CHAPTER 18

ENERGY

Introduction

Australia is well endowed with energy resources and is presently one of only five OECD countries that are net energy exporters. It presently supplies about two-thirds of its oil requirements from domestic sources and should be able to maintain this relatively favourable situation for some years at least.

Estimates of Australia's demonstrated economically recoverable resources of energy as at December 1982 are:

Brown coal	36,129 mega tonnes
Black coal	30,432 mega tonnes
Uranium	314,000 tonnes U
Natural gas	500.74 teralitres
Crude oil and natural gas liquids	409.20 gigalitres

Additionally, there are huge inferred resources of black coal amounting to about ten times the demonstrated figure quoted above but presently uneconomic, and resources of oil shale equivalent to about ten times the level of crude oil and condensate resources.

In recognition of the importance of energy resources to Australia's national wealth, policies have been developed to respond to the changing pattern of world energy supplies, to try to minimise uncertainty for the future and to develop other energy sources which can substitute for oil in a wide range of uses, in both domestic and export markets. The basic aims of these policies are:

- to attempt to ensure that an adequate supply of energy is available at all times;
- to facilitate the efficient use of energy in Australia and the efficient development of Australia's energy resources in response to the needs of domestic and overseas energy markets; and
- to seek an equitable sharing of the benefits of energy resource development amongst the Australian community.

More specific objectives in relation to liquid fuels are:

- to prepare Australia for major interruptions to oil supplies through stocks and emergency allocation schemes and other short lead time measures;
- to pursue, in an economically efficient manner, a high level of self-sufficiency in liquid fuels over the longer term through, for example:
  - encouraging conservation, and more efficient use of liquid fuels;
  - replacing the use of oil by relatively abundant energy sources such as coal and natural gas;
  - encouraging petroleum exploration and development; and
  - developing technologies for alternative energy sources, particularly liquid fuels and including renewables.

In establishing an appropriate framework within which Australia's energy industries can develop, the Government attaches key importance to the pricing and fiscal environment surrounding production, consumption and trade of Australia's energy resources. Realistic pricing of all energy resources is of fundamental importance in developing this framework. The policy of import parity pricing of indigenous crude oil has been, and is important in meeting the Government's policy objectives in the energy field generally and in the field of liquid fuels in particular. This is supplemented however by measures such as support for energy research and development. In this respect a total of $97 million has been committed to energy research and development through the National Energy Research, Development and Demonstration Program since its inception in 1978. The primary focus of the Program has been the co-ordination and support of research and development activity in Australia to achieve a full understanding of the extent and quality of Australia's energy resource base, and the development of appropriate technologies to enable these resources to be used to their fullest extent for the benefit of the Australian people.

The Government has indicated that a priority matter for its attention is reform of the existing arrangements for the taxation of energy and other extractive industries. It has expressed a preference for the replacement of the present complex system of Commonwealth and State taxes, royalties, licence fees and other charges currently applicable to many extractive industries with more equitable and efficient profits-related taxes.

Advice and co-ordination

Institutional Arrangements

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

The Department of Resources and Energy provides advice to the Minister on energy policy and provides support for a number of advisory bodies including the National Energy Research Development and Demonstration Council (NERDDC), the Australian Minerals and Energy Council (AMEC), the National Oil Supplies Advisory Committee (NOSAC), the National Petroleum Advisory Committee (NPAC), the National Fuels Emergency Consultative Committee (NFECC), and the Coal Consultative Committee (CCC).

It is also responsible for implementation of action required from Australia's membership of the International Energy Agency (IEA) and for the national system of accounting for a control of nuclear materials under Australia's Agreement with the International Atomic Energy Agency (IAEA).

International Energy Agency

The International Energy Agency (IEA) was established in Paris in November 1974 as an autonomous institution within the framework of the Organisation for Economic Co-operation and Development (Australia did not seek membership at that time). Australia joined the IEA in May 1979.

The objective of the IEA is to implement the International Energy program as set out in the Agreement authorising the establishment of the Agency. This Agreement encompasses an Emergency Oil Sharing Scheme (EOSS) to be activated in an emergency supply situation, an information system on the international oil market, regular consultations with the major oil companies, the promotion of relations with oil producing and consuming countries, and long-term co-operation in energy aimed at reducing dependence on oil. The IEA's long-term co-operation program includes the promotion of energy conservation, the acceleration of the development of non-oil energy sources and the encouragement of energy research and development projects.

The main decision making body of the IEA is the Governing Board. The Board usually meets annually at Ministerial level and more frequently at senior official level. The Secretary of the Department of Resources and Energy is currently Chairman of the Governing Board meetings at official level. The IEA has standing groups on Long-Term Co-operation, the Oil Market, Emergency Questions, and relations with producers and other consuming countries and a Committee on Research and Development.

Research and Development

NERDDC

The Department of Resources and Energy through the National Energy Office provides policy and technical advice on energy research, development and demonstration and administers the National Energy Research, Development and Demonstration Program (NERD&D Program).

The National Energy Research, Development and Demonstration Council (NERDDC) was established in May 1978. It advises the Minister for Resources and Energy on the development and co-ordination of a national program of energy research and the disbursement of funds under the NERD&D Program. Council consists of twelve members drawn from government, private industry and tertiary institutions who are appointed by the Minister on the basis of established expertise in the energy field. It is supported by seven Technical Standing Committees (TSCs), covering all major areas of energy technology, which provide expert technical advice. The NERD&D Program is funded from the accrued funds paid to the Coal Research Trust Account under the provision of the *Coal Research Assistance Act* 1977 and from the Energy Research Trust Account for which funds are provided from a Departmental Appropriation for energy research.

During 1982–83 a further $17 million was committed to energy research projects over a wide range of energy technologies. This brought the total committed to date under the NERD&D Program to around $97 million. NERDDC and its TSCs also assist the Department in monitoring scientific and technical progress and performance of projects being supported.

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

Energy research within the Institute of Energy and Earth Resources is carried out with the objectives of improving methods of locating, evaluating, defining and characterising Australia's energy resources and of planning their development and effective use, consistent with the minimisation of environmental stresses. Divisions of the Institute engaged in energy research are the Division of

Geomechanics at Syndal (Vic.); the Division of Energy Chemistry at Lucas Heights (N.S.W.); the Division of Energy Technology at Highett (Vic.); the Division of Fossil Fuels at North Ryde (N.S.W.); the Division of Mineral Chemistry at Port Melbourne (Vic.); the Division of Mineral Engineering at Clayton (Vic.); the Division of Mineral Physics at North Ryde (N.S.W.), Lucas Heights (N.S.W.) and Port Melbourne (Vic.), and the Physical Technology Unit at Ryde (N.S.W.).

Research on certain renewable sources of energy is carried out in the Institute of Biological Resources (Divisions of Plant Industry, Tropical Crops and Pastures, Water and Land Resources and the Centre for Irrigation Research) and in the Institute of Industrial Technology (Divisions of Applied Organic Chemistry and Chemical Technology).

NOSAC

The National Oil Supplies Advisory Committee (NOSAC) was formed in 1983 by the amalgamation of separate Commonwealth/industry and Commonwealth/State bodies set up during the period of tight oil supply in 1979. Representatives of the Commonwealth Government, State Government energy authorities and major domestic oil producers and refiners meet in NOSAC about three times a year to review the situation and outlook for domestic and international oil supplies. Matters discussed include oil production, new oil and gas developments, imports, exports, stock levels, regional shortages, industrial relations, shipping, technical matters and government policies affecting the oil industry.

AMEC

The Australian Minerals and Energy Council (AMEC) is a Commonwealth/State Ministerial body which was established in 1976, replacing the former Australian Minerals Council. It is principally a body for consultation on energy matters and provides a forum for Ministers to discuss energy policy issues of mutual concern and to co-ordinate policy action. It is assisted by several committees including the AMEC Advisory Committee, the Standing Committee on Offshore Petroleum Legislation, the Sub-committee on Waste Oil Recovery and the Working Group on Mapping for Mining Developments.

ACCC

The Australian Coal Consultative Council (ACCC) was established following a Coal Industry Conference in Canberra on 30 March 1983. Its terms of reference are to review and report from time to time on the economic and structural problems of the industry. The Council is a tripartite body, chaired by the Minister for Resources and Energy. Its membership comprises the New South Wales and Queensland Ministers responsible for the industry, coal mine proprietors, mining unions and the ACTU. The Australian Mining Industry Council was recently granted 'observer' status.

At the first meeting of the Council on 29 April 1983, it was decided that a National Research Group reflecting the tripartite composition of the Council should be set up to advise the Council.

NPAC

Membership of the National Petroleum Advisory Committee (NPAC) is drawn from agricultural, general aviation, fishing, manufacturing, mining, shipping and transport industries, oil industry, trade union movement and motorists' organisations as well as Commonwealth, State and Territory Governments. The Department of Resources and Energy provides the Secretariat for NPAC. In accordance with the NPAC recommendations the Commonwealth Government has introduced the *Liquid Fuel Emergency Act 1983* and established with the States and the Northern Territory the National Fuels Emergency Consultative Committee.

NFECC

The National Fuels Emergency Consultative Committee (NFECC) chaired by the Commonwealth and comprising officials of the Commonwealth, States and the Northern Territory, was established in late 1983 to consult and advise Governments on matters relevant to the preparation for, and detailed management of, a national liquid fuels crisis; and to act as the prime channel of consultation between Governments in the event of such a crisis.

Resources

Black coal

Black coal is currently second to petroleum products as 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 from the main centres of population.

Australia's inferred resources of black coal are very large, amounting to over 500,000 megatonnes (Mt). At 31 December 1982, Australia's demonstrated economic resources of black coal were estimated to total 52,868 Mt of which 30,432 were considered recoverable. These recoverable resources are located almost entirely 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, and small deposits are being worked in Western Australia, South Australia and Tasmania.

For further details relating to the production of black coal in Australia see Chapter 16, Mineral Industry. Details about the nature and age of black coal are given in Year Book No. 64, pages 460 and 461.

Brown coal

Australia's measured and indicated resources of brown coal are estimated at 83,600 Mt, located principally in Victoria's Latrobe Valley (35,030 Mt). 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 at many places along the southern margin of the continent, as far north as central Queensland, and 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 for power generation, briquetting and char manufacture. Production of brown coal in Victoria during 1981–1982 was 33.4 Mt. The brown coal deposits of the Latrobe Valley have been developed by the State Electricity Commission of Victoria (SECV) for the generation of electricity. By the end of 1982, about 800 Mt of raw brown coal had been mined.

Energy research and development statistics

Estimates of the expenditure on energy R&D carried out in Australia during 1979–80, and classified by energy objective, are presented in the table below.

The estimate of manpower resources devoted to energy R&D in Australia during 1979–80 was 2,570 man years. Of this amount, business organisations accounted for 980 man years, general government organisations for 789 man years and higher education organisations for 801 man years.

More detailed statistics are contained in the ABS publication *Research and Experimental Development; Energy Production, Utilisation and Conservation, All Sectors, Australia, 1979–80* (8110.0)

ENERGY RESEARCH AND EXPERIMENTAL DEVELOPMENT(a), AUSTRALIA, 1979-80
DETAILS OF R & D EXPENDITURE BY ENERGY OBJECTIVE(b)
($'000)

Energy objectives(b)			*Sector of performance(d)*			*Source of funds(f)*
Energy codes	*Description*	*Total expenditure(c)*	*Business enterprises(e)*	*General government and higher education*	*Industry*	*Government*
	Production and utilisation of energy—					
513	Oil and gas—mining extraction techniques	170	(g)	(g)	(g)	(g)
111	—refining, transport and storage	1,311	756	555	753	558
112,523,533	—other	5,278	(g)	(g)	(g)	(g)
113,114,514,524,534	Oil shale and tar sands	696	(h)1,593	(h)4,552	(h)1,636	(h)4,508
512	Coal—mining extraction techniques	4,961	2,169	2,793	1,653	3,308
121	—preparation and transport	5,523	3,865	1,658	3,385	2,138
122	—combustion	3,844	3,216	627	2,956	888
211	—conversion	7,761	2,285	5,476	1,183	6,578
123,522,532	—other	8,464	6,742	1,722	5,706	2,758
131	Solar—heating and cooling	7,224	3,103	4,121	2,925	4,299
132	—photo electric	1,800	521	1,279	596	1,204
133	—thermal electric	287	73	214	16	271
141	Nuclear—non-breeder—light water reactor					
142	—other converter reactor	18,558				
143,511,521,531	—fuel cycle		5,815	16,289	6,177	15,927
144	—supporting technologies					
145	—breeder	—				
146	—fusion	3,545				
151	Wind					
152	Ocean	907	278	629	174	733
153	Geothermal					
221	Biomass	4,091	1,704	2,387	1,486	2,605
154	Other sources and new vectors	1,283	668	615	434	849
	Conservation of energy					
311	Industry	3,852	2,794	1,058	2,249	1,603
312	Residential and commercial	2,344	851	1,493	956	1,388
313	Transportation	4,775	3,502	1,273	2,551	2,225
314	Other	640	482	158	462	178
	Other energy R & D (including supporting technologies)—					
411	Electric power conversion	2,262	1,614	648	1,456	807
412	Electricity, transmission and distribution	3,182	1,888	1,294	2,054	1,128
413	Energy storage, n.e.i.	1,098	(i)	(i)	(i)	(i)
414	Energy system analysis	869	30	839	59	810
415	Other	2,503	(j)619	(j)2,982	(j)772	(j)2,830
	Total all energy objectives	**97,228**	**44,567**	**52,661**	**39,636**	**57,592**

(a) Refers to R & D activity predominantly directed towards producing, storing, transmitting, utilising and conserving energy. (b) The energy objective categories represent ultimate national needs rather than the immediate objective of the researcher or the organisation performing the energy R & D. (c) Includes expenditure associated with overhead staff providing indirect services to energy R & D. (d) The sector classification used is adapted from the guidelines specified by the OECD for use in the conduct of R & D studies. (e) Excludes enterprises in ASIC Division A – i.e. enterprises mainly engaged in agriculture, forestry, fishing and hunting. (f) In accordance with IEA practice, source of funds are classified as either Industry or Government. (g) Included with oil shale and tar sands (codes 113, 114, 514, 524, 534). (h) Comprises codes 513, 112, 523, 533, 113, 114, 514, 524, 534. (i) Included with other (code 415). (j) Comprises codes 413 and 415.

Petroleum

For a definition of petroleum, together with a brief description of recovery techniques and the history of the search for petroleum in Australia, *see* Year Book No. 64, pages 461 and 462.

Major prospects for new oil discoveries are in untested areas and it is likely that most of Australia's undiscovered oil will be contained in only a few fields. Extrapolation from known areas suggests that undiscovered oil will be of the lighter types and that more gas fields than oil fields will be found. Assessments by the Bureau of Mineral Resources, Geology and Geophysics in March 1983 indicate that there is a 50 per cent chance of finding at least another 286 gigalitres (GL) (1,800 million barrels) of crude oil in Australia. This compares with demonstrated economic resources of 260 GL (1,640 million barrels) and demonstrated sub-economic resources of 22 GL (138 million barrels) as at 31 December 1982.

PETROLEUM RESOURCES (a) AS AT 31 DECEMBER 1982

(*Source:* Department of Resources and Energy)

Basin	*Demonstrated Economic (b)*				*Demonstrated Sub-economic (c)*			
	Crude oil GL	*Condensate* GL	*LPG* GL	*Sales gas* 10^9m^3	*Crude oil* GL	*Condensate* GL	*LPG* GL	*Sales gas* 10^9m^3
Bowen-Surat (Qld)	1	—	—	2	—	—	—	3
Gippsland (Vic)	225	28	59	190	—	—	—	—
Gippsland-Bass-Otway (Vic./Tas.)	—	—	—	—	16	9	9	45
Cooper (S.A./Qld)	12	6	12	80	—	1	1	7
Carnarvon-Canning (W.A.)	11	47	48	336	—	—	—	—
Carnarvon-Browse-Bonaparte (W.A./N.T.)	—	—	—	—	6	16	20	209
Perth (W.A.)	1	—	—	3	—	—	—	—
Amadeus (N.T.)	10	2	4	30	—	—	—	—
Total	**260**	**83**	**123**	**641**	**22**	**26**	**30**	**265**

(*a*) Based on the McKelvey classification which sub-divides 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 extrapolation 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.

PETROLEUM PRODUCTION IN AUSTRALIA

(*Source:* Department of Resources and Energy)

Year	*Crude oil and Condensate* ML	*LPG (a)* ML	*Natural gas* GL
1978–79	24,847	3,170	7,767
1979–80	23,667	3,111	9,008
1980–81	23,052	2,982	10,435
1981–82	22,378	3,029	11,550
1982–83	22,069	2,906	11,654

(*a*) Naturally occurring.

Liquefied petroleum gas

Liquefied petroleum gas (LPG) is a valuable co-product of oil and gas production and petroleum refining. The major constituents of LPG are propane, propylene and iso- and normal-butane, which are gaseous at normal temperatures and pressures and are easily liquefied at moderate pressures or reduced temperature. Because of the low boiling points of its constituents LPG has to be refrigerated or pressurized in storage and transport, which makes operations expensive. LPG is a promising alternative transport fuel for high mileage vehicles in capital cities.

Identified economically recoverable resources of LPG at December 1982 of 100,380 megalitres (ML) are concentrated in Bass Strait, the North West Shelf and the Cooper Basin. In addition the Bureau of Mineral Resources, Geology and Geophysics estimates there is an 80 per cent probability of future discoveries identifying a further 90,000 ML of LPG.

Production of naturally occurring LPG in Australia in 1982-83 was 2,906 ML (virtually all being extracted from crude oil and natural gas from the Bass Strait fields). About 66 per cent of Australia's LPG production is exported (2,334 ML in 1982-83)—mainly to Japan. Exports could be diverted to meet domestic needs, given sufficient incentive. Most of Australia's 1982-83 consumption of LPG of 1,029 ML was obtained from oil refineries and as a by-product of the chemical industry.

The Cooper Basin producers have announced their intention to recover LPG from mid-1984 as part of a liquids extraction scheme. Annual output from the Basin is expected to be about 1 ML in the mid-1980s.

Pricing of Australian crude oil

The pricing of Australian crude oil at import parity levels is fundamental to energy policy in Australia. Crude oil is a scarce and valuable resource and the Government considers that it should be competitively priced, to ensure that its usage recognises this value. Import parity pricing is considered essential to encourage:

- conservation of liquid fuels;
- exploration and development;
- substitution by more plentiful gaseous and solid fuels; and
- the economic development of liquid fuel substitutes.

Import parity pricing provides the basis for the long-term security of supply for Australia and the continuous adaption of the Australian economy to changing world energy prices.

The present pricing and excise arrangements are based on the June 1983 Commonwealth Government announcements. Refiners pay import parity prices for all crude oil. Producers receive the full import parity price for oil discovered on or after 18 August 1976. For oil discovered before 18 September 1975 (old oil), producers pay excise according to the annual production of the producing field (or area). These rates are given in the following table.

CRUDE OIL PRODUCTION: EXCISE PERCENTAGES PAID AND PRODUCER RETURNS, AUSTRALIA

		Producer returns (a) as from 1 July 1983		
Annual production from field/area	*Excise as a percentage of Bass Strait import parity price*	*Bass Strait*	*Barrow Island*	*Cooper Basin*
Megalitres	*Percentage*	*$/kilolitre*	*$/kilolitre*	*$/kilolitre*
0-50	0	229.85	234.23	229.64
50-100	5	218.36	222.74	218.15
100-200	15	195.37	199.75	195.16
200-300	20	183.88	188.26	183.67
300-400	40	137.91	142.29	137.70
400-500	70	68.95	73.33	68.74
500-600	80	45.97	50.35	45.76
Greater than 600	87	29.88	34.26	29.67

(a) Moonie and Dongara crude oils receive the full import parity price of $240.59/kL and $214.56/kL respectively, since their production does not exceed 50 ML per annum. Jackson crude oil receives the full import parity price of $219.67/kL since its production is excise free new oil.

The import parity prices are currently reviewed every six months (1 January and 1 July), but more frequently if there are major changes in circumstances. The prices are based on the landed cost of Saudi Arabian Light crude oil at the nearest refinery port to the producing field adjusted for domestic freight costs and quality differentials. The current import parity prices, from 1 July 1983, are $229.85/kL ($36.53/barrel) for Bass Strait crude, $234.23/kL ($37.22/barrel) for Barrow Island, $214.56/kL ($34.10/barrel) for Dongara, $219.67/kL ($34.91/barrel) for Jackson, $229.64/kL ($36.49/barrel) for other Cooper Basin, $240.59/kL ($38.23/barrel) for Moonie and nearby areas. These prices are based on a $US29/barrel price for the marker crude, Saudi Arabian Light.

Royalties are paid to the relevant State Governments for onshore production and, in the case of offshore production, are shared between the Commonwealth and the States under the Petroleum (Submerged Lands) (Royalty) Act.

Crude Oil Allocation Scheme

The crude oil allocation scheme was designed to stimulate the production of Australian crude oil by guaranteeing a market for this production which was then a relatively expensive source of crude oil. The present allocation scheme first came into operation in September 1971. On 17 September 1980 the then Minister for National Development and Energy announced the extension of this scheme, subject to some modifications, until 31 December 1984.

The Scheme provides for the allocation of indigenous crude oil to refiner/marketers based on their market share of most refined petroleum products sold in Australia.

The only major petroleum product that currently does not attract a full allocation is fuel oil.

An important modification made to the crude oil allocation scheme in 1980 was that from 1 January 1981, producers of crude oil who continue the sale of gas condensate (liquid petroleum produced in association with natural gas) may retain an equivalent volume of crude oil for their own use or disposal. This producers' entitlement to crude oil is however subject to the crude oil excise and import parity pricing arrangements. Condensate marketed separately from a crude oil stream is not subject to allocation and excise and is sold at free market prices.

In August 1983, the Government announced that exports of Bass Strait crude oil which are surplus to domestic refiners' requirements would be permitted. Government approval would be required for each export cargo.

The crude oil allocation scheme facilitates an equitable distribution, to the refiners, of indigenous crude oil at the import parity price.

Pricing of liquefied petroleum gas (LPG)

Under the pricing arrangements applying since April 1980, the Commonwealth Government sets the price that the producers receive for LPG sold for automotive, domestic and traditional commercial/industrial uses at a level such that the resulting retail prices provide an incentive for its use as an automotive fuel, and do not cause undue hardship to other users. The policy was designed to maintain an ongoing substantial margin between the prices of petrol and LPG. The Government's LPG price scheme does not apply to large scale non-traditional commercial/industrial uses, exports or petrochemical uses. In these areas, the price is determined by commercial negotiation.

The price set by the Government for both naturally occurring and refinery produced LPG is determined at the lesser of $205 per tonne indexed to increases in the import parity price of indigenous crude oil since 1 January 1980, and the export parity price. Until 30 June 1981, the index linked price applied, but following a significant fall in the world market price for LPG, the prices applying were then based on the export parity price until 30 June 1983. Due to increases in international prices and the March 1983 devaluation of the Australian dollar, the designated price at 1 July 1983 was the crude oil linked price of $304.44 per tonne.

Under the excise arrangements announced on 8 April 1980, producers of naturally occurring LPG from fields in production prior to 17 August 1977 pay excise at a rate equivalent to 60 per cent of the excess of the weighted average of domestic and export prices of $147 per tonne. Naturally occurring LPG from fields brought into production on or after 17 August 1977 remains free of excise.

A factor in the retail price of LPG and reticulation gas produced from LPG and naphtha is the subsidy of $80 per tonne introduced during 1980 for household users and commercial and industrial users in areas without access to natural gas. The subsidy is due for review by March 1984.

Oil shale

A description of the nature and location of Australian oil shale deposits is given in Year Book No. 67, page 468.

Investigations into shale oil development are concentrated on the deposits at Rundle and Condor. In addition, studies are continuing at other deposits, including Yaamba, Julia Creek and Nagoorin.

Uranium

Details concerning the use and discovery of uranium and the development of uranium mining in Australia are contained in Year Book No. 67, pages 468 and 469.

Following the change of Government in March 1983 the new Government instituted a complete review of all aspects of Australia's policies as they relate to uranium, covering the future of existing mines, the development of new mines, the terms and conditions to be imposed on any exports and the question of further processing in Australia including enrichment. The outcome of this review was expected to be announced in late 1983.

Pending the completion of this review, commitments under existing approved contracts were being met. In the case of France however, future supplies of Australian uranium for end use in France were not being approved in circumstances of continued French nuclear testing in the South Pacific.

Australian Atomic Energy Commission (AAEC). The AAEC was established as a statutory body by the Commonwealth Parliament under the *Atomic Energy Act* 1953.

The AAEC's activities are controlled by a Commission which is responsible to the Minister for Resources and Energy. The Atomic Energy Act provides for the Commission to consist of five Commissioners including a Chairman.

Moving in its earliest days towards the planning and construction of a nuclear research establishment at Lucas Heights near Sydney, the Commission arranged for a nucleus of scientists and engineers to obtain training and experience through overseas attachments, mainly in the United Kingdom. By the late 1950's a research and development (R&D) program had been initiated at its research establishment.

The Commission's current nuclear program includes radioisotope production and applications, waste management studies, environmental science (particularly in relation to uranium mining activities) and provision of support for regulatory and international operations. The Commission also operates two nuclear research reactors 'HIFAR' 10 megawatt (MW) thermal and 'MOATA' 100 kilowatt (kW) thermal at Lucas Heights.

The programs, structure and functions of the AAEC are currently under review. Particular attention is being given to ensuring that the functions and programs of the AAEC are appropriate to national requirements.

Current expenditure by the AAEC is of the order of $39 million a year. Staff totals some 1120 professional, technical, trade, administration and support personnel.

The AAEC participates in the activities of the Australian Institute of Nuclear Science and Engineering. The Institute, which has a corporate membership comprising the Commission and the Australian universities, is concerned with the awarding of studentships, fellowships and research grants, with the organising of conferences and with arranging the use of AAEC facilities by research workers within the universities and colleges of advanced education. The Australian School of Nuclear Technology, located at Lucas Heights, is a joint enterprise of the AAEC and the University of New South Wales. Courses are provided regularly on such subjects as radio-nuclides in medicine, radiation protection and nuclear technology. Participants have been drawn from Australia, New Zealand, Asia, Africa, Papua New Guinea and the Pacific region.

The Atomic Energy Act is the principal Commonwealth legislation in the nuclear field. As well as being the legislative basis for the AAEC, the Act provides for Commonwealth powers over uranium and nuclear materials. It was also used as the basis for the authorisation of the Ranger Uranium Mine.

The Government's policy is to replace the Atomic Energy Act with new legislation for the AAEC, and to give effect to Australia's international nuclear non-proliferation and safeguards obligations.

For further details relating to the production of uranium in Australia see Chapter 16, Mineral Industry.

Thorium

Thorium is about three times as abundant in the earth's crust as uranium. However, because of the resistance of primary thorium minerals to chemical alteration, secondary thorium minerals are rare. Thorium therefore occurs in fewer geological environments than uranium. The bulk of potentially exploitable resources of thorium occur in essentially lower grade accumulations than the exploitable resources of uranium. Most of the world's thorium resources occur in monazite, a complex silicate which is currently recovered primarily for its content of rare-earth oxides. Primary thorium minerals (including monazite) are resistant to oxidation and form economically important placer deposits. Large deposits occur throughout the world in beach and stream placers and also as hard-rock deposits in veins, sedimentary rocks, alkalic igneous rocks and carbonatites.

In Australia, by-product monazite in titanium-bearing minerals sands on the east and west coasts of the continent is currently the only economical source of thorium, although other occurrences of thorium minerals are known. Australia currently supplies about half of the world's monazite requirements.

The Commonwealth Government controls the export of thorium and thorium minerals under the authority of the Customs (Prohibited Exports) Regulations as amended from time to time by Statutory Rules. The export of minerals containing thorium and thorium compounds and alloys is prohibited without the approval of the Minister for Trade.

Solar energy

Solar radiation is measured continuously on a routine basis by the Bureau of Meteorology at 28 stations throughout Australia. These stations also supply data on air temperatures, dewpoint and wind.

Like wind, tidal and wave energy, solar energy is inexhaustible and shares with these energy sources a number of properties which make it both difficult and costly to collect, store and transform into useful work. In particular, these are the characteristics of low intensity and of geographic, seasonal and daily variations.

The use of solar energy for domestic hot water supply is well established commercially in Australia and the solar hot water systems industry production now has a value of about $44 million per annum.

With a view to industrial application, advanced collectors have been designed which can produce steam. Currently, however there appear to be few applications of solar energy which are economically attractive to industry.

The use of passive solar design principles in housing is increasing and relatively low cost passive designs have been developed. In the area of electricity generation, photo-voltaics are already viable in some small-scale specialist applications, for example in navigation and communications stations. If costs are reduced, solar electricity may be used increasingly in the future for remote homestead or community power supply and for water pumping. Solar cooling is not economic at this stage owing to high capital costs and low efficiencies.

Ocean thermal energy

In Australia, virtually no assessment of the potential of the ocean thermal energy source has been made. It has been suggested that tropical waters such as those off the Queensland coast would be suitable, but power generated from this area would be a considerable distance from the major power consumers in the south and probably not competitive with electricity based on coal.

Wind energy

Using data from Bureau of Meteorology stations, CSIRO has undertaken a continental wind assessment of Australia. In addition, a number of site specific wind resource assessments have been carried out by CSIRO and other bodies. Broadly, these studies indicate that while the bulk of the Australian inland has relatively low average windspeeds, some coastal and island localities have favourable wind energy resources, notably on the Western Australian, South Australian and Tasmanian coasts, in Bass Strait and on Lord Howe Island.

At present the use of wind energy in Australia is confined principally to mechanical windmills for water pumping and small wind electricity generators for remote areas. In addition three larger machines in the 20-55 kW range are currently being demonstrated on Rottnest Island in Western Australia and a 55 kW wind generator is operating at Ballarat.

It is unlikely that wind energy will be able to compete on a widespread and large scale with coal for electricity generation in Australia, but where wind resources are favourable wind turbines could find increasing application in remote areas, which currently rely on diesel fuel for electricity production.

Geothermal energy

Most of Australia's geothermal resources are of conduction-dominated type. The most extensive and well documented study in Australia of subsurface temperatures has been made in bore-holes in the Great Artesian Basin. In this basin, about 20 per cent of indexed water bores penetrate to depths greater than 1,000 m and since geothermal gradients are generally greater than 30°C/1,000 m, it is reasonable to assume that hot water can be obtained from such aquifers. Of the total number of indexed water bores, only a very small proportion have water temperatures greater than 100°C.

Australia's geothermal resources in other basins are probably comparable with that in the Great Artesian Basin, since the extrapolation of flow rates and temperatures to other sedimentary basins is considered geologically reasonable. Economic and technical difficulties suggest that in the foreseeable future the potential use of our geothermal resources will be largely restricted to hot water supply, for space heating and light industrial purposes.

In Australia, it has been estimated by the Bureau of Mineral Resources that identified (demonstrated and inferred) geothermal resources are about 1 per cent of Australia's annual primary energy consumption. Undiscovered geothermal resources may be many orders of magnitude greater than the above estimate.

Tidal energy

Tidal energy is a dispersed energy source derived from regular fluctuations in the combined gravitational forces exerted by the moon and the sun, at any one point on the earth's surface, as the earth rotates. The mean tidal range in the open ocean is about 1 metre, but under suitable hydraulic and topographical conditions, much higher tides than this build up in places around coasts, due to resonance. Because only two commercial tidal plants exist so far in the world, relatively little is known about the possible environmental impact of large-scale utilisation. It is unlikely, however, that tidal installations would be entirely without effect on the ecological life of bays and estuaries within their area of influence due, for instance, to silting and concomitant dredging.

Around Australia there are theoretically very large amounts of tidal energy available, especially on the north-west coast where the tidal range is as great as 11 metres and where the topography is suitable. The tidal potential of this region has been the subject of a series of investigations, including one carried out in 1965 on one of the most promising sites at Secure Bay. It was concluded that a minimum of 12

years design and construction time would be required, although the cost of electricity at the site would be similar to that derived from conventional thermal stations. However, the long distances to potential markets result in a doubling of these electricity generation costs. Subsequent studies by the State Energy Commission of Western Australia have indicated that lead times and construction costs could be reduced but not sufficiently to make tidal energy economically attractive even if a suitable electricity consumer were nearby.

The likelihood of early exploitation of this resource would appear to be less than in other countries, if only because of the long distances involved in transmission to population centres. In Australia, the major consumer regions are located along coastlines where the tidal range is very small.

Biomass

Biomass includes crops, wood, agricultural and forestry residues, and animal wastes. Currently only two forms of biomass are used significantly as energy resources in Australia. These are firewood and bagasse, both converted to energy by direct combustion.

Approximately 2 megatonnes of firewood are used annually in Australia, equivalent in energy terms to 82.3 petajoules, or 2.6% of Australia's primary energy demand. Production is expected to remain stable at about this level through the 1980s.

Bagasse is the fibrous residue remaining after extraction of the juice from sugar cane. It is the major fuel used in the sugar industry, providing 68.5 petajoules or 2.2% of Australia's total primary energy demand.

Biomass also has a possible use as a source of liquid fuels for transport, particularly ethanol and methanol. Technologies are commercially available for converting biomass to liquid fuels. The major impediments to its current use are that it is not competitive with conventional fuels and generally vehicle modifications are necessary for satisfactory operation.

In 1979, the CSIRO completed a survey of the potential for the production of these fuels from agricultural and forestry resources in Australia. The resources considered were both new energy crops and forest plantations, as well as the residues from existing crop and forest production. In estimating potential new crop production, it was assumed that all land with suitable climate, soil and terrain for an energy crop would be available for energy farming except land at present under crops or sown pastures. The total biomass resources considered could provide a net liquid fuels output of 460 petajoules, 65% of the energy used as liquid fuel in transport in 1977-78. This is a net figure taking into account the liquid fuel used in production. It does not take into account socio-economic considerations such as more profitable or socially desirable uses of the land available for new crops. It must be considered as an upper limit only.

Recent studies have shown that, largely as a result of the cost of production of the feedstocks, liquid fuel from biomass is at a major economic disadvantage compared to petroleum-based fuels, and is unlikely to be commercialised on a significant scale in the near future.

Electric power

The information contained in this section relates to situations existing and projects contemplated, and may be considerably affected by changes in policy or plans, or by developments in the projects themselves. Greater descriptive and historical detail about the various systems is contained in earlier issues of the Year Book.

Hydro-Electric Resources

With the exception of Tasmania, Australia is generally not well-endowed with hydro-electric resources because of low average rainfall and limited areas of high relief. Major hydro-electric potential is confined to Tasmania and the Great Dividing Range areas of Victoria, New South Wales and Queensland, with some small potential on rivers draining into the Timor Sea in Western Australia and the Northern Territory.

The practical potential of hydro-electric power in Australia has been estimated at 24,000 gigawatt hours (GWh) per year, of which about 60% has currently been developed. In 1981/82, hydro-electric generation of 14,516 GWh was slightly down on the previous year owing to drought conditions.

At 30 June 1982 the installed hydro-electric generating capacity of 6,332 mega watts (MW) represented 23% of total installed capacity.

Future hydro development will be mainly limited to environmentally acceptable sites in Tasmania, and to a lesser extent North Queensland, as most of the low cost resource elsewhere has already been developed. Although hydro-electric power stations will continue to be constructed into the 1990s and probably beyond, hydro's share of total generation will decline as increasing load is met mainly by coal-fired power stations.

Snowy Mountains Hydro-Electric Scheme

The Snowy Mountains Scheme is a dual purpose complex which supplies water for generation and irrigation. It is located in south-eastern Australia, and on its completion 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.

The Scheme was designed and constructed by the Snowy Mountains Authority which was established by the *Snowy Mountains Hydro-Electric Power Act* 1949. It was completed in 1974 and has an installed capacity of 3,740 MW and an annual average energy output of over 5,000 GWh. An average of 2,300 GL of water per year has become available for irrigation in the Murray and Murrumbidgee rivers as a result of the Scheme.

The operation and maintenance of the Scheme is directed by the Snowy Mountains Council which was established in 1959 following an agreement between the Commonwealth, New South Wales and Victorian Governments. The Commonwealth Government reserves 670 GWh of the Scheme's output for supply to the Australian Capital Territory, the remainder being shared between the States of New South Wales and Victoria in the ratio 2:1.

Electricity generation and transmission

The following table shows details of thermal and hydro electricity generated in Australia during recent years.

ELECTRICITY (*a*)—THERMAL AND HYDRO

Year	*Million kWh*
1976–77	82,522
1977–78	86,095
1978–79	90,857
1979–80	95,910
1980–81	100,782
1981–82	105,034

(*a*) Figures represent estimates of total electricity generated by public utilities, factories generating for their own use, and factories supplying electricity for domestic and other consumption.

NEW SOUTH WALES

Electricity Commission of New South Wales and electricity supply authorities

The main function of the Commission is the generation and transmission of electricity, which it sells in bulk to distributing authorities (mainly local government bodies) throughout a large part of the State, to the Government railways and to certain large industrial consumers. As the major generating authority, it is also responsible for the development of new power sources except in the Snowy Mountains region.

The retail sale of electricity to the public is, in general, carried out by separate electricity supply authorities. At 30 June 1983 there were 28 retail supply authorities throughout the State, comprising 23 electricity county councils (consisting of groups of shire and/or municipal councils), 1 city council, 1 shire council, and 3 private franchise holders.

Most electricity distribution areas have been consolidated into county districts consisting of a number of neighbouring local government areas grouped for electricity supply purposes and administered by a county council comprising representatives elected by the constituent councils. Of the 175 cities, municipalities and shires in New South Wales, 172 are included in one or other of the 23 electricity county districts.

The Energy Authority of New South Wales

The *Electricity Development Act* 1945, confers broad powers on the Energy Authority to co-ordinate and develop the public electricity supply industry. The functions of the Authority include the

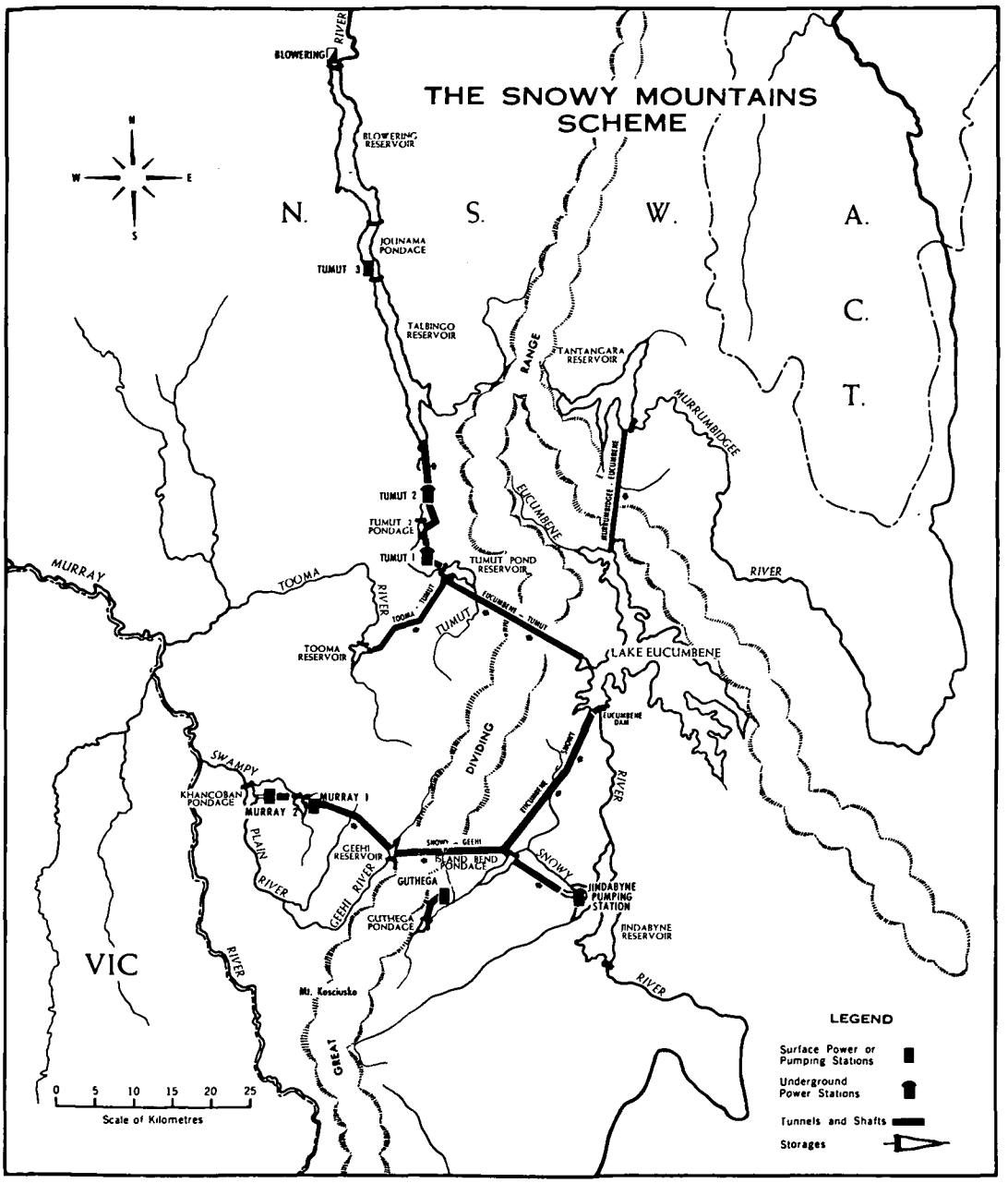
THE SNOWY MOUNTAINS SCHEME
N. S. W. A. C. T.
VIC
BLOWERING RIVER
BLOWERING
BLOWERING RESERVOIR
JOUNAMA PONDAGE
TUMUT 3
TALBINGO RESERVOIR
TUMUT 2
TUMUT 2 PONDAGE
TUMUT 1
TUMUT POND RESERVOIR
TOOMA RIVER
TOOMA RESERVOIR
TUMUT
EUCUMBENE - TUMUT
LAKE EUCUMBENE
EUCUMBENE DAM
EUCUMBENE
EUCUMBENE - SNOWY
DIVIDING RANGE
TANTANGARA RESERVOIR
MURRUMBIDGEE - EUCUMBENE
MURRUMBIDGEE RIVER
EUCUMBENE RIVER
MURRAY RIVER
SWAMPY PLAIN RIVER
KHANCOBAN PONDAGE
MURRAY 1
MURRAY 2
GEEHI RESERVOIR
SNOWY - GEEHI
ISLAND BEND PONDAGE
GUTHEGA
GUTHEGA PONDAGE
GEEHI RIVER
SNOWY RIVER
JINDABYNE PUMPING STATION
JINDABYNE RESERVOIR
Mt. Kosciusko
GREAT DIVIDING RANGE
0 5 10 15 20 25
Scale of Kilometres
LEGEND
Surface Power or Pumping Stations
Underground Power Stations
Tunnels and Shafts
Storages

PLATE 40

promotion of the wise use of electricity, especially its use for industrial and manufacturing purposes and for primary production. Technical advice is given to retail electricity supply authorities on various aspects of their activities such as the framing of retail electricity tariffs, public lighting and the standardising of materials and equipment.

The Authority continues to administer the Rural Electricity Subsidy Scheme which terminated on 30 June 1983. Under the scheme, the rural electrical development of the State has now been virtually completed where the extension of supply is economically feasible. Local electricity suppliers receive subsidies from the Authority towards the cost of new rural lines. At 30 June 1983 the Authority was committed to the payment of $45,216,203 in subsidies, of which $39,661,585 had been paid. Further details of the operation of the scheme are given in Year Book No. 56, page 956.

The Authority also administers the Traffic Route Lighting Subsidy Scheme, which provides for financial assistance to councils towards the cost of installation of improved lighting on traffic routes traversing built-up areas with the objective of reducing the incidence of at night road accidents. Since the introduction of the scheme in 1964, subsidy has been approved in respect of some 1,866 kilometres of traffic routes throughout the State.

Generation and transmission

Of the State's electrical power requirements during the year ended 30 June 1983, almost all was generated in New South Wales (89.8 per cent by thermal fired power stations, 5.9 per cent from the Snowy Mountains Hydro-electric Authority and 0.9 per cent by other hydro-electric stations). The remaining 3.4 per cent was supplied by various sources, including interchange with other States and other small generating authorities in New South Wales.

Major generating stations. At 30 June 1983 the major power stations of the State system of the Electricity Commission of New South Wales and their nominal capacities were as follows: Liddell (Hunter Valley), 2,000 MW; Munmorah (Tuggerah Lakes), 1,400 MW; Vales Point (Lake Macquarie), 2,195 MW; Eraring, 1,320 MW; Wallerawang (near Lithgow), 1,240 MW. The total nominal capacity of the Electricity Commission's system as at 30 June 1983 was 9,851 MW. The greater part of the Commission's generating plant is concentrated within a hundred and eighty-five kilometre radius of Sydney.

Major transmission network. The retailing of electricity to 97 per cent of the population of New South Wales is in the hands of local distributing authorities, which obtain electricity in bulk from the Commission's major State network. This network of 500 kV, 330 kV, 132 kV, 66 kV and some 33 kV transmission lines links the Commission's power stations with the load centres throughout the eastern portions of the State, extending geographically over 650 kilometres inland.

At 30 June 1983 there were in service, 3,940 circuit kilometres of 330 kV, 7,328 kilometres of 132 kV transmission lines and 282 kilometres of 500 kV transmission lines. There were also in service 5,424 kilometres of transmission line of 66 kV and lower voltages, and 517 kilometres of underground cable. The installed transformer capacity at the Commission's 174 substations was 28,888 MVA.

Separate systems and total State installed capacity. Several local government bodies operate their own power stations and generate a portion of their requirements which is supplemented by interconnection with the system of the Electricity Commission. Of these, the more important are the Northern Rivers County Council (installed capacity 13.1 MW), the North-West County Council (15.75 MW) and the New England County Council (57 MW). The aggregate effective capacity for the whole of New South Wales systems and isolated plants was approximately 9,880 MW at 30 June 1983, while the number of ultimate consumers at this date was 2,130,945.

Future developments

Future projects include the installation of 5,280 MW of coal-fired generating plant. Two additional 660 MW units are being installed at Eraring Power Station on the central coast and will be commissioned progressively for full commercial service over the period 1983-1984. At Bayswater Power Station, which is situated in the Hunter Valley, construction has commenced on four 660 MW units. Two 660 MW units are also planned for Mount Piper Power Station which is located on the western coalfield near Wallerawang. Commissioning of the Bayswater units is planned between 1985 and 1987 with Mount Piper to follow at a later date.

Construction of a double circuit 500 kV transmission line between Eraring and Kemps Creek, west of Sydney is complete. This transmission line is initially operating at 330 kV but operation at 500 kV is planned early in 1984. A double circuit 500 kV transmission link will be constructed from Bayswater Power Station to Mount Piper Power Station and thence to Marulan where it will be interconnected with the existing transmission system between the Snowy Mountains and Sydney.

Hydro-electricity

The greater part of the hydro-electric potential of New South Wales is concentrated in the Snowy Mountains area (*see* Snowy Mountains Hydro-electric Scheme, page 406). Apart from this area, major hydro-electric stations are in operation at the Warragamba Dam (50 MW) and Hume Dam (50 MW). In addition, there are six smaller hydro-electric installations in operation in various parts of the State. A pumped-storage hydro-electric system to produce 240 MW has been installed as part of the Shoalhaven Scheme in conjunction with the Metropolitan Water Sewerage and Drainage Board.

VICTORIA

State Electricity Commission (SEC)

The SEC is Australia's largest electricity supply authority and individual coal producer. It is a semi-government authority with the principal responsibility of generating or purchasing electricity for supply throughout Victoria. It may own, develop and operate brown coal open cuts and briquetting plants and develop the State's hydro-electric resources. It is required to meet, from its own revenue, all expenditure involved with operating its power and fuel undertakings and to provide for statutory transfers to the consolidated revenue of the State. In 1982–83 its revenue was $1,275 million. At 30 June 1983 it had total fixed assets of $4,620 million and a staff of 22,800.

The SEC was established by an Act of the Victorian Parliament in 1921 and now operates under the *State Electricity Commission Act 1958*. Since it began operating, the SEC has expanded and co-ordinated the generation, purchase and supply of electricity on a statewide basis to the stage where its system provides almost all the electricity produced in Victoria and its transmission covers almost the entire population of the State. At 30 June 1983 it distributed electricity directly to 1.363 million customers and indirectly to a further 278,000 through 11 metropolitan councils which buy power in bulk for retail distribution under franchises granted by the Victorian Government before the SEC's establishment.

Existing electricity system

The SEC Act requires the SEC to apply the natural resources of the State. Of the State's recoverable fossil fuel reserves, brown coal represents 94.6 per cent, natural gas 2.6 and oil 2.8. The SEC therefore has committed itself to increasing the proportion of total Victorian requirements met with coal-based energy.

Victoria's electricity system is based upon the State's extensive brown coal resource in the Latrobe Valley 140 to 180 km east of Melbourne in central Gippsland. It is one of the largest single brown coal deposits in the world, amounting to 108,000 megatonnes of which 35,000 are economically winnable.

The coal is young and soft with a moisture content of 60 to 70 per cent and occurs in thick seams from relatively close to the surface to a depth of several hundred metres. The coal can be won continuously in large quantities and at low cost by a specialised mechanical plant. The SEC's coal-fired power stations have been established near the coal deposits because the coal's moisture content would make the coal expensive to transport, every three tonnes of material including two tonnes of water.

The major brown coal-fired generating plants in the system are the 1,600 MW Hazelwood and 1,450 MW Yallourn 'W' power stations. Other brown coal-fired plants are Morwell (170 MW) and Yallourn 'C', 'D' and 'E' (521 MW). These stations are all located in the Latrobe Valley and generate three-quarters 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), Dartmouth (150 MW), Eildon/Rubicon/Cairn Curran (137 MW). Victoria is also entitled to about 30 per cent of the output of the Snowy Mountains Hydro-electric Scheme and half of the output of the Hume hydro-electric station near Albury.

The SEC's total installed generating plant capacity at 30 June 1983 was 6,344 MW, including both capacity within the State and that available to it from New South Wales. In 1982–83 electricity generated by the SEC in its thermal and hydro-electric power stations and purchased totalled 25,196 GWh.

Power station construction

Construction of the Loy Yang 'A' power station complex south-east of Traralgon in the Latrobe Valley was authorised by the Victorian Government in 1976. It is the largest single engineering project undertaken in Australia. Coal-fired, Loy Yang will provide base load electricity for the Victorian grid and almost double the State's generating capacity. The project nominally comprises two 2,000 MW power stations, Loy Yang 'A' and Loy Yang 'B' in eight 500 MW units. The first unit is to come into service in 1984.

Transmission and distribution

The distribution of electricity throughout Victoria has been completed, except for some isolated and remote areas of the State. Main transmission is by 500, 330, 220 and 66 kV transmission lines which supply the principal distribution centres and interconnection between generating sources.

Three 500 kV transmission lines, Australia's first, and six 220 kV lines link the Latrobe Valley stations with Melbourne and the State grid while three 330 kV lines provide the interstate link, two through the Snowy scheme. Bulk distribution of power throughout the main regional areas is by 220 kV lines to terminal stations which reduce the voltage to 66 kV or 22 kV for delivery to zone substations for further distribution. Feeder lines then deliver to distribution substations which in turn reduce the voltage to 415/240 volts for reticulation to individual customers. Some big industrial concerns take power at higher voltages.

Major development of the transmission system in 1982–83 included the completion of the third 500 kV line from Hazelwood to South Morang to reinforce the system between the Latrobe Valley and Melbourne. Another major project was the completion of the 272 km 500 kV line from Geelong to Portland, the longest transmission line of its type in Australia. Two 500 kV lines, completed between Sydenham and Geelong, will meet Geelong's projected demand and, with the Geelong-Portland line, supply an aluminium smelter proposed for development at Portland.

QUEENSLAND

Organisations

The State Electricity Commission of Queensland's main functions are to plan and ensure the proper development and co-ordination of the electricity supply industry throughout the State; to enforce safety regulations; to control electricity charges; to raise capital for development and to administer the *Electricity Act* 1976-1982 which regulates the electricity supply industry in Queensland.

The Queensland Government has decided to amalgamate the functions of the Commission and the Queensland Electricity Generating Board. Enabling legislation is to be introduced as soon as possible, however, as an interim measure the Government has dissolved the Generating Board and appointed the Commission to perform the duties of that Board.

The Queensland Electricity Generating Board is responsible for generation and main transmission. It operates the State's major power stations, and supplies, via its Statewide transmission network, energy in bulk to the seven distributing boards whose responsibility it is to distribute electricity to consumers in their respective areas. These boards are The South East Queensland Electrictity Board; The South West Queensland Electricity Board; The Wide Bay—Burnett Electricity Board; The Capricornia Electricity Board; The Mackay Electricity Board; The North Queensland Electricity Board and the Far North Queensland Electricity Board.

Four of these distributing boards (The South West Queensland, The Capricornia, The North Queensland and The Far North Queensland) also operate small internal combustion stations in their respective areas.

Electricity generation, transmission and distribution

Over ninety per cent of the State's generation is derived from steam power stations fuelled by black coal. Hydro-electric stations located in North Queensland provide around 5 per cent, depending on rainfall in the catchment areas, with the balance being generated by gas turbine and diesel power stations using light fuel oil. The Roma diesel power station also uses locally produced natural gas. Electricity generated by the public supply authorities in Queensland in 1982–83 totalled 14,736 million kWh. In addition 171 million kWh were purchased in bulk from other producers of electricity for redistribution to consumers.

At 30 June 1983 the total generating capacity of the publicly-owned stations in the State was 3,614 MW, comprising 3,246 MW of steam plant, 132 MW of hydro-electric plant, 178 MW of gas turbine plant and 58 MW of internal combustion plant.

The following table lists the regional locations, types and capacities of major publicly-owned power stations in Queensland.

QUEENSLAND POWER STATIONS—CAPACITY AND TYPE, 30 JUNE 1983

(*Source*: Department of Resources and Energy)

Location	*Type*	*Capacity (MW)*
	SOUTHERN REGION	
Swanbank A	Steam	396
Swanbank B	Steam	480
Swanbank C	Gas turbine	30
Tennyson	Steam	240
Bulimba	Steam	180
Middle Ridge	Gas turbine	60
Tarong	Gas turbine	15
	CENTRAL REGION	
Gladstone	Steam	1,650
Gladstone	Gas turbine	14
Callide	Steam	120
Rockhampton	Gas turbine	25
	NORTHERN REGION	
Kareeya	Hydro	72
Barron Gorge	Hydro	60
Collinsville	Steam	180
Mackay	Gas turbine	34

The electrical transmission and distribution system within the State comprised 133,690 circuit kilometres of electric lines and at 30 June 1983 supplied approximately 909,000 customers. The main transmission voltages are 275 kV, 132 kV, 110 kV, 66 kV and in certain areas 33 kV and 22 kV. The single wire earth return system is used extensively in rural electrification and 38,128 kilometres of line for this system of distribution was in service at 30 June 1983.

Future development

There are four major generation projects being developed and under construction in Queensland and when completed will provide a sound basis for ensuring adequate electricity supply for the State into the next decade.

The Wivenhoe Pumped Storage Hydro Electric project when completed in 1984 will consist of two 250 MW pump/turbine generating units, 107 route kilometres of 275 kV transmission lines and one substation with a total transformer capacity of 624 MVA.

The Tarong Power Station will consist of four 350 MW generating units and the expected commissioning dates for each of the four sets are May 1984, May 1985, February 1986 and November 1986. Included with the project is a 15 MW gas turbine generating unit which was commissioned in March 1983 and is now available to supply power to the system. To connect this power station to the main transmission network will require the construction of 331 route kilometres of 275 kV transmission lines and 3 substations with a transformer capacity of 2,000 MVA.

The Callide "B" Power Station, expected to be completed by 1989, will consist of two 350 MW generating units and its connection to the central grid will involve the construction of 290 route kilometres of 275 kV transmission lines and installation of transformers with a capacity of 800 MVA.

The fourth power station is to be sited at Stanwell (24 km south-west of Rockhampton) and may be required to produce energy as early as 1989. The power station will consist of four 350 MW generating units and will necessitate construction of almost 400 kilometres of 275 kV transmission line.

SOUTH AUSTRALIA

Electricity Trust of South Australia

In 1946 the assets of the Adelaide Electric Supply Co. Ltd were transferred to a newly-formed public authority, the Electricity Trust of South Australia, which became responsible for unification and coordination of the major portion of the State's electricity supply and which took over the powers previously vested in the South Australian Electricity Commission. In addition to the powers specified in the Adelaide Electric Supply Company's Acts, 1897–1931, the Trust may supply electricity direct to consumers within a district or municipality with the approval of the local authority; arrange, by agreement with other organisations which generate or supply electricity, to inter-connect the mains of the Trust with those of other organisations; and give or receive supplies of electricity in bulk.

Capacity and production

Of the total installed capacity in South Australia at 30 June 1982, the Electricity Trust operated a plant with a capacity of 2,090 MW, making it the most important authority supplying electricity in the State. There were approximately 576,000 ultimate consumers of electricity in the State, of whom 566,874 were supplied directly and approximately 9,000 indirectly (i.e. through bulk supply) by the Trust. Its major steam stations are Osborne (240 MW), Port Augusta Playford 'A' (90 MW) and Playford 'B' (240 MW), and Torrens Island (1,280 MW). The Trust also operates a turbo-generator station at Dry Creek (156 MW), a small station at Port Lincoln (9 MW), and one at Snuggery (75 MW).

The two main fuels used by the Trust are sub-bituminous coal from Leigh Creek for the Playford power stations at Port Augusta and natural gas from the Gidgealpa-Moomba field for the Torrens Island and Dry Creek stations.

WESTERN AUSTRALIA

State Energy Commission of Western Australia

On 1 July 1975 the Government of Western Australia combined the State Electricity Commission and the Fuel and Power Commission to form a new organisation known as the State Energy Commission of Western Australia. The Commission is specifically charged with the responsibility for ensuring the effective and efficient utilisation of the State's energy resources and for providing its people with economical and reliable supplies of electricity and gas.

The Commission owns and operates four major thermal power stations. These are located at Kwinana, Muja, South Fremantle and Bunbury and all use local coal to produce electricity. Kwinana power station also has the capacity to burn oil or natural gas. A small hydro-electric station is situated at Wellington Dam near Collie, and there are gas turbine generating units at Geraldton and Kwinana.

Power from the four major stations is fed to an interconnected grid system which supplies the electricity needs of 98 per cent of the State's population. The grid services the metropolitan area and the South West and Great Southern areas, including an area extending to Koolyanobbing and northwards as far as Kalbarri, some 100 km north of Geraldton.

In areas too remote to utilise the interconnected grid system, diesel power stations are used. The Commission owns and operates 10 of these diesel stations. Of the remaining stations, 22 are owned by local authorities but operated by the Commission under the Country Towns' Assistance Scheme (CTAS).

The CTAS was introduced when steeply rising oil prices in the 1970s caused dramatic increases in country electricity prices. Under this scheme, the Commission operates the electricity undertakings but ownership remains with the shires which are required to raise the funds needed for capital works, including generating plant, distribution extensions and upgrading.

In areas supplied with power through the interconnected grid, or Commission owned and/or operated diesel power stations, uniform tariffs apply.

At 30 June 1983 the Commission's generating capacity from its interconnected grid system was 1782 MW, while the capacity of its supply system in country areas was 98.58 MW.

TASMANIA

A considerable part of the water catchment in Tasmania is at high level. The establishment of numerous dams has created substantial artificial storage which has enabled the State to produce energy at a lower cost than elsewhere in Australia and in most other countries. Another factor contributing to the low cost is that rainfall is distributed fairly evenly throughout the year with comparatively small yearly variations. Abundant and comparatively cheap supplies of electricity played an important role in attracting industry to Tasmania. For information on hydro-electric development in Tasmania prior to the establishment of the Hydro-Electric Commission in 1930, *see* Year Book No. 39, pages 1192–3.

Hydro-Electric Commission

The Commission was created in 1930, taking over the activities of the Hydro-Electric Department and the existing small hydro-electric installations. Development initially concentrated on hydro-electric generation feeding into a State-wide power grid (King Island from 1951 and Flinders Island from 1968 are outside the grid and are supplied by diesel generators). Unusually low rainfall during 1967 severely restricted the State's generating capacity and prompted the construction of a substantial oil-fired thermal station with a capacity of 240 MW. This station, completed during 1974, is used as required.

Output and capacity of hydro-electric system

At 30 June 1983 the generating system had an average capacity, with maximum thermal generation, of 9,478 MWh/year. The approved remaining works at the Pieman River Power Development, scheduled for completion in 1986, will increase the system average capacity to 10,486 MWh/year, with maximum thermal generation.

Work began in 1982-83 on the Gordon River Power Development Stage 2 but was halted by the Federal government refusing consent for the project to proceed.

The Hydro-Electric Commission in August-September 1983 began work on two smaller hydro power schemes in Western Tasmania. These are the Anthony Power Development scheduled for completion in 1990 and the King River Power Development which is expected to be commissioned a year later. They will add about 116 MW to the installed generating capacity, and will together produce about 980 MWh of electricity in an average year.

AUSTRALIAN CAPITAL TERRITORY

The supply authority is the A.C.T. Electricity Authority which took over the functions of the Canberra Electric Supply Branch, Department of the Interior, on 1 July 1963. Supply was first made available in Canberra during 1915 and was met from local steam plant. Connection to the New South Wales interconnected system was effected in 1929. The Authority electric supply requirements are met by a Snowy Mountains reservation of 670 GWh and the balance provided by the Electricity Commission of New South Wales. The locally-owned plant consists of 3 MW diesel alternators which are retained as a standby for essential supplies. The total number of ultimate consumers at 30 June 1983 was 85,792. During the year 1982–83 the bulk electricity purchased was 1,600 GWh and the system maximum demand was 475 MW.

NORTHERN TERRITORY

The Northern Territory Electricity Commission is a Statutory Authority operating under the *Northern Territory Electricity Act* 1978 (as amended to date), with responsibility for generation, distribution, transmission and sale of electricity in the Northern Territory. The Commission's responsibilities also include electrical safety and inspections.

In Darwin, the major electricity supply source is Stokes Hill Power Station, with an installed capacity of 141 MW, and standby gas turbines are located at Berrimah and Snell Street, with a combined capacity of 40 MW.

In the major centres of Alice Springs, Tennant Creek and Katherine, diesel power stations generate power with a capacity of 36.76 MW (Alice Springs), 7.8 MW (Tennant Creek) and 14.36 MW (Katherine). As additional sets are being installed at Alice Springs, provision is being made for dual firing in view of the forthcoming supply of natural gas from Palm Valley.

A new power station at Yulara (Ayers Rock Tourist Village) was commissioned in September 1982 with an installed capacity of 2.6 MW. Tennant Creek's total capacity rose to 9.6 MW in October 1982 with the installation of a sixth set.

The Commission operates a number of smaller diesel stations, by an agency arrangement, in the following smaller townships—Pine Creek (.95 MW), Elliott (.536 MW), Mataranka (.4 MW), Larrimah (.2 MW), Ti Tree (.318 MW), Borroloola (.56 MW), Newcastle Waters (.116 MW) and Timber Creek (.2 MW). An advanced coal-fired power station with a planned capacity of 300 MW is being constructed on Channel Island, 45 km from Darwin. When completed in 1988, this station will be interconnected with Katherine and the smaller communities presently using diesel generation.

Many small communities in the Territory generate their own power using diesel fired conventional generating sets. The Department of Transport and Works has responsibility for the installation and maintenance of power generation in Aboriginal settlements, which comprise the greater majority of these small outlying communities.

Electricity and gas establishments

The census of electricity and gas industries covers distribution as well as production and is conducted as a component of the ABS's integrated economic statistics system. This system has been developed so that data from each industry sector conform to the same basic conceptual standards thereby allowing comparative analysis between and across different industry sectors. The results of this census are therefore comparable with economic data collections undertaken annually for the mining and manufacturing industries and periodically for the wholesale trade, retail trade and construction industries.

The following table shows a summary of operations of electricity and gas establishments for 1981–82. Further details are available in the publication *Electricity and Gas Establishments: Details of Operations, Australia, 1981-82* (8208.0)

ELECTRICITY AND GAS ESTABLISHMENTS—SUMMARY OF OPERATIONS, 1981–82

State or Territory	Establishments at 30 June	Employment at 30 June			Wages and salaries	Turnover	Stocks		Purchases, transfers in and selected expenses	Value added	Fixed capital expenditure less disposals
		Males (No.)	Females (No.)	Total (No.)	($m)	($m)	Opening ($m)	Closing ($m)	($m)	($m)	($m)
New South Wales—											
Electricity	34	28,206	2,953	31,159	567,900	2,874,142	164,958	281,200	1,586,617	1,403,766	477,820
Gas	21	2,562	612	3,174	47,947	259,764	12,667	16,158	141,687	121,567	30,300
Queensland—											
Electricity	11	11,095	1,481	12,576	216,232	1,178,642	63,805	75,672	622,303	568,207	502,043
Gas	7	613	108	721	10,194	63,454	7,141	6,834	33,482	29,665	19,024
Other States—											
and Territories (a)—											
Electricity	40	35,404	2,823	38,227	703,683	2,747,947	153,641	123,796	1,152,914	1,615,188	1,387,584
Gas	6	5,596	850	6,446	112,784	599,926	24,847	26,054	227,517	373,617	111,088
Australia—											
Electricity	85	74,705	7,257	81,962	1,487,815	6,800,731	382,404	530,668	3,361,834	3,587,161	2,367,447
Gas	34	8,771	1,570	10,341	170,925	923,144	44,655	49,046	402,686	524,849	160,412

(*a*) Includes Victoria, South Australia, Western Australia, Tasmania, Northern Territory and Australian Capital Territory. At the end of June 1982 the number of establishments were: Victoria—electricity 14, gas 1; South Australia—electricity 13, gas 2; Western Australia— electricity 8, gas 2; Northern Territory—electricity 2 and Australian Capital Territory—electricity 1.

National Energy Survey

In June 1983 a survey was conducted throughout Australia to obtain information about the number and type of selected domestic appliances held by households. It was undertaken as part of the regular population survey which is based on a multi-stage area sample of private dwellings (houses, flats, etc) and non-private dwellings (hotels, motels, etc) and covers about two-thirds of one per cent of the population of Australia. For the purposes of the National Energy Survey certain types of dwellings, such as non-private dwellings, caravan parks and dwellings occupied by more than one household, or diplomatic personnel or persons from overseas holidaying in Australia, were excluded.

The following table shows households by major appliances and facilities. Further data relating to the National Energy survey are published in *National Energy Survey: Household Appliances, Facilities and Insulation, Australia, June 1983* (8212.0)

HOUSEHOLDS BY MAJOR APPLIANCES AND FACILITIES, JUNE 1983

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	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Australia
Refrigerator—									
One door (*a*)	787.5	685.6	326.6	212.1	210.7	85.7	14.7	31.8	2354.6
Two door (*a*)	735.7	474.1	321.9	182.8	159.5	44.4	13.0	36.0	1967.4
Combination	230.9	128.5	129.7	67.7	64.3	7.5	5.3	6.1	640.0
Total	*1754.0*	*1288.2*	*778.3*	*462.6*	*434.5*	*137.6*	*33.0*	*73.9*	*4962.0*
Freezer—									
Top opening	538.9	393.6	291.5	157.1	137.3	70.2	13.5	21.4	1623.4
Front opening	236.5	161.1	91.9	81.7	64.9	13.9	6.0	11.2	667.2
Total	*775.4*	*554.7*	*383.4*	*238.8*	*202.2*	*84.2*	*19.5*	*32.5*	*2290.7*
Oven	1744.0	1282.6	770.2	460.7	431.5	137.3	33.2	73.7	4933.1
Hotplates	1722.3	1261.3	758.4	459.8	424.5	134.9	33.2	73.9	4868.3
Microwave oven (*b*)	228.8	84.2	74.3	34.7	56.1	6.7	3.6	10.0	498.4
Electric frypan/skillet (*b*)	680.3	382.5	377.4	187.2	156.5	69.4	12.1	29.8	1895.3
Vertical grill (*b*)	134.7	78.4	46.8	39.8	24.7	11.1	1.8	5.4	342.6
Crockpot (*b*)	107.5	53.9	52.2	31.4	27.9	6.7	3.4	6.1	289.1
Dishwasher	308.3	246.5	142.3	53.8	57.0	18.6	5.9	21.7	854.1
Washing machine—									
Automatic	1196.5	893.9	493.3	249.0	261.5	82.2	27.0	61.2	3264.7
Other	406.8	270.2	237.3	186.6	139.8	52.0	4.6	8.4	1305.6
Total	*1603.3*	*1164.1*	*730.6*	*435.6*	*401.3*	*134.2*	*31.5*	*69.7*	*4570.3*
Clothes drier—									
Rotary	762.5	591.4	306.4	180.6	122.5	72.1	10.3	36.3	2082.1
Cabinet	70.9	43.8	11.1	24.7	8.8	5.2	*	2.1	167.2
Total	*833.4*	*635.2*	*317.6*	*205.3*	*131.3*	*77.2*	*10.9*	*38.4*	*2249.3*
Hotwater system—									
Shared	46.8	35.4	15.1	4.4	3.1	*	*	*	107.5
Non-shared	1688.7	1249.0	746.7	454.0	428.1	135.6	32.1	72.6	4806.8
Total	*1735.5*	*1284.4*	*761.8*	*458.4*	*431.2*	*136.3*	*32.7*	*74.0*	*4914.3*
Main heating—									
Central	13.2	168.1	*	2.3	*	3.6	*	5.6	195.9
Oil	128.0	95.4	18.5	47.3	56.4	20.7	*	12.6	380.2
Electric	1084.8	295.2	395.3	197.8	132.6	48.7	2.2	47.4	2204.0
Gas	173.5	717.4	10.4	113.5	66.7	7.2	*	4.2	1093.3
Woodfire/solid fuel	193.4	150.4	38.7	75.8	93.0	59.6	*	7.8	619.7
No heating	70.8	5.6	223.9	6.2	32.5	*	28.6	*	368.0
Air-conditioning	518.5	472.4	124.9	291.2	161.5	1.2	19.7	17.7	1607.0
Wall insulation (*c*)	165.0	211.9	67.9	41.0	18.6	19.9	2.9	10.3	537.5
Ceiling insulation (*c*)	608.5	695.9	119.2	248.4	159.9	53.1	11.1	48.5	1944.6
Swimming pool—									
With filter	198.6	117.1	75.5	32.8	51.3	6.0	5.3	5.4	492.0
No filter	3.9	6.0	*	*	*	*	*	—	13.4
Total	*202.5*	*123.1*	*77.1*	*33.4*	*51.8*	*6.7*	*5.5*	*5.4*	*505.4*
Total households	**1762.2**	**1293.9**	**780.5**	**463.5**	**435.6**	**138.0**	**33.3**	**74.0**	**4981.1**

(*a*) Refers only to external doors. (*b*) Included only if used more than once a week. (*c*) Excludes households in flats and mobile and improvised dwellings. * Subject to sampling variability too high for most practical uses.

BIBLIOGRAPHY

ABS Publications

Directory of ABS Energy Statistics (1107.0).

Other Publications

Other organisations which produce statistics in this field include the Department of Resources and Energy, the Joint Coal Board, the Australian Institute of Petroleum, the Electricity Supply Association of Australia and the Bureau of Mineral Resources, Geology and Geophysics. 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 energy field also publish or make available a significant amount of energy information.