoria to NSW. After completion of a pipeline from the Amadeus Basin, Darwin's gas and electricity needs will be independent of coal supplies. Export parity prices for natural gas and depletion of smaller, eastern basins may hasten construction of other links.

The benefits of proposed north-south links between the eastern states' electricity grids are outweighed by their costs (55), but Victoria and SA have announced plans to share power to take advantage of their half-hour time-zone difference by extending the high-voltage line west from the Alcoa

smelter at Portland, Victoria. NSW is also looking at future links (56), apart from the existing link between NSW and Victoria via the Snowy Mountains scheme.

DEREGULATING OIL The southwestern Pacific has recently been in something of a deregulation fever. Both Australia and New Zealand have removed barriers to the unfettered operations of their financial sectors, and the Australian government is cautiously studying the introduction of a free market in crude oil. Exports of Bass Strait crude oil have been allowed since 1983, and in 1984 the government deregulated any Bass Strait annual production above 350,000 bbl/day. The government's export controls (also used for exports of coal, uranium, natural gas, and LPG) enable it to prevent exports or to levy an export tax, as in the case of some black coal. (Under the Commonwealth's new uranium policy, exports from the two existing mines and the proposed new mine at Olympic Dam, SA, will be permitted, subject to strict conditions related to IEA safeguards and nonproliferation of nuclear weapons.)

The government argues (57) that the crude oil allocation scheme and IPP policy have resulted in stability for producers (especially the small ones) and refineries, at some cost in terms of efficiency and flexibility. Since Australian crudes are too light for the production of heavy fractions, the surplus has been exported, and heavier crude imported. A free market (with some safeguards for small producers) would lead to more competition and prices possibly lower than Import Parity. It would also continue to provide exploration incentives. A more flexible form of the crude oil levy—"reference" prices with ex post adjustments to tax payments—could cope with a free market, with a two per cent fall in net excise receipts for each $A1/bbl drop below current prices. Short-term emergencies would require reimposition of export controls.

For production from the prospective fields in the Timor Sea, southeast Asian refineries might offer better prices than southeast Australian refineries; for Perth, Darwin, and Brisbane, imported refined products might be cheaper than domestically refined products. This would exacerbate the distortions that the Prices Surveillance Authority currently maintains with its uniform capital-city base wholesale prices, and raises questions about the desirability of government intervention in the pricing of other fuels as well as refined petroleum products. The oil price slump of 1986 increased the pressures for deregulation.

Pricing Aspects

I believe that Australia has been well served in one respect by successive Commonwealth governments. Perhaps because oil exploration and production have been in the hands of private corporations since oil was first

discovered in Australia in 1953, prices have played an important role in governments' responses to changes in the price and availability of imported oil. Price was used in the decision to encourage production of the Gippsland Basin in 1969; the price for "new" oil was set at world parity in 1975 as an incentive for further exploration and development; domestic refineries—and so Australian petroleum users—have had to pay world parity prices from August 1978. The government in 1978 priced LPG at import parity for domestic users, but political pressures led to lower controlled prices for some users from 1980 to 1985, when world parity was again achieved (21).

Edwards (58) examines possible justifications for government intervention in energy markets to set energy prices at other than competitively determined levels: to take advantage of world market power if it exists, to make users pay for transport infrastructure, to raise revenue through energy taxation, to increase energy self-sufficiency, and to redistribute among regions and economic sectors. He concludes that the only intervention appropriate is that which raises the user price of energy, especially that of liquid fuels. In arguing that setting energy prices below the free-market level to promote distributional goals is an extremely costly method of income redistribution, he is agreeing with Porter (38). (Policy responses to the 1986 oil price slump are discussed above in the context of Import Parity Pricing.)

ELECTRICITY Prices for domestic sales of coal, natural gas, and electricity are not determined at world parity or by the Commonwealth. The Treasury (30) pointed out that black coal exports take place under privately negotiated contracts, with producers receiving world prices for their product (less any export duty payable to the government), and that private domestic users generally pay prices that permit returns to producers comparable with those from export sales. An exception to this is the supply of coal used by state electric utilities, many of which obtain coal at prices well below world parity, either through the direct ownership of coal mines or through preferential supply arrangements for particular grades of steaming coal. The Treasury argued that electricity tariffs should be set as if world parity prices had been paid, which would encourage conservation while allowing gains from special arrangements to accrue to the community as a whole.

It is not clear whether electricity tariffs have followed this rule since, despite governmental public ownership, there has been a tendency for the utilities to keep their commercial arrangements with large users confidential. This has led to accusations of politically motivated cross-subsidization, especially in the heat of the debate on the proposed construction of the

Gordon-below-Franklin Dam by the Tasmanian Hydro-Electric Commission. Recently the State Electricity Commission of Victoria has pledged that all long-term tariffs for very large, high-load-factor customers "will be made public and will not involve elements of subsidy by either other electricity customers or the taxpayer" (15). As Swan (5a, 59) has argued, the rate of return on capital invested must reflect its opportunity cost to the community. Using market measures of the riskiness of the industry, he estimates that the appropriate real pre-tax cost of capital for Australian governmental electric utilities is eight per cent per annum or higher (59). The Victoria government has announced that energy utilities in that state must set their prices to move towards a target real rate of return on their assets of four per cent per annum, which it claims "represents the long-term opportunity cost of debt and equity capital," to encourage more productive use of the assets (15). Moreover, to encourage a shift of load from peak to off-peak periods, greater use of time-of-day pricing is necessary, although, as Donnelly (39) argues, lack of adequate data has precluded estimation of electricity demand sensitivity to such pricing. Electricity tariffs have been used by state governments as redistributive instruments among user classes.

NATURAL GAS Gas prices charged at the wellhead are generally based on long-term contracts negotiated at the commencement of production, and are, according to the Treasury (30), well below current "world" prices for alternative energy forms, especially after allowance is made for gas's nonprice advantages over petroleum products: relative price stability, lower user handling and storage costs, and lower pollution control costs. Moreover, as with the capital invested in electricity generation, pipeline systems financed by public authorities have not always been required to earn rates of return reflecting private opportunity costs, which has led to inefficiencies in production and consumption.

In production, low prices tend to discourage optimal recovery and exploration, which may also adversely affect oil discovery. In consumption, low prices tend to encourage overuse at the expense of substitutes, such as coal, which may be more readily available. The Treasury (30) argued that persistent, low prices would encourage waste, discourage exploration, and lead to premature depletion of reserves. Recently the Victoria government has moved to reduce the relative price advantage of natural gas with respect to off-peak electricity (15). At the same time, the State Energy Commission of WA, with a take-or-pay contract for natural gas piped from the North West Shelf, is locked into a position of serious oversupply because of a gross overestimate of expected demand. Indeed, the federal government has been forced to surrender its future royalties to reimburse

the state government for financing problems caused by the contract (60, 61). The Commonwealth does not have the power to set gas prices at world parity, even when, as is the case of SA gas from the Cooper Basin supplying NSW consumers in Sydney, the gas crosses state borders. There is always the potential for the states to compete by offering gas at low long-term prices to encourage new industry. The Minerals and Energy Council may not be sufficient to prevent this occurring, although the Western Australian example is not apparently due to state rivalry. The Commonwealth could exercise more leadership by, for example, convincing the Loans Council to require that commercial rates of return be used for the capital investment of pipelines and electricity generation plant when such capital is borrowed overseas (for which Loans Council approval is necessary). There are limits on the states' powers, as Victoria found when the High Court thwarted its attempt to tax natural gas passing through its pipeline from the Bass Strait fields.

Other Aspects

We have argued above that policy analysts may have emphasized energy supply at the expense of consumption, pricing, and external aspects. Similarly, emphasis on distributional and environmental aspects has been evident from protests against nuclear power in other countries, and from concern with pollution, uranium mining, and exploration and mining in (state-controlled) National Parks (62) in Australia. In the long run, conflicting pressures between environmental concerns and the desire to produce and consume more energy can only grow.

Twelve years after the first oil price rise, the most complete statement of Commonwealth energy policy to date is a 1979 paper (31) concerned mainly with the cost, availability, and degree of self-sufficiency of liquid fuels. (Reflecting an unpublished Green Paper on Australian energy policy, it falls short of defining clear "energy strategies.") Saddler (18) argues that because of the pervasive effects of the various processes of energy extraction, conversion, transport, and use—effects on the transport system, on property values, on the environment, on government borrowing and investment, on industrial relations, on foreign investment, and on future availability of fossil fuels—any national energy policy must encompass the political and social issues raised, as well as those of the economics of liquid-fuel supply. In this he has been supported by Diesendorf (31), Crossley et al (63), Richards (64), and the Institution of Engineers (65).

MACROECONOMIC IMPACTS Australia has its own version of the "Dutch disease" or "deindustrialization," known as the Gregory thesis. Gregory (66) argues that, under full employment, small-country assumptions,

increased exports from the mining sector, at a time of buoyant world prices, would result in an increase in imports and a reduction in traditional nonmineral exports, such as agricultural commodities. In the late 1970s, as the rising price of oil stimulated Australian exports of coal and uranium, there were fears that such sectoral shifts would permanently harm the agricultural sector (67). Today, with steady or falling world prices, and with an Australian dollar effectively devalued more than 20% since early 1985—partly in response to large foreign borrowings in the early 1980s for energy infrastructure—there is little discussion of these possibilities (68).

CONCLUSION

We have attempted to demonstrate that the only significant policy response of the Commonwealth to the rises in energy prices in the past twelve years has been the Import Parity Pricing of indigenous crude oil in conjunction with the crude oil levy. As the world price of oil—and hence the price of Australian petroleum products—rose, the fall in coal's share of TE consumption in Australia was halted and reversed, and oil's share of TE consumption fell, while energy users substituted other fuels for oil, and exploration for new oil reserves accelerated. But is response to external events enough?

Energy is important to Australia. The levy has raised up to eight per cent of the central government's annual revenues. The country has been well placed to respond to the higher world demand for traded coal that has accompanied the oil price rises, and is now the world's largest coal exporter. But as a nation Australia has not adequately faced the issue of the best use of her energy resources.

We have outlined other measures the government has taken to augment energy supply, and the voluntary programs to reduce demand, especially for liquid fuels. Government funds for energy-related research have been directed at alternative energy sources, with possible long-run payoffs, but only rarely at research in understanding the demand side. However, it is difficult to deny that at all levels, "ad hoc expediency still characterizes much of Australia's [energy] policy-making" (69).

Through its control over offshore oil production, the Commonwealth has been able to impose IPP and the crude oil levy; through its export controls it has power over coal and uranium exports. But, in the federal structure of Australia's energy economy, it is the states that control the production and pricing of natural gas and electricity. A world price for crude oil but states' control over gas and electricity prices has resulted in inefficient allocation decisions, as states' rivalries have maintained under-

pricing of these two forms of energy. Moreover, the federal separation of powers may partly explain the lack of a coherent Commonwealth response to the need for a consistent energy policy. Energy consumption is not an end in itself; the demand for energy is derived from the demand for final goods and services. The advantage of this fact is that it may be possible to achieve the final output (of warmth, food, shelter, transport) by using substitute fuels, or by using less energy altogether. The disadvantage is that energy use is inseparably intertwined with our economic, political, and social lives. The Commonwealth has been developing a liquid fuels policy, not an energy policy. A comprehensive Commonwealth energy policy would at a minimum consider the environmental and social consequences, as well as the economic consequences, of changes in the supply (the relative prices and the availability) of energy sources, of changes in the technology of energy production and transformation, and of changes in patterns of energy use. Such a policy need not be interventionist, but reliance on market or quasi-market allocations should not preclude knowledge and understanding of these wider impacts.

In an analysis of market and nonmarket perspectives on energy policy, Gruen & Hillman (70) compare the implicit philosophies of the Treasury submission (30) and the aborted Green paper on energy policy, respectively. They refer to Wright's (71) notion of a "political" good as "one that is systematically and persistently allocated on grounds other than economic efficiency," and argue that the Treasury submission can be viewed as an argument against categorization of energy as a political good. The moves towards deregulation of Australian crude-oil production and use can be seen as evidence that the Treasury view has prevailed, even with a Labor government. Galligan (72) and Nemetz et al (73) suggest that it might have happened by default; "market-based policy is easier to implement and consequently more likely to be used in a federal system than is a government directive system" (72).

There are three concerns with a default market system: long-run effects, price fluctuations, and distributional effects. As Folie & Ulph (74) and Nemetz et al (73) note, absence of a complete set of contingent markets often results in myopic marginal adjustments. The exhaustibility of Australia's oil reserves means that intertemporal market allocation may not be socially optimal. However, the government is presently encouraging indigenous production, which is evidence that it may have a higher discount rate than that of the market. There might also be a role for government intervention to smooth fluctuations in domestic energy prices in response to unstable world commodity markets (73) if such fluctuations inhibit appropriate development and investment; there is no evidence of this occurring, however. Both Saddler (18) and Galligan (72) express

concern at the effects of market allocation on the balance of wealth and power in Australia, particularly in the case of oil corporations. However, it remains to be shown that changes in this balance, if any, have adversely affected the efficiency of energy allocation and the well-being of Australians.

Australia's policies towards energy are a consequence of the federal structure, the historical patterns of public/private ownership of energy supplies, capital investments that embody previous decisions on fuels, evolving knowledge about Australia's energy resources, and existing patterns of energy end use. None of these is likely to change quickly. But will Australia's energy policies encourage the most efficient use of her energy resources, subject to environmental and social considerations? In the absence of another world oil crisis, these abundant resources will likely offset the lack of broad analysis and cooperative planning that would constitute an Australian energy policy.

ACKNOWLEDGMENTS

I wish to thank John Stringer for his insights and comments, an anonymous referee, and the staff of the AGSM Library for their assistance in obtaining papers and data.

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Annual Review of Energy
Volume 11, 1986

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