

Chapter Seventeen

# Mining and Energy

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Prior to the 1995 Year Book, the subjects of this chapter were covered in two separate chapters — Mining and Minerals; and Energy. Because of the interrelationships, the two subjects are now combined in this chapter.

## THE MINING INDUSTRY

Mining, as defined in the 1993 edition of the *Australian and New Zealand Standard Industrial Classification (ANZSIC)* (1292.0), broadly relates to the extraction of minerals occurring naturally as solids such as coal and ores; liquids such as crude petroleum; or gases such as natural gas.

The mining sector contributed \$17,315 million or 4.3 per cent of Australia's Gross Domestic Product (GDP) in 1992–93.

### Main features of 1992–93

Table 17.1 provides a summary of the operations of the mining industry in 1992–93. Turnover increased in the mining industry by two per cent to \$28,980.9 million whilst employment in the industry dropped by five per cent to 58,047 people.

The industries most responsible for the rise in turnover were oil and gas, up \$378.6 million to \$8,456.1 million; and coal, up \$409.0 million to \$9,259.1 million. Other industries to increase turnover were copper ore, up \$261.6 million to \$893.3 million and bauxite, up \$23.5 million to \$778.1 million.

Industries that declined in turnover were: silver-lead-zinc ore, down \$173.0 million to \$955.7 million; other metal ores, down \$144.8 million to \$824.5 million; iron ore, down \$80.3 million to \$3,262.6 million; mineral sands, down \$56.0 million to \$502.5 million; and gold ore, down \$9.2 million to \$4,048.9 million.

Table 17.2 contains a summary of the operations of the mining industry in 1992–93, by State and Territory.

## Mineral production

Australian production in the metallic minerals, coal, oil and gas sectors for 1992–93 was valued at \$26,721.3 million, an increase of 2.8 per cent over the previous year (table 17.3). Metallic mineral production dominated with \$10,920.3 million or 40.9 per cent of the total, while coal was 28.4 per cent of the total and oil and gas 30.7 per cent.

By value, the two largest components of metallic mineral production were gold and iron ore which accounted for \$3,961.8 million and \$3,025.6 million, respectively, or a combined share of 64.0 per cent.

Western Australia accounted for both the largest share of metallic mineral production with \$7,390.8 million or 67.7 per cent, and the largest share of total mineral production with \$10,285.9 million, 38.5 per cent of the total.

The increase in the value of mineral production in 1992–93 was due to the oil and gas industry which rose to \$8,216.2 million from \$7,811.8 million in 1991–92. This represented a rise of \$404.4 million or 5.2 per cent.

The value of metallic minerals decreased marginally, falling 0.3 per cent while the value of coal production rose 5.1 per cent primarily due to increased prices. The total value of the coal industry (excluding Tasmania) was \$7,584.8 million in 1992–93. New South Wales and Queensland are the major coal producing States with 44.2 per cent and 46.9 per cent of the market, respectively.

In 1992, Australia remained the world's largest producer of bauxite (38.1% of total world production); diamonds (36.4%); lead (16.4%); and the mineral sands concentrates of ilmenite (55.4%), rutile (43.9%) and zircon (39.2%).

17.1 MINING: SUMMARY OF OPERATIONS BY INDUSTRY  
(\$ million)

Items	Coal		Oil and gas		Iron ores		Bauxite		Copper ores		Gold ores	
	1991-92	1992-93	1991-92	1992-93	1991-92	1992-93	1991-92	1992-93	1991-92	1992-93	1991-92	1992-93
INCOME AND EXPENDITURE												
Turnover(a)	8,850.1	9,259.1	8,077.5	8,456.1	3,342.9	3,262.6	754.6	778.1	631.7	893.3	4,058.1	4,048.9
Plus closing stocks	753.2	758.0	205.3	220.3	357.2	333.3	42.6	44.8	108.4	151.8	541.9	577.6
Less opening stocks	756.8	775.1	164.1	221.5	306.7	363.2	45.4	42.8	92.6	103.5	562.6	550.8
Less purchases, transfers in & selected expenses	4,068.2	3,968.8	643.2	735.0	981.3	998.0	220.6	248.0	224.5	291.6	1,974.4	1,981.9
Value added	4,778.4	5,273.2	7,475.5	7,720.0	2,412.1	2,234.7	531.2	532.2	423.0	650.0	2,063.0	2,093.8
FIXED CAPITAL EXPENDITURE												
Fixed capital expenditure less disposals	502.9	884.4	1,573.0	1,621.8	287.0	408.0	26.3	65.0	93.2	87.9	446.0	477.5
EMPLOYMENT DETAILS												
Establishments at 30 June (no.)	143	148	102	101	17	18	11	11	9	13	157	152
Employment at 30 June (no.)(b)	26,990	26,687	5,046	4,987	8,392	7,001	2,153	1,917	2,351	2,512	7,665	7,586
Wages and salaries (\$m)(c)	1,727.8	1,774.1	373.3	377.3	466.7	439.8	96.9	86.7	112.9	132.5	359.9	346.9

For footnotes see end of table.

17.1 MINING: SUMMARY OF OPERATIONS BY INDUSTRY — continued  
(\$ million)

	Mineral sands		Silver-lead-zinc ores		Other metal ores(d)		Total metal ores		Total coal, oil and gas and metal ores	
	1991-92	1992-93	1991-92	1992-93	1991-92	1992-93	1991-92	1992-93	1991-92	1992-93
INCOME AND EXPENDITURE										
Turnover(a)	558.5	502.5	1,128.7	955.7	969.3	824.5	11,443.8	11,265.7	28,371.4	28,980.9
Plus closing stocks	161.3	127.9	198.0	157.8	212.4	187.8	1,621.7	1,580.9	2,580.3	2,559.2
Less opening stocks	166.5	136.9	204.9	207.3	196.3	205.2	1,575.1	1,609.7	2,496.0	2,606.3
Less purchases, transfers in & selected expenses	287.7	291.0	548.3	545.2	364.2	365.0	4,601.1	4,720.7	9,312.5	9,424.5
Value added	265.5	202.4	573.5	361.0	621.2	442.1	6,889.4	6,516.1	19,143.2	19,509.3
FIXED CAPITAL EXPENDITURE										
Fixed capital expenditure less disposals	72.0	23.2	188.9	92.1	108.0	208.3	1,221.4	1,362.0	3,297.3	3,868.1
EMPLOYMENT DETAILS										
Establishments at 30 June (no.)	21	19	17	17	22	14	254	244	499	493
Employment at 30 June (no.)(b)	1,833	1,862	4,386	3,480	2,532	2,015	29,312	26,373	61,348	58,047
Wages and salaries (\$m)(c)	78.2	71.3	214.1	193.8	137.2	107.7	1,465.9	1,378.7	3,566.9	3,530.1

(a) Includes transfers out to other establishments of the same management unit where appropriate. (b) Includes working proprietors. (c) Excludes amounts drawn by working proprietors. (d) Includes nickel ore mining.

Source: Mining Industry, Australia (8402.0).

**17.2 MINING: SUMMARY OF OPERATIONS BY STATE/TERRITORY**  
(\$ million)

<i>Items</i>	<i>New South Wales(a)</i>		<i>Victoria</i>		<i>Queensland</i>		<i>South Australia</i>	
	<i>1991-92</i>	<i>1992-93</i>	<i>1991-92</i>	<i>1992-93</i>	<i>1991-92</i>	<i>1992-93</i>	<i>1991-92</i>	<i>1992-93</i>
<b>INCOME AND EXPENDITURE</b>								
Turnover(b)	4,551.0	4,662.5	3,630.6	4,073.6	6,477.5	6,751.2	1,095.1	1,093.4
Plus closing stocks	487.1	456.8	61.5	45.9	661.5	699.7	87.1	93.1
Less opening stocks	468.4	510.7	46.1	62.7	680.2	645.0	96.5	93.2
Less purchases, transfers in & selected expenses	2,162.1	2,120.2	170.9	196.4	2,828.5	2,783.7	233.5	204.9
Value added	2,407.7	2,488.4	3,475.1	3,860.4	3,630.2	4,022.2	852.2	888.4
<b>FIXED CAPITAL EXPENDITURE</b>								
Fixed capital expenditure less disposals	430.4	399.3	253.9	244.3	442.8	767.0	93.8	140.7
<b>EMPLOYMENT DETAILS</b>								
Establishments at 30 June (no.)	99	102	11	16	123	126	16	16
Employment at 30 June (no.)(c)	17,819	16,833	1,031	1,082	15,667	15,432	2,269	2,237
Wages and salaries (\$m)(d)	1,128.0	1,122.0	124.5	103.7	893.3	920.0	96.5	104.5

  

	<i>Western Australia</i>		<i>Tasmania</i>		<i>Northern Territory</i>		<i>Australia</i>	
	<i>1991-92</i>	<i>1992-93</i>	<i>1991-92</i>	<i>1992-93</i>	<i>1991-92</i>	<i>1992-93</i>	<i>1991-92</i>	<i>1992-93</i>
<b>INCOME AND EXPENDITURE</b>								
Turnover(b)	10,707.9	10,575.9	382.6	330.4	1,526.7	1,493.9	28,371.4	28,980.9
Plus closing stocks	971.3	984.1	59.3	48.9	252.7	230.7	2,580.3	2,559.2
Less opening stocks	924.5	980.4	58.5	58.3	221.8	256.0	2,496.0	2,606.3
Less purchases, transfers in, & selected expenses	3,438.8	3,641.2	179.2	173.8	299.4	304.2	9,312.5	9,424.5
Value added	7,315.9	6,938.5	204.1	147.1	1,258.2	1,164.3	19,143.2	19,509.3
<b>FIXED CAPITAL EXPENDITURE</b>								
Fixed capital expenditure less disposals	1,891.6	2,209.1	31.7	29.0	153.1	78.7	3,297.3	3,868.1
<b>EMPLOYMENT DETAILS</b>								
Establishments at 30 June (no.)	202	189	11	9	37	35	499	493
Employment at 30 June (no.)(c)	21,088	19,543	1,716	1,526	1,758	1,394	61,348	58,047
Wages and salaries (\$m)(d)	1,140.5	1,111.9	92.6	89.1	91.5	78.9	3,566.9	3,530.1

(a) Includes the Australian Capital Territory. (b) Includes transfers out to other establishments of the same management unit where appropriate. (c) Includes working proprietors. (d) Excludes amounts drawn by working proprietors.

Source: Mining Industry, Australia (8402.0).



## 17.3 MINERAL PRODUCTION, STATES AND AUSTRALIA, 1992-93

Mineral	Units	Australia						1992-93				
		1990-91	1991-92	NSW	Vic.	Qld	SA	WA	Tas.	NT	Australia	
Metallic minerals												
Bauxite	'000 tonnes	41,831	34,788	—	—	8,770	—	26,448	—	5,728	40,946	
Copper concentrate	'000 tonnes	(a)1,004	(a)915	175	55	827	n.a.	75	108	14	(a)1,254	
Gold bullion (dore)	kg	264,993	259,656	10,309	3,118	47,194	—	195,259	275	19,176	275,331	
Iron ore	'000 tonnes	111,475	114,781	—	—	—	2,514	111,730	1,459	—	115,703	
Iron oxide for												
Cement manufacture	tonnes	89,585	104,569	14,773	—	10,785	—	—	83,344	—	108,902	
Coal washing	tonnes	229,452	204,285	45,670	—	21,046	—	—	155,094	—	221,810	
Lead concentrate	'000 tonnes	870	858	319	—	393	—	28	162	28	930	
Manganese ore	'000 tonnes	1,488	1,238	—	—	—	—	251	—	1,174	1,425	
Mineral sands												
Ilmenite concentrate	'000 tonnes	1,328	1,424	7	—	157	—	1,352	—	—	1,516	
Leucoxene concentrate	'000 tonnes	24	12	—	—	—	—	11	—	—	11	
Monazite concentrate	'000 tonnes	7	7	—	—	—	—	6	—	—	6	
Rutile concentrate	'000 tonnes	202	169	50	—	59	—	76	—	—	185	
Zircon concentrate	'000 tonnes	317	342	45	—	53	—	302	—	—	400	
Nickel concentrate	'000 tonnes	510	476	—	—	—	—	522	—	—	522	
Nickel ore	'000 tonnes	1,133	831	—	—	259	—	—	—	—	259	
Tantalite-columbite concentrate	tonnes	703	873	—	—	—	—	537	—	—	537	
Tin concentrate	tonnes	10,957	10,995	19	—	79	—	209	12,080	—	12,387	
Uranium concentrate (U308)	tonnes	(a)2,913	(a)2,901	—	—	—	n.a.	—	—	1,342	(a)1,342	
Zinc concentrate	'000 tonnes	1,810	1,927	602	—	622	—	263	454	70	2,011	
Other metallic minerals	tonnes	101,418	91,113	6,805	—	19,816	1,179	—	95,099	9	122,908	
Total value of metallic minerals	\$'000	10,909,859	10,957,237	465,379	89,967	1,702,212	287,130	7,390,763	(b)310,224	674,566	10,920,259	
	(b)	(b)									(b)	

For footnotes see end of table.

## 17.3 MINERAL PRODUCTION, STATES AND AUSTRALIA, 1992-93 — continued

Mineral	Units	Australia							1992-93	
		1990-91	1991-92	NSW	Vic.	Qld	SA	WA	Tas.	NT Australia
Saleable coal										
Black coal	'000 tonnes	166,505	176,570	84,211	—	85,302	2,778	5,428	251	—
Brown coal	'000 tonnes	48,884	51,452	—	48,428	—	—	—	—	—
<b>Total value of coal</b>	<b>\$'000</b>	<b>6,753,719</b>	<b>7,216,392</b>	<b>3,351,286</b>	<b>379,419</b>	<b>3,555,055</b>	<b>54,691</b>	<b>244,312</b>	<b>n.p.</b>	<b>—</b>
Oil and gas										
Crude oil-stabilised(d)	mega litres	29,189	31,984	—	17,804	1,180	1,662	6,533	—	3,413
Natural gas	giga litres	15,593	16,289	—	6,823	1,314	4,200	3,960	—	334
Ethane	giga litres	175	182	—	171	—	16	—	—	—
Liquefied petroleum gases	mega litres	3,517	3,638	—	2,741	136	852	—	—	—
Liquefied natural gases	'000 tonnes	3,577	4,250	—	—	—	—	4,922	—	—
<b>Total value of oil and gas</b>	<b>\$'000</b>	<b>8,629,350</b>	<b>7,811,764</b>	<b>—</b>	<b>n.p.</b>	<b>261,988</b>	<b>n.p.</b>	<b>2,650,804</b>	<b>—</b>	<b>675,733</b>
<b>Total value of metallic minerals, coal and oil and gas</b>	<b>\$'000</b>	<b>26,292,928</b>	<b>25,985,393</b>	<b>3,816,665</b>	<b>n.p.</b>	<b>5,519,255</b>	<b>n.p.</b>	<b>10,285,879</b>	<b>310,224</b>	<b>1,350,299</b>

(a) Excludes South Australia. (b) Includes Tasmanian coal production. (c) Excludes Tasmania. (d) Includes condensate.

Source: Mining Production, Australia (8405/0).

## Exports

Australia is the world's largest exporter of black coal, alumina, diamonds and ilmenite, rutile and zircon; the second largest exporter of iron ore, aluminium, lead and zinc; and the third largest exporter of gold.

Exports of mining products rose in value by 8.4 per cent in 1992-93 to \$15,860 million or 26.1 per cent of total merchandise exports. This followed a rise of 2.6 per cent in 1991-92.

The percentage contributions of the major mineral products to total exports have remained fairly stable over the period 1990-91 to 1992-93. Black coal remains the largest single export item and the main mineral exported, with a value of \$7,538 million in 1992-93, 12.4 per cent of total exports. Gold was the next most valuable mineral exported with a value of \$4,315 million in 1992-93. Other major exports were iron ore (\$2,895 million, 4.8% of total exports), crude oil (\$1,801 million, 3.0%), zinc ores (\$539 million, 0.8%) and uranium (\$125 million, 0.2%).

Exports of mining products together with basic manufactures of mineral origin grew by 5.6 per cent in 1992-93 following growth of one per cent in 1991-92. However, as a proportion of total exports they declined from 41 per cent in 1991-92 to 40 per cent in 1992-93.

The major contributors to the export value increase in 1992-93 were coking coal, up \$537 million (13%) to \$4,542 million; refined gold, up \$299 million (7%) to \$4,302 million (with about 40% of the increase attributable to gold of overseas origin); crude oil, up \$231 million (14%) to \$1,852 million; liquefied natural gas (LNG), up \$208 million (25%) to \$1,051 million; steaming coal, up \$158 million (6%) to \$2,891 million; aluminium metal, up \$151 million (10%) to \$1,723 million; and copper, up \$82 million (12%) to \$790 million.

The only commodity which recorded a substantial decrease in export value in 1992-93 was uranium, which fell \$122 million (50%) to \$123 million. Commodities recording smaller falls were bauxite, down \$33 million (28%) to \$85 million; zircon concentrate, down \$32 million (34%) to \$61 million; and

iron, ingot steel and ferroalloys, down \$29 million (8%) to \$313 million.

## Imports

In 1992-93, mining sector imports were \$2,551 million, a rise of 41.9 per cent on the 1991-92 total of \$1,798 million.

With the inclusion of basic manufactures of mineral origin, mineral resource imports totalled \$5,594 million in 1992-93. This represents a rise of \$1,215 million (28%) on 1991-92. The dominant contributors to the increase were crude oil, up \$922 million (40%) to \$3,224 million; and refined petroleum products, up \$205 million (45%) to \$660 million.

## Selected commodity review

**Gold** production (content of all minerals) in Australia during 1992-93 was 244,595 kilograms. Western Australia accounted for most production with 73.4 per cent, followed by Queensland with 14.0 per cent, Northern Territory (6.9%), New South Wales (3.2%) and Victoria (1.7%).

Gold is Australia's second biggest export earner, having overtaken wool in 1990-91. In 1992-93 it accounted for 7.1 per cent of total exports at a value of \$4,315 million. The main markets were Singapore (\$1,910 million), Japan (\$816 million) and Hong Kong (\$612 million).

The gold mining industry employed 7,586 people in 1992-93 or 13.1 per cent of total employment in the metallic minerals, coal, oil and gas industries, making it the second highest employer in the mining sector behind coal.

Australia accounts for 11.1 per cent of estimated world gold production, with South Africa being the world's biggest gold producer.

**Iron ore** production in 1992-93 was 115.7 million tonnes of which 93.0 per cent or 107.6 million tonnes was exported. Iron ore mining employs over 7,000 people.

Almost 97 per cent of production takes place in Western Australia's Pilbara region. Iron ore is also mined in South Australia and Tasmania.

Iron ore accounted for \$2,895 million or 4.8 per cent of total exports in 1992-93. Japan is Australia's largest market, taking

nearly half of its exports (49.2% in dollar terms). Other important markets are Korea (16.5%), China (14.8%), Taiwan (4.9%) and Germany (3.4%).

**Bauxite and alumina.** Australia is the world's largest bauxite and alumina producer and the fourth largest aluminium producer.

Bauxite mining employed 1,917 people nationally (June 1993), with mines in Western Australia south of Perth, in the Northern Territory on the Gove Peninsula and in Queensland at Weipa. Generally the bauxite ore is not sold but processed to alumina for sale or for conversion to aluminium. Alumina production reached 12.2 million tonnes in 1992-93 while refined aluminium production was 1.3 million tonnes.

In 1992-93, alumina ranked fifth by value among major commodity exports with 3.8 per cent of total exports, 9.4 million tonnes valued at \$2,302 million; aluminium ranked seventh with 3.4 per cent, 1.1 million tonnes valued at \$2,047 million.

Japan was the major market for aluminium taking 32.3 per cent while East and South East Asia together accounted for over 86 per cent of exports.

**Mineral sands** describes the group of minerals comprising ilmenite, leucoxene, rutile, monazite and zircon, which are produced from deposits on the east and west coasts of Australia. Australia was the world's largest producer of ilmenite (55.4%), rutile (43.9%) and zircon (39.2%) in 1992.

Despite overall increases in the quantity of production of mineral sands, the value of production decreased by 18.0 per cent to \$412.8 million in 1992-93. For the same period, exports were valued at \$236.1 million, a fall of 19.0 per cent from the 1991-92 value.

Ilmenite, leucoxene and rutile are sources of titanium metal and are used in the manufacture of paint and other pigments and as a coating on welding-rod electrodes. Zircon is the major source of zirconium which is a corrosion-resistant metal used in nuclear reactors and chemical processing equipment. Monazite contains certain rare-earth elements and thorium which is used in incandescent gas mantles and as a fuel in nuclear reactors.

Thorium is a radioactive mineral that is about three times as abundant as uranium, but occurs in fewer geological environments and in lower grade accumulation. Most of the world's resources of thorium occur in monazite, which in Australia is produced from titanium-bearing mineral sands. Australia presently supplies about 65 per cent of the world's traded monazite. Exports from Australia of thorium and thorium-containing ores require the approval of the Minister for Primary Industries and Energy under the Customs (Prohibited Exports) Regulations.

**Diamonds** were first extracted in 1982 in Western Australia.

Australia is now the world's largest producer of diamonds (gem and industrial) with 36.4 per cent of world production in 1992. Most of this is from the Argyle Diamond Mine in the Kimberley region of Western Australia. This mine commenced operations in December 1985 and is the world's biggest single producer of diamonds.

In 1992-93, 32.2 mega carats of diamonds (sorted and unsorted) were exported with a value of \$483 million.

**Uranium.** Australia has about 31 per cent of the Western world's low-cost uranium reserves. Deposits occur in the Northern Territory, Western Australia, South Australia and Queensland.

Australia's reasonably assured uranium resources, at December 1992, totalled 462,000 tonnes of uranium recoverable at less than \$US80 per kg U.

The Australian Government maintains its 'three mines' policy with regard to uranium mining, the mines being the Ranger and Nabarlek mines in the Northern Territory and Olympic Dam in South Australia.

The Ranger deposit was discovered in 1969, 250 kilometres east of Darwin, and mining commenced in 1981.

The Nabarlek deposits were discovered in 1970. The Nabarlek 1 deposit is completely mined out and the mine has been on care and maintenance since 1989 while negotiations proceed over the Nabarlek 2 deposits.

The Olympic Dam deposits were discovered in 1975 and mining commenced in 1988.

Production of uranium (contained in uranium oxide) for 1992-93 was 2,293 tonnes, 1,132 tonnes from Ranger and 1,161 tonnes from Olympic Dam.

Uranium oxide exports in 1992-93 were 2,289 tonnes valued at \$123 million.

All Australian uranium production is exported, in the form of yellow cake, principally for use as fuel for nuclear power stations. Minor quantities are used in medical, industrial and scientific applications.

All exports of Australian uranium are subject to the most stringent safeguards which provide assurance that none of the material is diverted from peaceful uses.

The *Nuclear Non-Proliferation (Safeguards) Act 1987* gives domestic effect to Australia's international nuclear non-proliferation obligations which require domestic legislation. The legislation establishes a system of permits for the possession and transport of nuclear material (defined to cover uranium, thorium and plutonium), and other physical items such as equipment and material used in nuclear reactors. The permit and related provisions also deal with the possession and communication of sensitive information about nuclear technology, in circumstances where that information is not already a matter of public record. The legislation is administered by the Australian Safeguards Office.

Australia has no nuclear power stations.

In 1992 Australia produced 11.4 per cent of the world's production (excluding the centrally planned economies).

**Coal.** Black coal is currently the largest source of primary energy in Australia. By world standards, in relation to present population and consumption, Australia is fortunate in the availability of easily worked deposits of coal. The country's main black coal fields are located in New South Wales and Queensland, not far from the coast and the main centres of population.

Of Australia's identified in situ resources of black coal, currently estimated at 72 gigatonnes (Gt), about 51 Gt are considered to be economically recoverable. They are located largely in the Sydney Basin in New South Wales and the Bowen Basin in Queensland. There are other coal-bearing

basins in New South Wales and Queensland, while small deposits are being worked in Western Australia, South Australia and Tasmania.

Black coal production in 1992-93 was 178 million tonnes. Two States dominated black coal production, New South Wales (84.2 million tonnes) and Queensland (85.3 million tonnes). The black coal industry was the single largest employer in the mining sector in 1992-93 employing 26,687 people.

More than half of New South Wales coal production is from underground mines whereas over 90 per cent of Queensland coal production is from open-cut mines.

Black coal produced in South Australia is used for electricity generation as is most of Western Australia's black coal, and by industry in Tasmania.

Black coal is Australia's biggest export earner accounting for 12.4 per cent of the total value of exports in 1992-93 or \$7,538 million, up from \$6,851 million (and down from 12.5% of total exports) in 1991-92. By far the biggest market for Australian coal was Japan which bought 63.9 million tonnes for \$3,761 million, 49.9 per cent of total sales. South Korea bought 15.5 million tonnes for \$917 million (12.1%) and Taiwan 8.3 million tonnes for \$441 million (5.8%).

Two-thirds of black coal production consisting of steaming coal, and hard and soft coking coal is exported.

Australia also produces brown coal in Victoria where it is used for electricity generation. In 1992-93 brown coal production was 48.4 million tonnes.

Australia's measured and indicated resources of brown coal were estimated to be around 41 Gt at December 1992. The main deposits are located in Victoria's Latrobe Valley (over 39 Gt). Small deposits exist in other areas of south Gippsland, in south-eastern Victoria at Gelliondale and in the south-central region at Anglesea, Bacchus Marsh and Altona. Deposits are also known to exist at many places along the southern margin of the continent, and as far north as central Queensland. Large deposits are being tested in the Kingston area of South Australia, the Esperance area of Western

Australia and at Rosevale in the north-east of Tasmania.

Because brown coal has a relatively low specific-energy value and high water content, its utilisation depends on large-scale, low-cost mining and negligible transportation costs in its raw state. In Victoria, the brown coal industry has reached a high degree of sophistication in mining, on-site development of power generation, briquette and char manufacture.

**Crude oil and condensate.** Indigenous production in 1992-93 at 30,592 megalitres (ML) (529 thousand barrels per day) of crude oil and condensate was slightly lower than production in 1991-92 of 31,984 ML. In 1992-93, the Bonaparte Basin produced 3,304 ML of crude oil, nearly 11 per cent of the total indigenous oil production. Production of crude oil from the Gippsland Basin accounts for 58 per cent of total indigenous crude oil production. The North West Shelf was the major producer of condensate during 1992-93 with 58 per cent of indigenous production sourced in that region.

Export volumes of crude oil and condensate increased by 12.6 per cent to 10,098 ML in 1992-93 compared with 1991-92. The main markets were Japan, Indonesia and Singapore. Imports of crude oil and condensate increased by 27 per cent to 19,421 ML.

**Liquefied petroleum gas** (LPG) is a valuable co-product of oil and gas production and petroleum refining. The major constituents of LPG are propane and iso- and normal-butane, which are gaseous at normal temperatures and pressures and are easily liquefied at moderate pressures or reduced

temperature. Operations involving LPG are expensive in relation to other liquid fuels because LPG has to be refrigerated or pressurised when transported and stored. LPG is an alternative transport fuel for high mileage vehicles in urban areas as well as a petrochemical feedstock and a traditional fuel.

Identified economically recoverable resources of LPG at December 1992 of 129,000 ML were concentrated in Bass Strait, the North West Shelf and the Cooper Basin.

Production of naturally occurring LPG in Australia in 1992-93 was 3,729 ML. The major contributors to this total were the Bass Strait fields (2,741 ML or 73% of total production) and the Cooper Basin (852 ML or 23% of total production). About 39 per cent of domestic LPG production is exported (1,480 ML in 1992-93), mainly to Japan. Domestic consumption of 3,532 ML in 1992-93 was met by 1,250 ML of product derived from processing industries, with supply shortfalls being met by naturally occurring product and imports.

**Natural gas.** During 1992-93, 23,953 million cubic metres of natural gas (including liquefied natural gas (LNG)) was produced for domestic consumption and export representing an increase of 6.2 per cent from the 1991-92 production level. A further 7,640 million cubic metres of natural gas from the export phase of the North West Shelf Project was liquefied for shipment to Japan. This export earned \$1,051 million and represented 30 per cent of total Australian natural gas production.

It is estimated that exports of LNG to Japan will continue to expand, rising to a peak of seven million tonnes per year by 1995-96.

#### 17.4 PETROLEUM PRODUCTION

Year	Crude oil and condensate	LPG(a)	Natural gas
	ML	ML	GL
1987-88	31,264	3,923	15,249
1988-89	28,255	3,763	15,772
1989-90	31,993	3,785	20,090
1990-91	31,955	3,547	21,109
1991-92	31,309	3,589	22,564
1992-93	30,703	3,776	23,953

(a) Naturally occurring.

Source: Department of Primary Industries and Energy.

The prospects of further discoveries of petroleum in Australia are considered to be only modest, the most prospective area being the sedimentary basins off the north-west coast. Consistent with the existing pattern of discoveries, undiscovered oil is likely to be of the light, low sulphur type and more gas fields than oil fields should be found. Assessments by the Bureau of Resource

Sciences indicate that there is an average probability of finding at least another 380 giga litres (GL) (2,400 million barrels) of crude oil in Australia. This compares with demonstrated economically recoverable resources of 258 GL (1,622 million barrels) and demonstrated sub-economically recoverable resources of 40 GL (251 million barrels) as at December 1991.

### 17.5 PETROLEUM RESOURCES(a), DECEMBER 1991

<i>Basin</i>	<i>Crude oil</i>	<i>Gas condensate</i>	<i>LPG</i>	<i>Sales gas</i>
	GL	GL	GL	TL
<b>Demonstrated economic resources(b)</b>				
Gippsland (Vic.)	126	22	42	222
Carnarvon (WA)	99	92	77	621
Cooper/Eromanga (SA/Qld)	11	7	11	76
Amadeus (NT) and Bonaparte (WA/NT)	20	2	1	20
Perth (WA)	1	—	—	4
Bowen/Surat (Qld)	—	—	—	—
Canning (WA)	—	—	—	—
Otway (Vic.)	—	—	—	1
<b>Total</b>	<b>258</b>	<b>124</b>	<b>131</b>	<b>944</b>
<b>Demonstrated sub-economic resources(c)</b>				
Gippsland/Bass (Vic./Tas.)	28	3	—	34
Bonaparte (WA/NT)	5	7	12	164
Carnarvon (WA)	4	4	2	378
Cooper/Eromanga (SA/Qld)	—	4	6	41
Browse (WA)	—	32	55	451
Perth (WA)	—	—	—	—
Amadeus (NT)	—	—	—	7
Bowen/Surat/Adavale (Qld)	—	—	—	3
Bass (Tas./Vic.)	2	6	8	10
Otway (SA/Vic.)	—	—	—	—
<b>Total</b>	<b>40</b>	<b>56</b>	<b>83</b>	<b>1,088</b>

(a) Based on the McKelvey classification which subdivides resources in terms of the economic feasibility of extraction and their certainty of occurrence. (b) Demonstrated economic resources are resources judged to be economically extractable and for which the quantity and quality are computed from specific measurements and extrapolations on geological evidence. (c) Demonstrated sub-economic resources are similar to demonstrated economic resources in terms of certainty of occurrence but are judged to be sub-economic at present.

Source: Department of Primary Industries and Energy.

### Mineral processing and treatment

As few minerals can be directly used in the form in which they are mined, most minerals

must undergo processing and treatment before utilisation. Table 17.6 shows the production of the main manufactured products of mineral origin during recent years.

## 17.6 PRODUCTION(a) OF PRINCIPAL MANUFACTURED PRODUCTS OF MINERAL ORIGIN

Commodity		1990-91	1991-92	1992-93
<b>METALS (b)</b>				
<b>Non-ferrous</b>				
Alumina	'000 tonnes	11,402	11,824	12,221
Refined aluminium	'000 tonnes	1,236	1,234	1,301
Refined copper	'000 tonnes	237	r276	312
Lead bullion (for export)(c)	'000 tonnes	176	202	238
Refined lead	'000 tonnes	220	r219	320
Refined zinc	'000 tonnes	320	325	326
Refined tin	tonnes	321	r248	258
<b>Ferrous</b>				
Pig iron	'000 tonnes	5,600	6,394	6,445
<b>Precious</b>				
Refined gold(d)	kg	255,318	281,835	288,188
Refined silver(e)	tonnes	409	382	355
<b>FUELS</b>				
<b>Petroleum products</b>				
Diesel-automotive oil	megalitres	10,284	10,279	10,603
Industrial fuel and marine fuel	megalitres	172	111	87
Fuel oil for burning	megalitres	2,623	r2,571	2,489
Automotive petrol	megalitres	16,454	17,192	17,730
<b>BUILDING MATERIALS</b>				
Clay bricks	millions	1,765	r1,632	1,722
Portland cement	'000 tonnes	6,110	r5,731	6,225
<b>CHEMICALS</b>				
Sulphuric acid	'000 tonnes	986	816	868
Superphosphate(f)	'000 tonnes	1,574	1,337	1,440

(a) Some products exclude production of single establishment manufacturing establishments employing less than four persons and production of establishments predominantly engaged in non-manufacturing activities but which may carry on in a minor way, some manufacturing. (b) Excludes secondary metal with the exception of basic iron. (c) Metallic content. (d) Newly won gold of Australian origin. (e) The unit of quantity for silver has been amended from kilograms to tonnes. (f) Double and triple superphosphate expressed in terms of single phosphate, that is, nine per cent P equivalent.

Source: Australian Bureau of Agricultural and Resource Economics (non-ferrous, precious metals and petroleum products only).

## MINERAL GEOLOGY

Minerals of economic significance occur throughout Australia, their geological age ranging from Pre-Cambrian to recent. Many of the large deposits such as the base metal deposits at Broken Hill (New South Wales), Mount Isa and Hilton (Queensland), McArthur Rivers (Northern Territory), the copper-uranium-gold deposit at Olympic Dam (South Australia); gold deposits of the Kalgoorlie region and iron ore deposits of the Pilbara region, both in Western Australia and the uranium deposits of the Alligator Rivers area of the Northern Territory, are Pre-Cambrian in age. In eastern Australia major deposits such as the Elura, Cobar, Woodlawn, Hellyer and Rosebery base metal deposits, the Renison tin deposit, Kidston, Mount Leyshon and most other gold deposits, and most black coal deposits, are Palaeozoic in age. Deposits formed in Tertiary

times include the brown coals of Victoria, the oil shales of eastern Queensland, the bauxites of Weipa (Queensland), Gove (Northern Territory) and the Darling Ranges in Western Australia, nickeliferous laterites at Greenvale (Queensland) and the mineral sands deposits of the Murray Basin.

Petroleum has been identified in the Australian sediments as old as Pre-Cambrian. Australia's major petroleum bearing basins are under Bass Strait (mainly Tertiary) and offshore north-western Australia (mainly Mesozoic). The main onshore basins are the Amadeus, Bowen/Surat, Cooper/Eromanga and Perth Basins.

Australia has over 20 per cent of the world's economically recoverable resources of bauxite, iron ore, mineral sands, uranium, industrial diamonds and tantalum. We have over 10 per cent of the world's economically



recoverable brown coal, lead, manganese, cadmium and zinc and over five per cent of the world's economically recoverable black coal, silver, nickel, lithium and gold.

## MINERAL EXPLORATION

Exploration consists of the search for new ore occurrences and undiscovered oil or gas, and/or appraisal intended to delineate or extend the limits of known deposits of minerals and oil or gas reservoirs by geological, geophysical, geochemical and other methods. This includes

drilling but excludes activities of a developmental or production nature. Exploration for water is excluded.

### Mineral exploration expenditure

Table 17.7 shows expenditure on private mineral exploration other than for petroleum in Australia during the last six years.

### Petroleum exploration expenditure

Table 17.8 shows expenditure on private petroleum exploration in Australia during the last six years.

**17.7 PRIVATE MINERAL EXPLORATION EXPENDITURE (OTHER THAN FOR PETROLEUM)**  
(\$ million)

	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93
New South Wales	64.5	50.6	55.1	60.6	63.3	60.9
Victoria	33.9	21.7	21.0	12.7	12.6	12.2
Queensland	159.3	139.8	128.4	124.1	109.9	117.9
South Australia	18.9	16.6	13.2	15.5	19.7	21.3
Western Australia	466.3	387.2	315.4	324.8	332.8	348.1
Tasmania	10.4	13.1	11.8	9.9	7.9	7.8
Northern Territory	48.9	68.6	62.6	53.9	57.8	63.5
<b>Australia</b>	<b>802.2</b>	<b>697.6</b>	<b>607.5</b>	<b>601.7</b>	<b>604.0</b>	<b>631.8</b>

Source: Actual and Expected Private Mineral Exploration, Australia (8412.0).

**17.8 PRIVATE PETROLEUM EXPLORATION EXPENDITURE**  
(\$ million)

	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93
Onshore	271.9	233.6	143.2	217.1	135.3	115.2
Offshore	223.2	405.7	439.4	365.4	338.8	496.7
<b>Total</b>	<b>495.1</b>	<b>639.3</b>	<b>582.6</b>	<b>582.6</b>	<b>473.9</b>	<b>611.9</b>

Source: Actual and Expected Private Mineral Exploration, Australia (8412.0).

## ADMINISTRATIVE AND FINANCIAL ARRANGEMENTS

### Mineral rights

Mineral rights in Australia are held by the State and Territory Governments and the granting of exploration and mining titles is administered by them under the respective State or Territory legislation. The Commonwealth Government holds rights to minerals on Australia's continental shelf beyond coastal waters of the States and the

Northern Territory and certain prescribed substances in the Northern Territory, within the meaning of the Atomic Energy Act (principally uranium). The Commonwealth Government is also able to influence overall development and production activity in the mineral industry by virtue of its constitutional powers with respect to international trade, customs and excise, taxation and foreign investment and has also established consultative mechanisms, such as the Australian Coal Industry Council.

## Mining and exploration for other than petroleum — legislation

**Onshore.** Each State or Territory has its own Mining Acts and Regulations governing the prospecting for and working of mineral deposits. These Acts and Regulations, although similar in principle, are different in detail.

Rights to explore for minerals are awarded by granting prospecting licences and (for larger areas) exploration licences or exploration permits. Each tenement sets out conditions such as minimum exploration expenditure each year, methods of prospecting and tenure of agreement. The tenure is usually limited. Most States and Territories make provision for Miner's Right which permits an individual to prospect or fossick for minerals on Crown Land.

**Offshore.** Following the enactment of the *Seas and Submerged Lands Act 1973*, the High Court confirmed that the Commonwealth has sovereignty over the territorial sea and sovereign rights over the resources of the whole of Australia's continental shelf. However, in the offshore Constitutional Settlement between the Commonwealth and the States reached in June 1979, it was agreed that responsibility for mining of the seabed of coastal waters (that is, the area on the landward side of the outer limit of the three nautical mile territorial sea) should lie with the States and the Northern Territory and should be governed by their legislation, while the Commonwealth should have responsibility for areas beyond. The *Offshore Minerals Act 1994*, which replaced the *Minerals (Submerged Lands) Act 1981*, provides for the granting and administration of exploration and mining licences in the Commonwealth sea.

## Petroleum mining and exploration — legislation

**Onshore.** In Australia, full control of petroleum mining rights is vested with the relevant State or Territory Government. Any organisation or individual proposing to undertake petroleum exploration or development must first satisfy the relevant government that it has access to the necessary financial and technical resources to undertake the proposed operations.

**Offshore.** The situation is the same as that detailed above for mining exploration and development, with the Commonwealth having sovereignty but administrative responsibility divided; in the case of petroleum, under the *Petroleum (Submerged Lands) Act 1967*.

The offshore legislation provides for:

- exploration permits, providing exclusive exploration rights over a specific area;
- production licences to authorise development and commercial production from discovered fields; and
- retention leases to allow security of tenure over discoveries not currently regarded as economic to mine.

Offshore projects, except the area around the North West Shelf Gas Project, are subject to Petroleum Resource Rent Taxation (PRRT). The tax is levied at a rate of 40 per cent on net project revenues. All exploration expenditures incurred by the explorer in PRRT liable areas are allowable deductions. The North West Shelf Project is subject to an excise on crude oil production and a royalty on the net wellhead value of all petroleum production.

The Timor Gap Zone of Cooperation Treaty designates an area of the Continental Shelf between Australia and Indonesia subject to control by a Joint Administration. Revenue collected from petroleum production taxation is shared between the two nations. The Treaty has provisions to prevent double taxation.

In order to encourage offshore petroleum exploration, the Commonwealth conducts a coordinated strategy involving the regular release of exploration areas, improved collection and dissemination of exploration data to explorers and enhanced company awareness about Australia's title acquisition and taxation agreements. A major feature of the strategy is that explorers are given advance notice of future releases of exploration areas.

## Mineral royalties

Mineral resources are owned by the Crown in Australia, either by the State and Territory Governments, within their borders (and up to three nautical miles offshore), or by the Commonwealth Government in offshore areas outside of the three nautical mile limit.

Accordingly, royalties are collected by State and Territory Governments for mining onshore and up to three nautical miles offshore and by the Commonwealth outside that limit.

State royalties regulations vary in regard to types of royalties, rates levied and those commodities subject to royalties.

In recent years some State Governments have negotiated special royalty arrangements with

companies which are seeking mineral leases for large-scale developments. These royalty rates may vary, depending on whether production is for export or for domestic processing. Examples of this type of royalty agreement are the Argyle Project in Western Australia and the Olympic Dam mine in South Australia. Mineral royalties received by governments in recent years are shown in table 17.9.

**17.9 MINERAL ROYALTY RECEIPTS BY GOVERNMENTS(a)**  
(\$'000)

	1987-88	1988-89	1989-90	1990-91	1991-92	1992-93
New South Wales(b)	97,166	99,387	128,966	155,006	141,819	150,380
Victoria(c)	r55,920	r60,043	r60,146	53,359	62,600	57,527
Queensland(b)	196,013	178,301	r207,954	227,566	263,406	303,194
South Australia	36,011	34,914	44,004	80,570	71,767	71,344
Western Australia(d)	r158,896	r168,479	r244,330	284,842	308,257	310,582
Tasmania	3,048	3,800	6,394	5,350	4,729	5,795
Northern Territory	10,642	9,514	24,079	28,350	28,265	14,942
Commonwealth Government	285,052	182,670	273,077	361,791	102,459	76,711
<b>Total</b>	<b>r842,748</b>	<b>r737,108</b>	<b>r988,950</b>	<b>1,196,834</b>	<b>983,302</b>	<b>990,475</b>

(a) Significant revisions have occurred to some figures due to the reclassification of petroleum royalty payments and payments to the States under arrangements relating to the collection of offshore petroleum royalties. (b) Includes royalties on sand and gravel from Crown lands. (c) Includes royalties on brown coal paid by State Electricity Commission. (d) Includes prepaid royalty of \$50 million in respect of diamond royalty agreement.

Source: Federal, State and Territory departments responsible for mining.

## Crude oil marketing and pricing arrangements

The crude oil market was deregulated on 1 January 1988. Refiners and producers are allowed to negotiate freely the quantities and prices of crude oil they buy and sell. Crude oil producers also have complete freedom to export crude oil as an alternative to selling on the domestic market, subject to government policy in times of emergency. The Commonwealth Government no longer fixes an Import Parity Price nor requires refiners to absorb quantities of Australian oil at that price, as it did prior to deregulation.

Decisions on major refinery investment associated with changes in domestic crude availability have been easier in a deregulated market and a significant program of investment in upgraded plant and equipment has already been undertaken.

The price of crude oil used for the purposes of excise tax assessment is the monthly

volume weighted average of realised prices of sales of oil from the area subject to excise.

## Pricing of liquefied petroleum gas (LPG)

As from 1 February 1989, the Commonwealth Government no longer sets the price of LPG on the Australian market. This decision represents an important move towards a free market in LPG and brings LPG into the same pricing arena as other major petroleum products. The Prices Surveillance Authority (PSA) has responsibility for determining the maximum wholesale price of LPG in each capital city.

## Pricing and export approval system for liquefied natural gas (LNG)

The Commonwealth Government removed volume controls on LNG exports in November 1991, but a price approval and monitoring system has been maintained to ensure that community returns are safeguarded. The

Department of Primary Industries and Energy has responsibility for price monitoring and the authority to approve export prices rests with the Minister.

### **Secondary tax arrangements in the petroleum industry**

In addition to general taxation arrangements applying to companies in Australia, petroleum production projects are subject to secondary taxes. The type and rate of secondary taxation (resource rent tax, resource rent royalty, or excise and royalties) depends on the location of the petroleum resource, the date of discovery of the petroleum reservoir and the date upon which production commenced.

A *Resource Rent Tax* (RRT) applies to petroleum projects in the majority of Australia's offshore areas beyond the States' territorial seas. Excluded are the North West Shelf production licence areas and associated exploration permits. Where RRT applies, it replaces excise and royalties which would otherwise have been levied.

A *Resource Rent Royalty* (RRR) may be applied to onshore petroleum projects by State Governments. Where RRR is applied the legislation provides for the Commonwealth to waive its crude oil excise whenever the relevant State Government negotiates an acceptable RRR agreement with the project producers and agrees to a satisfactory revenue sharing formula with the Commonwealth.

*Excise* applies to crude oil production from the North West Shelf projects offshore and all onshore areas (except Barrow Island where a RRR applies).

Crude oil excise is based on the annual level of crude oil sales from individual production areas and is levied as a percentage of the realised price received by producers.

Different excise scales are applicable to oil production depending upon the date of discovery of the production area and the date when the area was first developed. In the case of new offshore projects to which excise and royalty apply, and all onshore fields, the first 30 million barrels of crude oil production are exempt from excise. Production beyond this level is subject to the appropriate excise rate.

Oil discovered before 18 September 1975 ('old' oil) attracts a higher rate of excise than oil

discovered on or after this date ('new' oil). An 'intermediate' scale also applies to oil produced from 'old' oil fields that were not developed as at 23 October 1984. However, in the case of all onshore fields that commenced production after 1 July 1987, production in excess of 30 million barrels is subject to 'new' oil excise.

A *Commonwealth Royalty* is also levied on offshore petroleum production from the North West Shelf Project. Proceeds are shared, generally on a 32:68 basis by the Commonwealth and Western Australia. Onshore petroleum rights are vested in the State and Northern Territory Governments and the Commonwealth does not in general receive a share of this royalty.

### **Incentives to encourage petroleum exploration and development**

Apart from the deregulation of crude oil marketing from 1 January 1988 and the concessions to the crude oil excise regime, the Government continues its policy of encouraging petroleum exploration and development in Australia.

Australian participation guidelines for foreign investment policy in respect of new oil and gas development proposals involving total investment of over \$10 million no longer apply. These projects will be allowed to proceed unless judged contrary to the national interest.

The rate of company tax has been reduced to 33 per cent and the immediate 100 per cent deductibility of exploration expenditure against company tax has been retained, as has the write-off over 10 or 20 years in equal instalments of expenditure on infrastructure such as pipelines.

The Government continues to release offshore petroleum exploration areas regularly, usually twice a year. The release made in November 1993 offered 11 areas off the coast of Western Australia, South Australia, Victoria, Tasmania, the Northern Territory and in the Territory of Ashmore and Cartier Island.

### **Administrative arrangements**

The Commonwealth Minister for Primary Industries and Energy has portfolio responsibility for national energy policy matters, including the commercial development of hydrocarbon fuels

and minerals. The Department of Primary Industries and Energy provides support for a number of advisory bodies including the Energy Research and Development Corporation, the Australian Minerals and Energy Council, the National Energy Consultative Council, the National Oil Supplies Advisory Committee, the National Petroleum Advisory Committee, the National Fuels Emergency Consultative Committee and the Australian Coal Industry Council.

The Department is also responsible for the implementation of action required from Australia's membership of the International Energy Agency and for the national system of accounting for control of nuclear materials under Australia's Agreement with the International Atomic Energy Agency.

### Research and development

The Energy Research and Development Corporation (ERDC) manages investment in energy research. Over the past three years, ERDC has committed approximately \$32 million to investments in innovation projects which have a total cost of approximately \$115 million.

ERDC manages projects in four portfolios: gas and liquid fuels, electricity, renewable energy sources and systems, and planned energy use (manufacturing, transport and housing).

Its role is to facilitate and stimulate investment in effective energy research for Australia. It seeks to bring together the people, organisations and resources necessary to successfully research, develop and commercialise innovative change.

Its objectives are to manage projects which will benefit Australia by increasing the efficiency of energy use, the diversity of energy supply, the development of competitive Australian industries and/or reducing adverse environmental impacts, energy requirements and energy costs.

### International Energy Agency (IEA)

The IEA (of which Australia is a member) carries out the International Energy Program and the Long Term Co-operation Program. These programs aim to:

- prepare member countries against risk of oil supply disruptions and share remaining supplies in the event of a severe oil shortfall;

- develop alternative energy sources and the more efficient use of energy through cooperative research and development programs; and
- promote cooperative relations with other oil-producing and oil-consuming countries.

## RESEARCH

Research investigations into problems of exploration, mining, ore-dressing and metallurgy are conducted by government bodies, universities, private enterprise, or by the combined efforts of all these. A summary of the main organisations and their functions follows.

### Australian Geological Survey Organisation

The Australian Geological Survey Organisation (AGSO), formerly called the Bureau of Mineral Resources, Geology and Geophysics (BMR), is Australia's premier geoscientific agency.

AGSO's primary mission is to build a national geoscientific mapping effort to encourage economically and environmentally sustainable management of Australia's minerals, energy, soil and water resources.

AGSO's role is to improve the quality, extent and accessibility of the geoscience knowledge base to underpin:

- the development of a more competitive and diversified Australian mineral and petroleum exploration industry;
- the improved management of Australia's natural resources consistent with the principles of ecologically sustainable development; and
- the development of effective strategies to mitigate natural geological hazards.

AGSO provides expert professional geoscientific advice on minerals, petroleum, ground water, coastal and marine issues and seismological and geological hazard analysis to underpin the development of management and land use strategies.

AGSO's activities include regional mapping and analysis of major mineral provinces and petroleum basins, regional environmental mapping (including land resources such as soils and ground water), airborne magnetic and radiometric surveying, onshore and offshore seismic surveying, the operation of geophysical

observatories and the development of an accessible National Geoscience Information System.

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

Minerals research by the CSIRO is primarily undertaken within the Institute of Minerals, Energy and Construction (IMEC).

Research and development activities of the Institute are designed to play a major contributing role in the development of sustainable and competitive minerals, energy and construction industries in Australia and in the creation of a better living and working environment for all Australians through:

- The provision of high-quality research, development and service capabilities which support existing and emerging industries as well as providing for the next generation of technology, products and processes.
- Helping to bring about safe and ecologically sustainable development for all Australians through research and advice on environmental issues related to IMEC's client industries.
- Working closely with industry, government and other organisations to help transform research outcomes into new or improved business opportunities including, where appropriate, the championing of individual projects.

### **University research**

The various universities in Australia carry out research into various aspects of the mineral industry such as geology, ore mineralogy and genesis, mining techniques, mineral processing, extractive metallurgy, and materials and metals technology.

### **Australian Mineral Industries Research Association Limited**

The Association provides high-quality development and management of jointly funded research projects for the benefit of the Association's members. Membership includes all the largest Australian mineral and coal companies, smaller exploration companies and suppliers of services to the industry. It sustains

an active involvement in four Co-operative Research Centres and was appointed in 1992 to manage the Australian Coal Association Research Program.

## **INTERNATIONAL ASSOCIATIONS**

Because Australia is a large supplier of certain minerals to the rest of the world, and because the industry depends to a large extent on the maintenance of a high level of exports, international relations are of considerable importance to the industry. The Commonwealth Government takes an active role in international consultations and discussions relating to minerals. The most important international links are:

- Association of Tin Producing Countries (ATPC);
- International Lead and Zinc Study Group (ILZSG);
- UNCTAD Intergovernmental Group of Experts (IGE) on Iron Ore; and
- International Nickel Study Group (INSG).

## **ENERGY**

Energy is fundamental to Australia's standard of living and economic performance. It has an important role to play in restructuring Australia's economy and improving its competitiveness.

The Commonwealth Government has a significant involvement in the activities of the energy sector. Its responsibilities for export policy and offshore petroleum activities have a major impact on specific development projects.

Key Australian energy policy objectives are:

- responsible development of a growing, internationally competitive energy export sector;
- promotion of efficient production, distribution and use of energy to maximise its contribution to Australia's economic performance;
- development of a flexible, dynamic energy sector capable of responding effectively to change;

- integration of economic efficiency in the production and use of energy with environmental goals through the principles of ecologically sustainable development; and
- promotion of domestic R&D aimed at efficient, ecologically sustainable energy production, diversification and use, complemented with international energy R&D cooperation.

In 1991, the Commonwealth released an energy policy discussion paper *Issues in Energy Policy: Agenda for the 1990s* which identified a number of key issues:

- developing a framework for a coordinated energy policy for all of Australia;
- developing effective mechanisms to incorporate the costs of environmental damage, risk or rehabilitation into energy costs and prices;
- improving energy efficiency as a cornerstone of sustainable energy production and use;
- reforming the electricity supply industry;
- drawing up a national strategy for the development of natural gas;
- maintaining energy supplies for Australia; and
- enhancing Australia's position as a reliable supplier of a diversified mix of clean fuels.

Progress on these issues means that Australia is now well placed to meet its key energy policy objectives.

Australia has abundant reserves of coal, gas and uranium to meet both export and domestic demands. Given currently known resources, it can continue current production rates in these energy sources for 300 years (black coal), 45 years (gas), and 145 years (uranium), respectively. Australia is one of only five Organisation for Economic Cooperation and Development (OECD) countries that are net energy exporters. Australia is:

- the world's largest exporter of coal, accounting for around one-third of the world seaborne coal trade;
- a major uranium producer and exporter; and
- currently an exporter of Liquefied Petroleum Gas (LPG) and petroleum products, and a major exporter of Liquefied Natural Gas (LNG).

Estimates of Australia's demonstrated economically recoverable resources of energy as at December 1992 were:

Black coal	51 Gt
Brown coal	41 Gt
Natural gas	888 TL
Uranium	462 kt

NOTE: Gt — gigatonnes; TL — teralitres; kt — kilotonnes.

Source: Bureau of Resource Sciences.

Information on petroleum resources is available in table 17.5.

## ENERGY RESOURCES

Information relating to mineral energy resources — black coal, brown coal, petroleum, uranium and thorium — is contained in the Mining Industry section of this chapter.

Information on other forms of energy resources follows.

### Solar

One of the best prospects for using many renewable energy technologies to generate electricity in the short to medium term appears to be in remote areas, where there are a total of more than 10,000 households and 300 communities which generate their own electricity. Remote area power supply systems can be based on different renewable energy technologies, depending on local resources. Photovoltaic cells are the most widely used technology, with some wind powered systems and a small number of micro-hydro systems. Batteries store electricity produced by the solar cells or wind turbines for use during periods when the sun is not shining or when there is no wind.

There are two main applications of solar energy that have the potential to make a significant contribution to grid-based electricity supply. These are photovoltaics and solar thermal technologies. One of the most promising applications of photovoltaics would appear to be on long feeder lines. It is also possible that solar power supply systems could be a cost effective source of peaking power in those electricity grids where the maximum

annual load occurs in summer. A wide range of solar thermal technologies are the subject of research and development around the world. These include systems where sunlight from a large field of mirrors is focused on a central receiver, where the heat is used to produce electricity; smaller, dispersed systems, each unit of which operates as a separate collector; and solar ponds which effectively collect and store low grade heat.

Passive solar design is an economically viable means of using solar technology throughout Australia. Careful attention to building design, materials and orientation can greatly decrease heating and cooling requirements (and increase comfort) for a modest increase in construction costs over conventional buildings. Passive solar design principles have shown that solar energy can meet up to 90 per cent of normal household space heating needs.

Australia has a well established domestic solar water heater industry. Domestic solar water heaters are installed on some 300,000 or five per cent of Australian houses. In Western Australia one in four households has a solar water heater, while in the Northern Territory the figure is 37 per cent. In the 1993-94 Budget, the Commonwealth Government announced that it would provide \$6 million for a program to enable solar water heaters to be provided to consumers at low initial outlay. The aim of the program is to develop, trial and demonstrate innovative means of financing solar water heaters. The program encouraged cooperative action between industry, energy utilities and financiers to provide households with solar water heaters at a low initial cost, with the balance to be recovered through payments collected through customers energy bills.

## Wind

Of the renewable energy technologies to emerge in the last 10-15 years, wind farms are probably the most promising and lowest cost option for large-scale power supplies in the near term. Australia's best wind resources are located in coastal regions of southern Australia, particularly in Tasmania, South Australia and Western Australia.

At Esperance in south-west Western Australia, the State Energy Commission of Western Australia has commissioned a 2.5 megawatt wind farm which will supply some

14 per cent of the town's power supply. In Victoria, a wind turbine has been installed at Breamlea, south-west of Melbourne, which produces some 100,000 kWh per annum, and preparations are now underway at Toora to connect a 10 MW wind farm to the grid in late 1994.

## Wave

Wave power plants are another potential source of electricity for Australia. Although detailed studies of Australia's best wave resources have yet to be undertaken, the best conditions appear to be in southern regions.

The commercial use of wave power throughout the world is presently confined to small-scale applications in areas which have traditionally relied upon high cost sources of electricity such as diesel generators. At this stage there appears to be considerable uncertainty about the cost of electricity produced by wave power plants.

## Geothermal

Geothermal heat can be used for the production of electricity. Commercially available geothermal power plant technology relies upon heat extracted from aquifers located in regions with significant geothermal activity. Possible areas identified in Australia are the Great Artesian Basin. Hot water from bores in these areas could provide an opportunity to produce electricity for homesteads and communities. A 120 KW demonstration plant is operating in Birdsville, Queensland. In Portland, Victoria, geothermal energy is currently being used for water heating at the municipal swimming pool, and also for space heating at the hospital and police station.

Hot dry rocks technology involves pumping water into holes drilled into hot areas deep beneath the earth's surface. This water is then collected and brought to the surface where it is used to generate electricity. Significant resources exist in central Australia.

Given the scale of the engineering required, this technology is likely to be only appropriate for grid connected applications. Further exploration is needed to delineate Australia's resources, as the best resources identified to date are located in central Australia, and significant costs would be associated with



transmitting electricity from this source to major metropolitan centres.

### **Municipal waste**

Rubbish dumps or landfills contain large amounts of organic matter. As time passes some of this organic matter is converted into methane by bacterial action. This methane is known as landfill gas and can be collected using drill holes and used either to power an engine to generate electricity for sale to the electricity grid, reticulated in natural gas pipelines or used as a source of heat for applications adjacent to the landfill (for example, brick works, heated swimming pool). The use of landfill gas power plants in Australia was pioneered by Northcote City Council with a Commonwealth grant.

Major landfill gas developments have occurred in the States of Victoria, New South Wales and South Australia. The first landfill gas-fuelled power station was commissioned in Victoria in May 1992, and that State now has three such power stations operating at Berwick (5.6 MW), Corio (0.9 MW) and Broadmeadows (5.0 MW). Similar power stations are now operating in New South Wales at Lucas Heights (4.0 MW, commissioned in May 1994) and at Wingfield in South Australia (5.0 MW, commissioned in July 1994).

### **Biomass**

Two forms of biomass most frequently used in Australia are wood and bagasse. Approximately 6.0 megatonnes of firewood are currently used annually in Australia, equivalent in energy terms to about 100 petajoules, or 2.5 per cent of total energy consumption.

Bagasse, the fibrous residue remaining after extraction of the juice from sugar cane, is the major fuel used in the sugar industry, providing about 70 petajoules, or 1.75 per cent of Australia's total energy consumption.

## **ELECTRICITY AND GAS SUPPLY**

At 30 June 1993, the total installed public electric generating capacity in Australia was 35.6 million kilowatts. Total electricity generation in 1992-93 was 152,426 million KWh.

Of total public electrical energy produced during 1992-93 hydro-electric sources provided approximately 11 per cent, and the balance was supplied by fossil fuels with approximately 88 per cent provided by coal. The development of coal-fired power stations has been facilitated by the presence of large demonstrated economic resources of coal close to the major industrial areas in New South Wales and Victoria.

About 90 per cent of electric power in Australia is produced by power stations owned and operated by State government utilities.

Natural gas consumption in 1992-93 was forecast to be 704 petajoules, an increase of 4.1 per cent on 1991-92 and contributed 17.1 per cent of Australia's forecast energy requirements.

Natural gas exports in the form of LNG (Liquefied Natural Gas), began in 1989 and for the year 1992-93 were equal to 270 petajoules.

## 17.10 ELECTRICITY AND GAS ESTABLISHMENTS: SUMMARY OF OPERATIONS, 1992-93

Items	Electricity					Gas
	NSW	Vic.	Qld	Other(a)	Aust.	Aust
<b>INCOME AND EXPENDITURE</b>						
Turnover(b)	7,882.8	3,579.0	3,545.1	3,278.7	18,285.7	3,142.4
Plus closing stocks	447.9	94.4	97.2	201.4	840.9	55.7
Less opening stocks	477.9	127.0	119.1	225.0	949.1	65.9
Less purchases, transfers in & selected expenses	4,200.1	1,119.4	1,788.3	1,189.2	8,297.1	1,498.2
Value added	3,652.7	2,426.9	1,735.0	2,065.9	9,880.5	1,633.9
<b>FIXED CAPITAL EXPENDITURE</b>						
Fixed capital expenditure less disposals	652.2	- 390.3	586.5	445.6	1,293.9	208.3
<b>EMPLOYMENT DETAILS</b>						
Establishments at 30 June (no.)	28	13	10	11	62	30
Employment at 30 June (no.)(c)	19,639	13,279	8,566	11,638	53,122	8,769
Wages and salaries (\$m)(d)	773.6	754.6	306.0	443.2	2,277.2	336.9

(a) South Australia, Western Australia, Tasmania, Northern Territory and the Australian Capital Territory. (b) Includes transfers out to other establishments of the same management unit where appropriate. (c) Includes working proprietors. (d) Excludes amounts drawn by working proprietors.

Source: *Electricity and Gas Operations, Australia* (8208.0).

The main features of the production and distribution of electricity and gas in each State and Territory are outlined below.

### Snowy Mountains Hydro-Electric Scheme

The Commonwealth Government's major direct role in the electricity supply industry is its major responsibility for the Snowy Mountains Scheme. It supplies water for both electricity generation and irrigation. Located in south-eastern Australia, on its completion in 1974, the Scheme was one of the largest engineering works of its type in the world. It impounds the south-flowing waters of the Snowy River and its tributary, the Eucumbene, at high elevations and diverts them inland to the Murray and Murrumbidgee Rivers through two tunnel systems driven through the Snowy Mountains. The Scheme also involves the regulation and utilisation of the headwaters of the Murrumbidgee, Tumut, Tooma and Geehi Rivers. The diverted waters fall some 800 metres and together with regulated flows in the Geehi and Tumut River catchments, generate mainly peak load electricity for the States of New South Wales and Victoria and the Australian Capital Territory as they pass through power stations to the irrigation areas inland from the Snowy Mountains.

A special article on the Scheme appeared in *Year Book Australia* 1986.

### New South Wales

Pacific Power (formerly the Electricity Commission) is responsible for the production of electricity and its bulk transmission throughout New South Wales. Twenty-five electricity supply authorities handle the retail distribution of electricity to consumers. It also supplies several large industrial customers.

Electricity for New South Wales is generated mainly in coal-fired thermal power stations, supplemented by a share of the Snowy Mountains Scheme together with smaller hydro and gas turbine power stations.

At June 1993 there were seven major power stations in the Pacific Power system and their base load capacities were as follows: Bayswater (Hunter Valley) 2,640 MW; Liddell (Hunter Valley) 2,000 MW; Munmorah (Tuggerah Lakes) 600 MW; Vales Point (Lake Macquarie) 1,320 MW; Eraring (Lake Macquarie) 2,640 MW; Wallerawang (near Lithgow) 1,000 MW; and Mount Piper (near Lithgow) 660 MW. The total nominal capacity (maximum continuous rating of the generators) of Pacific Power's system at 30 June 1993 was 11,514 MW. The maximum demand for electricity from the system during 1992-93 occurred on 20 July 1992 and was 9,792 MW. Electricity sent out from these power stations in 1992-93 was 48,473 GWh.

Interconnection of the New South Wales and Victorian power systems with that of South Australia was completed in December 1989 and commercial operations began in March 1990. Studies have begun to explore interconnection of the New South Wales and Queensland power systems.

The greater part of the hydro-electric potential of New South Wales is concentrated in the Snowy Mountains Scheme. New South Wales' share sent out over its system in 1992-93 was 3,854 GWh. Apart from this scheme, major hydro-electric stations are in operation at the Warragamba Dam (50 MW) and Hume Dam (50 MW). A pumped-storage hydro-electric system to produce 240 MW has been installed as part of the Shoalhaven Scheme in conjunction with the Water Board. In addition, there are five smaller hydro-electric installations in operation in various parts of the State.

Electricity sent out over Pacific Power's system from these hydro-electric stations in 1992-93 was 181 GWh.

Total electricity generated in New South Wales from all sources in 1992-93 was 57,794 GWh, with 51,131 GWh sent out over Pacific Power's system.

Natural gas was made available to Sydney consumers with the completion of an overland supply pipeline from the Moomba field in South Australia in 1976. Since then lateral pipelines have been completed to a number of New South Wales towns.

The total amount of gas (of all types) available for issue through mains in New South Wales in 1992-93 was 96 petajoules.

## Victoria

The State Electricity Commission (SEC) is a body corporate and one of the largest public sector organisations in Australia. It is a self-supporting business and is the principal supplier of electricity throughout Victoria.

The SEC's total installed generating plant capacity (maximum continuous rating of the generators) at 30 June 1993 was 7,763 MW, including both capacity within the State and that available to it from New South Wales. In 1992-93, electricity generated by the SEC in its thermal and hydro-electric power stations, or purchased, totalled 39,091 GWh.

At June 1993, it distributed electricity directly to 1,654,700 customers and indirectly to a further 292,400 through 11 metropolitan councils.

Victoria's electricity system is based upon the State's extensive brown coal resource in the Latrobe Valley, 140 to 180 kilometres east of Melbourne in central Gippsland, one of the largest single brown coal deposits in the world — see earlier section on brown coal.

The major brown coal-fired generating plants in the system are the 2,000 MW Loy Yang 'A', the 1,600 MW Hazelwood and 1,450 MW Yallourn 'W' power stations, followed by Morwell (170 MW). These stations are all located in the Latrobe Valley and generate 85 per cent of the State's electricity requirement.

Other thermal stations are Jeeralang (465 MW) gas turbine station in the Latrobe Valley and Newport 'D' (500 MW) gas-fired station in Melbourne. There are hydro-electric power stations in north-eastern Victoria: Kiewa (184 MW), Eildon-Rubicon-Cairn Curran (135 MW) and Dartmouth (150 MW). In 1992-93, Victoria also took 1,927 GWh of the output of the Snowy Mountains Hydro-Electric Scheme and half of the output of the Hume hydro-electric station near Albury.

The Loy Yang 'B' station, the second part of the Loy Yang Project, has approved capacity of 1,000 MW in two units of 500 MW each.

The Gas and Fuel Corporation combines the resources of government with those of private enterprise to supply gas.

Gas is reticulated to around 1.27 million domestic, industrial and commercial customers through an underground network of transmission pipelines and mains, some 24,089 kilometres in length.

In addition to the greater Melbourne area, a reticulated supply is provided in 50 cities and towns throughout Victoria and in Albury, New South Wales.

Ninety-nine per cent of reticulated supply is Bass Strait natural gas, purchased from Esso and BHP. Six towns in western Victoria receive a reticulated supply of tempered liquefied petroleum gas.

## Queensland

The main supply of electricity in Queensland is controlled by the Queensland Electricity Commission (QEC). The QEC provides electricity to major users of power and to seven Electricity Boards which in 1992–93 provided power to 1,123,671 domestic and 175,658 commercial and industrial consumers, increases of 8.9 and 3.8 per cent, respectively over the previous year.

Electricity generation in Queensland is based primarily on the State's plentiful resources of black coal. In 1992–93, Stanwell, Callide B, Tarong, Gladstone Swanbank A and Swanbank B steam plants consumed 12,278 kilotonnes of coal and 16,874 tonnes of oil. This generated 28,307.2 GWh of energy or 99 per cent of energy generated in Queensland. The hydro-electric plants at Kareeya, Barron Gorge and Wivenhoe produced 271.4 GWh of energy in 1992–93.

Planning for the future is still based on coal-fired power stations providing the bulk of Queensland's electrical energy needs, augmented as necessary by pumped-storage and conventional hydro-electric stations for peaking capacity.

Natural gas produced for sale in Queensland comes from three main areas, the Surat-Bowen Basin concentrated around Roma, the Denison Trough and south-west Queensland. Natural gas from the Surat-Bowen Basin is piped to the Wallumbilla junction of the Roma to Brisbane pipeline for compression and reticulation to domestic, commercial and industrial consumers in Roma, Dalby, Oakey, Toowoomba, Ipswich, Brisbane and the Gold Coast. A pipeline was recently constructed connecting the Surat-Bowen Basin and the Denison Trough to commercial and domestic users at Gladstone and Rockhampton. Recent developments have seen the south-west Queensland gas fields connected to the South Australian gas network.

## South Australia

The Electricity Trust of South Australia (ETSA) is responsible for unification and coordination of the major portion of the State's electricity supply.

At June 1993, the Electricity Trust's installed capacity was 2,350 MW. Its major power

stations are Torrens Island (1,280 MW), Port Augusta Northern Power Station (500 MW), and Port Augusta Playford 'B' (240 MW). The Trust also operates gas turbine stations at Dry Creek (156 MW), Mintaro (90 MW) and Snuggery (75 MW) and a small diesel station at Port Lincoln (9 MW).

The Electricity Trust supplies directly or indirectly more than 99 per cent of all electricity customers connected to the public supply within the State. The remainder are supplied by small diesel generating plants situated in towns in the more remote areas of the State. Total Electricity Trust customers at 30 June 1993 was 675,452.

A 500 MW capacity interconnection with the Victorian–New South Wales systems has been operational since March 1990.

SAGASCO Holdings Ltd has responsibility for oil and gas exploration, development and production, and the distribution within the State of gas and LPG. It has three subsidiaries: South Australian Gas Company Ltd (to supply gas to Adelaide and surrounding areas), SAGASCO Resources Ltd (to undertake oil and gas exploration, development and production) and SAGASCO LPG Pty Ltd.

Natural gas is reticulated throughout most of Adelaide, Angaston, Whyalla, Mount Gambier, Peterborough and Port Pirie. Liquefied petroleum gas is distributed by reticulation at Roxby Downs and Renmark and is available elsewhere as bottled gas.

## Western Australia

Most of the electricity production in the State is generated by the State Energy Commission of Western Australia (SECWA), whose responsibilities include ensuring the effective and efficient use of the State's energy resources and the provision of economical and reliable supplies of electricity and gas. Significant amounts of electricity are also generated by private enterprise, particularly large-scale mining companies in the Pilbara region.

SECWA operates two power grid systems, one for the Pilbara and the other for the south-west, which supply the electricity needs of 98 per cent of the State's population.

- The South-West Interconnected System services an area from Kalbarri in the north to Bremer Bay in the south and from Perth east

to Kalgoorlie. Three major thermal power stations provide the bulk of electricity for the system. They are located at Muja (1,040 MW capacity) and Bunbury (120 MW), both are coal fired and generated around 66 per cent of electricity supplied through the system during 1991-92; and at Kwinana (880 MW), fuelled by coal, heavy fuel oil and North West Shelf gas. Gas turbines are located at Pinjar (north of Wanneroo), Mungarra (south-east of Geraldton), Kwinana, Geraldton and Kalgoorlie to provide peak and emergency power. The commissioning of an additional four 36 MW and one 116 MW gas turbines during 1993, make Pinjar the third largest station in this system with 18.0 per cent of the total capacity of 2,754 MW.

- The Pilbara Interconnected System links Karratha, Dampier, Cape Lambert, Wickham, Roebourne, Port Hedland and Goldsworthy. Electricity is supplied from Cliffs Robe River Iron Associate's gas-fired station at Cape Lambert. Additional power can be drawn from the SECWA stand-by diesel generating facility at Port Hedland, from Hamersly Iron Proprietary Limited's power station at Dampier and from a SECWA gas turbine generating unit also located in Dampier.

Outside the electricity grid systems, SECWA operates another 28 smaller diesel power stations and provides support services for the Aboriginal and Torres Strait Islander Commission to help run 34 Aboriginal village power stations in remote areas of the State. At 30 June 1993, SECWA had 677,477 customer accounts for electricity throughout Western Australia.

The North West Shelf provides most of the natural gas to SECWA with a small amount of gas also being received from the onshore Woodada gas field (near Dongara). In addition to reticulating (principally) North West Shelf natural gas to customers linked to the Dampier to Bunbury pipeline, SECWA also reticulates tempered liquefied petroleum (TLP) gas to customers in Albany on the south coast, and Simulated Natural Gas (SNG) to customers in Mandurah, south of Perth. At 30 June 1993, there were 297,562 customer accounts for natural gas, 2,870 customer accounts for TLP gas and 2,599 for SNG gas. This represents an increase in customers of 7.9 per cent since June 1992.

Research continues into alternative sources of energy. Western Australia's geographical and climatic characteristics are such that it has potential to take advantage of advances in the use of solar, wind, hydro-electric and tidal or wave power.

Wind power was of some significance as an energy source in the early days of settlement and is still used extensively in agricultural and pastoral areas for pumping water for stock. In March 1987, SECWA commissioned six 60 kilowatt wind turbines at Salmon Beach, a few kilometres west of the south coastal town of Esperance, to augment the local electricity supply. A second wind farm was commissioned at Ten Mile Lagoon, Esperance during March 1994. This two MW wind farm is expected to supply 14 per cent of the power requirements of Esperance and save 1.6 million litres of fuel which would have been otherwise consumed by the diesel power station. A wind power generator is also being used to augment the electricity supply on Rottne Island.

Consultations and feasibility studies have started for a proposed 16 MW hydro-electric scheme power station sited at the Ord River diversion dam, which could be operating by mid-1996 to supply power to Kununurra and Wyndham.

Agreement has been reached to buy electricity from Western Australia's first private power station using landfill gas. The power station at the Redhill landfill site (approximately 25 kilometres north-east of Perth) was commissioned in June 1993, and has a capacity of about two MW which is sufficient to supply electricity for 2,000 average homes.

## Tasmania

Tasmania's electricity requirements are provided by the Hydro-Electric Commission. The total installed generator capacity at 30 June 1993 was 2,435 MW of which almost 90 per cent was supplied by an integrated hydro-network. An oil-fired thermal station of 240 MW is located at Bell Bay.

The Hydro-Electric Commission also purchased electricity amounting to five GWh from two privately-owned developments.

Hydro-electric power accounts for almost all reticulated energy in Tasmania. A usually reliable distribution of rainfall throughout the year and

the establishment of numerous lakes within the State, has created substantial artificial storage.

The total energy generated during the 1992-93 financial year was 8,849 GWh, a small decrease from the previous year. Total sales amounted to 8,183 GWh of which 5,224 GWh was sold to the major industrial sector.

Total water storages at June 1993 were 41.8 per cent, a rise of 8.8 per cent in the 12 month period. The total energy yield from storages during 1992-93 was 100.8 per cent of the long-term average. Bell Bay thermal station was not required to contribute to the State's energy requirements for the year.

Commissioning of the Anthony Power Development, the last hydro-power development, took place on 13 May 1994. It will be known as the Tribute Power Station and will add 84 MW to the installed capacity of the system.

A \$150,000 feasibility study into the introduction of wind power on King Island commenced in January 1994, and is expected to lead to the installation by 1995 of wind turbines to meet an estimated 20 per cent of the Island's energy needs.

Gas is only a minor energy source in Tasmania. Town gas is manufactured and reticulated in Launceston only. Bottled LPG is a minor domestic, commercial and motor fuel in the State.

### **Northern Territory**

The Power and Water Authority (PAWA) is responsible for generation, transmission and distribution of electricity and the sale of natural gas in the Northern Territory.

PAWA supplies electricity to 51,800 services in four major regional centres and eight minor centres.

There are 70 remote communities with PAWA electricity supplies.

Total energy generated in the Northern Territory in 1992-93 was 1,198 GWh. Total sales comprised 806 GWh to businesses and 300 GWh to domestic consumers.

Natural gas pipelines from the Amadeus Basin in central Australia supply the Territory's four major centres — Darwin, Katherine, Tennant Creek and Alice Springs — all of which use indigenous natural gas, replacing imported heavy fuel oil and distillate as fuel for electricity generation. A combined cycle block of 100 MW comprises half of the installed capacity at Channel Island Power Station near Darwin.

A privately-built, owned and operated transmission line between Darwin and Katherine, allows reserve capacity to be shared and has reduced costs because of the higher operating efficiencies of Channel Island Power Station compared with Katherine Power Station.

A privately-owned power station of 15 MW capacity is situated at Pine Creek. It is operated by PAWA under contractual arrangements and supplies PAWA customers at and around Pine Creek.

### **Australian Capital Territory**

Electricity is distributed within the Territory by the ACT Electricity and Water Authority (ACTEW). During 1992-93 the total bulk electricity purchased was 2,347 GWh, comprised of 1,677 GWh provided by Pacific Power, and 670 GWh reserved from the Snowy Mountains Hydro-Electric Authority. The system's maximum demand was 572 MW. ACTEW supplied 117,765 customers at June 1993.

Natural gas from the Moomba fields in South Australia is piped to Canberra via a 70 kilometre spur which branches from the main Moomba-Sydney pipeline at Dalton.

During 1992-93, AGL Canberra Ltd reticulated 4,328 terajoules of natural gas to 1,251 commercial and industrial establishments and about 39,280 homes.

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### Other Publications

Other organisations which produce statistics in this field include the Australian Bureau of Agricultural and Resource Economics, the Department of Primary Industries and Energy, the Joint Coal Board, the Australian Institute of Petroleum and the Electricity Supply Association of Australia. State government departments and instrumentalities also are important sources of energy data, particularly at the regional level, while a number of private corporations and other entities operating within the mining and energy fields also publish or make available a significant amount of information.

**FOR MORE INFORMATION**

The ABS has a far wider range of information on Australia than that contained in the *Year Book*. Information is available in the form of regular publications, electronic data services, special tables and from investigations of published and unpublished data.

For further information contact ABS Information Services at one of the addresses listed on the page facing the Introduction to the *Year Book*.