

## ENERGY AND MINERALS

## ENERGY

**Department of Minerals and Energy**

The Department of Minerals and Energy was formed in 1977 as a result of the amalgamation of the Mines Department and the Ministry of Fuel and Power. This was authorised by the *Minerals and Energy Act 1976* passed by the Victorian Parliament late in 1976, the major part of which was subsequently proclaimed to come into operation on 1 September 1977.

The Department of Minerals and Energy is responsible for the administration and regulation of all legislation relating to mining and energy which was administered by the two former organisations. This includes the following Acts: *Coal Mines Act 1958*; *Corio to Newport Pipeline Act 1953*; *Explosives Act 1960*; *Extractive Industries Act 1966*; *Gas Act 1969*; *Groundwater Act 1969*; *Inflammable Liquids Act 1966*; *Liquefied Petroleum Gas Act 1958*; *Liquefied Gases Act 1968* (partially proclaimed); *Mines Act 1958*; *Mining Development Act 1958*; *Petroleum Act 1958*; *Petroleum (Submerged Lands) Act 1967*; *Pipelines Act 1967*; *Shell (Corio to Williamstown) Pipelines Act 1964*; *Underseas Mineral Resources Act 1963*; *Coal Mine Workers' Pensions (Early Retirement) Act 1958*; *Minerals and Energy Act 1976*; and *Mines (Aluminium Agreement) Act 1961*.

The Minister for Minerals and Energy also temporarily retains his old portfolio "Minister of Mines" as is required under the provisions of the *Petroleum (Submerged Lands) Act 1967*, relating to his role as Designated Authority under that Act. He is also responsible for the administration of the State Electricity Commission of Victoria, the Gas and Fuel Corporation of Victoria, the Victorian Brown Coal Council, and the Victorian Solar Energy Council. This latter body was established on 1 January 1981.

The Geological Survey Division of the Department carries out field surveys and regional exploration and the Draughting Branch produces geological maps and technical reports which increase understanding of the geology, petroleum, mineral, stone, and groundwater potential of Victoria. Deep drilling to establish groundwater resources for town water supply purposes is undertaken, together with various other shallow drilling programmes, by the Drilling Branch of the Oil and Gas Division of the Department. The Oil and Gas Division administers, on behalf of the Commonwealth Government, the Offshore Petroleum (Submerged Lands) Act, under which crude oil amounting to almost 70 per cent of Australia's requirements is produced. Core and cuttings from drilling operations are retained in a core library, and a geological museum and comprehensive library are maintained. Technical and drilling assistance and loans or grants are considered for exploration, prospecting, and approved development projects. Assays and analyses of natural products are undertaken in the laboratory of the Chemical Branch of the Department, which also offers advice on mineral problems of a chemical nature. Stamp batteries are maintained at five country locations to enable trial crushings to be made for the benefit of prospectors. The Department also undertakes certain reclamation projects on abandoned mines and the capping or filling of disused shafts on Crown land.

### General

In 1979-80, about 78 per cent of Victoria's electricity needs were produced by the brown coal fired generating stations situated in the coalfields in the La Trobe Valley and 8 per cent by peak-load thermal stations. A further 3 per cent of Victoria's electricity requirements is currently generated in hydro power stations located in the north-eastern ranges of the State and 11 per cent is obtained from the Snowy Mountains Hydro-Electric Scheme in New South Wales.

About 96 per cent of Victoria's petroleum refinery crude oil input in 1978-79 came from the State's offshore oilfields and the balance was derived from crude oil imported from the Middle East.

During recent years, natural gas has assumed an increasingly important role in the supply of energy in Victoria. Over 99 per cent of all gas used in Victoria for domestic and industrial purposes is produced from the offshore gas and oilfields in Bass Strait. It is estimated that this resource is adequate to provide Victoria's needs for the next 30 years. There is a small but steadily increasing use of liquefied petroleum gas (propane, butane) derived from refineries and the Bass Strait gas and oilfields.

In 1978-79, gas provided 48 per cent of Victoria's total secondary energy requirements (excluding transport). Electricity provided 26 per cent, petroleum 18 per cent, and other fuels 8 per cent.

#### VICTORIA—PRIMARY ENERGY RESERVES (PROVEN ECONOMICALLY RECOVERABLE), 1979-80

Source	Million terajoules	Per cent
Crude oil	9.6	2.1
Brown coal	442.8	95.7
Natural gas	7.4	1.6
Gas liquids	2.7	0.6
Total	462.5	100.0

Source: Department of Minerals and Energy.

Further reference: *Victorian Year Book 1978*, pp. 295-7

### Brown coal

#### Location

Victoria's largest resources of fossil fuels are the huge deposits of brown coal in the central Gippsland region. These extend over an area commencing about 140 kilometres in an easterly and south-easterly direction from Melbourne, with by far the most valuable and best quality coal being located in an area known as the La Trobe Valley. These deposits, which form the bulk of primary energy available to Victoria, compare in extent with other major deposits of brown coal in the world. Smaller deposits exist in other areas in south Gippsland, in south-eastern Victoria at Gelliondale, in the south-central region at Anglesea, Bacchus Marsh, Altona, and in south-western Victoria near Portland. These deposits, although extensive, do not compare in magnitude and importance to those in the La Trobe Valley and comprise only about 5 per cent of the total resource in the State. A map of brown coal areas of Victoria can be found on page 298 of the *Victorian Year Book 1978*.

#### Resources

The resources of brown coal in Victoria have been determined as 124,307 megatonnes. This is the current geological assessment but as a result of continuing drilling programmes, knowledge of these resources is gradually being increased as more deposits are revealed in areas not yet fully explored, particularly in the eastern part of the coal-bearing areas of the La Trobe Valley in central Gippsland.

The resources which have been proven as potentially economically recoverable are classified as reserves. The balance is marginal or sub-marginal but is classified as part of the total resource. This is illustrated in the following table:

**VICTORIA—RESOURCES AND RESERVES OF BROWN COAL AT 1 JULY 1980**  
(Original quantities in place)

Area	Resources (megatonnes)				Reserves (megatonnes)	
	Measured	Indicated	Inferred	Total	Economic	Readily recoverable
La Trobe Valley	(a)64,923	42,924	—	(a)107,847	(b)35,754	(a)11,630
Stradbroke	—	2,800	—	2,800	2,800	680
Gelliondale	450	850	(c)4,300	(c)5,600	(c)5,600	450
Anglesea	(d)450	—	—	(d)450	(d)100	(d)100
Bacchus Marsh	(e)110	—	—	(e)110	(e)30	(e)30
Bacchus Marsh-Altona	—	—	7,500	7,500	—	—
<b>Total</b>	<b>(f)65,933</b>	<b>46,574</b>	<b>11,800</b>	<b>(f)124,307</b>	<b>(g)44,284</b>	<b>(f)12,890</b>

(a) Includes 656.4 megatonnes excavated in the La Trobe Valley to 1 July 1980.

(b) Includes 656.4 megatonnes excavated in the La Trobe Valley to 1 July 1980 and about 5,000 megatonnes under La Trobe Valley townships, storage dams, etc., and about 1,000 megatonnes under A.P.M. mill area.

(c) Includes about 450 megatonnes under Alberton township and off-shore from Gelliondale.

(d) Includes 11.3 megatonnes excavated from Anglesea open cut to 1 July 1980.

(e) Includes 10 megatonnes excavated from Maddingley open cut to 1 July 1980.

(f) Includes 677.7 megatonnes excavated to 1 July 1980. (See also footnotes (a), (d), and (e).)

(g) Includes 677.7 megatonnes excavated to 1 July 1980, 4,300 megatonnes inferred coal at Gelliondale, and about 6,000 megatonnes beneath La Trobe Valley townships, etc. (See also footnotes (b), (c), (d), and (e).)

NOTE. Economic reserves have been designated by the following criteria:

(1) Separate or individual seams must exceed 15.2 metres in thickness.

(2) The top of the uppermost seam must be within 91.4 metres of the natural land surface.

(3) The vertical coal to overburden ratio must exceed 0.5:1, calculated to the base of the seam or, where the coal continues to a greater depth, to a maximum depth of 200 metres below the surface. Where multiple seams are involved, those less than 15.2 metres in thickness are rated as overburden.

Readily recoverable reserves are those which satisfy modern power station requirements being winnable by large-scale open cut operations at present day costs, subject to limiting factors such as batter slopes, depth of open cut, location of towns and rivers, etc.

Source: *Brown Coal Reserves in Victoria*, State Electricity Commission of Victoria.

### *La Trobe Valley coalfields*

Thick coal seams occur close to the surface in two large areas known as the Yallourn-Morwell and the Loy Yang coalfields and in several smaller areas. The Yallourn-Morwell coalfield is split into the Yallourn-Maryvale and the Morwell-Narracan fields by the town of Morwell and the services corridor containing the Princes Highway and the East Gippsland rail line. The brown coal in these seams ranges in geological age from Eocene to early Miocene and are therefore between 50 and 20 million years old.

The La Trobe Valley brown coal resources have been determined as 107,847 megatonnes at 1 July 1980. An amount of 35,754 megatonnes has been classified as economic reserves of which 11,630 megatonnes are considered readily recoverable using present mining techniques.

### *Other coalfields*

#### *Stradbroke*

This is a newly discovered field in the Strzelecki Ranges adjacent to the southern flank of the La Trobe Valley with estimated reserves of 2,800 megatonnes in the economically winnable category.

#### *Gelliondale*

The Gelliondale coalfield is located beneath the flat coastal plain adjacent to the south Gippsland highlands. The boundaries of the field have not been clearly defined, but an area approximately 10 kilometres long and 2.5 to 4 kilometres wide has been closely drilled and shown to contain an important economic coalfield. The deposit is second in size to the La Trobe Valley. Measured and indicated reserves total about 1,300 megatonnes of which readily recoverable reserves are estimated at 450 megatonnes.

### *Production, 1979-80*

During the period 1 July 1979 to 30 June 1980, 32.9 megatonnes of brown coal was mined in Victoria. Of this quantity, 31.6 megatonnes was won by the State Electricity Commission of Victoria from 3 open cuts it operates in the La Trobe Valley and an

assumed 1.3 megatonnes by two privately owned companies in the south-central region (Anglesea and Bacchus Marsh).

The principal use for brown coal mined in Victoria is for the generation of electricity, 27.8 megatonnes being used in 1979–80 for this purpose. Only about 4.9 megatonnes was used during the same period for other purposes such as briquette manufacture and steam raising.

#### *Other uses for brown coal*

##### *Briquettes*

Raw brown coal is treated and compressed into regular shaped pellets of a convenient size called briquettes to produce a high grade solid fuel having a moisture content of about 15 per cent. Briquettes are transported more economically than raw coal for industrial and domestic use. They are also used in power stations as a fuel stock for the production of char and can be used to produce liquid hydrocarbons.

Only coal from the Yallourn open cut is used for making briquettes as it is the highest quality coal available in the La Trobe Valley. Approximately 3 tonnes of raw coal are used to produce a tonne of briquettes and about 1 tonne of brown coal is used for raising steam used in the process of manufacturing 1 tonne of briquettes. The annual production of briquettes reached a peak of 1.9 million tonnes during 1965 but with the advent of natural gas declined to less than 1 million tonnes in 1976. Production in 1979–80 was 1,235,000 tonnes.

##### *Char*

Char is a form of high-grade carbon made by the carbonisation of brown coal. It can be used as a source of carbon or as a reducing agent in chemical and metallurgical industries. There are two privately owned plants operating in Victoria at present for the production of char. Both are in the La Trobe Valley and both purchase briquettes and small amounts of brown coal from the State Electricity Commission. The larger plant, at Morwell, has an output capacity of 60,000 tonnes a year.

##### *Coal to oil conversion*

The Victorian Brown Coal Council manages Victoria's research and development programme into potential uses of brown coal (excluding electricity and natural gas production). The Council was established by an Act of the Victorian Parliament which became operative on 1 January 1979, and succeeded an advisory committee (the Victorian Brown Coal Research and Development Committee) established in 1975.

The endowment of Victoria with brown coal in very large quantities — reserves that are economically recoverable using existing technology amount to more than 35 billion tonnes — makes it possible to consider using some of this coal for the production of synthetic oil. Other products such as solvent refined coal, used in the steel industry, can also be readily manufactured from Victorian brown coal.

The research programme of the Council covers both the description of coal quality in the various fields potentially available for conversion and the behaviour of brown coal when subjected to solvent refining and hydrogenation. Simple tests have indicated that the liquid yields from the various fields differ only slightly, despite considerable variation in some coal properties from field to field. While brown coal suffers some disadvantages for conversion in its high oxygen and moisture content, it offers the advantages of low ash and sulphur contents and high reactivity.

The Victorian Brown Coal Research Advisory Committee and a group of industries contributing to the funding of research provide expert advice into the formulation of the brown coal research programme.

The development of feasibility studies and experimental programmes is undertaken in collaboration with overseas groups and Australian consultants. In respect of processing studies, steps have been taken towards establishing a major pilot plant in Victoria based on the SRC (solvent refined coal) approach to brown coal liquefaction adopted by the Nippon Brown Coal Liquefaction Co. Ltd. (successor to KOMINIC). Consultative arrangements have been set up with the Government of Japan, and an agreement has been

made between the Victorian Government in relation to the pilot plant and feasibility study proposals. A co-ordinating committee has also been set up with the Mitsui SRC Development Company to assist that company's feasibility studies into the production of solvent refined coal for use in the steel industry.

The Council is the Victorian agency concerned in the management and conduct of the Joint Australian/Federal Republic of Germany Coal-to-Oil Feasibility Study, in which four Australian State governments are involved with the West German Government and seven large German companies. Council personnel have worked on the Study programme in Germany. One of the German companies (Rheinische Braunkohlenwerke AG, Cologne) has proposed applying the Study results to a more specific study of a coal production and liquefaction operation in Victoria. The Victorian Government has made an agreement with the company to facilitate carrying out the proposal.

A "Coalfields Development Strategy Study" has been conducted by an Australian consultant under contract to the Council, to indicate possible ways of winning large annual tonnages of brown coal from the more extensive coal-bearing areas.

**Further reference:** Victorian Brown Coal Council, *Victorian Year Book 1980*, pp. 288-9

## Electricity

### *State Electricity Commission of Victoria*

The most widely used and extensively distributed form of energy in Victoria is electricity. This is generated and distributed by the State Electricity Commission of Victoria, a public utility formed by an Act of the Victorian Parliament in 1920. Since it was formed the Commission has expanded and co-ordinated the generation, transmission, and supply of electricity on a State-wide basis to the point where it now produces all of the electricity generated in Victoria available for public supply.

At 30 June 1980, the Commission with 20,383 personnel and capital assets of \$3,214m distributed electricity to 1,295,100 consumers throughout Victoria. In addition, eleven metropolitan municipal councils purchased electricity in bulk from the Commission for retail distribution to a further 271,800 customers. Nearly 115,000 kilometres of power lines are used by the State Electricity Commission of Victoria and the municipal networks.

### *Other electricity producers*

A 150 MW power station owned and operated by Alcoa of Australia Ltd produces electricity using brown coal found as a fossil fuel at Anglesea in south central Victoria to supply the company's alumina smelter at Point Henry on Port Phillip Bay. A number of other industrial enterprises such as the Shell Refinery at Corio generate electricity within their own plant.

### *Existing electricity system*

The development of Victoria's electricity system is based on the utilisation of Victoria's extensive brown coal resources in the La Trobe Valley in central Gippsland with supplementary development of hydro sources in north-eastern Victoria. Victoria is entitled to receive one-third (New South Wales receives two-thirds) of the electricity generated in the Snowy Mountains Hydro-Electric Scheme after the Commonwealth Government's requirements for the Australian Capital Territory have been met. Victoria also shares with New South Wales the electricity generated at the Hume hydro station near Albury on the Murray River.

In 1979-80, 80 per cent of Victoria's electricity needs was generated from brown coal. Brown coal is also manufactured into a high quality fuel in the form of briquettes. About 46 per cent of these are consumed in power stations, the balance being sold to industry and for domestic purposes.

The major station in the Commission's interconnected system is the 1,600 MW brown coal fired power station at Hazelwood which alone generates 46 per cent of Victoria's electricity. The other brown coal fired, base load, power stations in the interconnected system are Yallourn, Morwell, and Yallourn "W".

There are also steam stations in Melbourne (Newport, Richmond, and Spencer Street), a gas turbine station at Jeeralang, and hydro-electric stations at Kiewa and Eildon, on the Rubicon and Royston Rivers near Eildon, and at Cairn Curran on the Loddon River near Bendigo.

### VICTORIA—POWER STATIONS: LOCATION, RATING, AND PRODUCTION

Station	Maximum continuous rating (a)	Electricity production							
		1976-77		1977-78		1978-79		1979-80	
		Quantity	Percentage of production	Quantity	Percentage of production	Quantity	Percentage of production	Quantity	Percentage of production
	MW	Mill kWh		Mill kWh		Mill kWh		Mill kWh	
Thermal stations—									
Hazelwood	1,600	9,534.3	50.1	9,228.3	47.3	9,405.8	45.2	9,758.6	45.7
Yallourn	521	2,939.5	15.4	2,183.9	11.2	2,939.0	14.1	2,608.6	12.2
Yallourn "W"	700	3,021.2	15.9	4,204.0	21.5	3,525.8	16.9	3,657.9	17.1
Morwell	170	1,159.3	6.1	830.1	4.2	1,178.5	5.7	1,140.1	5.3
Newport	198	270.1	1.4	306.4	1.6	373.7	1.8	439.2	2.1
Spencer Street (b)	90	41.1	0.2	109.9	0.6	184.1	0.9	212.7	1.0
Richmond	38	10.5	0.1	54.7	0.3	58.7	0.3	42.0	0.2
Jeeralang	465	—	—	—	—	478.7	2.3	1,046.6	4.9
Total SEC thermal	3,782	16,976.0	89.2	16,917.3	86.7	18,144.3	87.2	18,905.7	88.5
Hydro stations—									
Kiewa (c)	184	259.8	1.4	251.5	1.3	327.7	1.6	304.8	1.4
Eildon (d)	135	278.4	1.4	263.0	1.3	228.9	1.1	279.2	1.3
Total SEC hydro	319	538.2	2.8	514.5	2.6	556.6	2.7	584.0	2.7
Total SEC	4,101	17,514.2	92.0	17,431.8	89.3	18,700.9	89.9	19,489.7	91.2
Net purchases	..	1,521.7	8.0	2,077.0	10.7	2,105.9	10.1	1,884.2	8.8
Total	4,101	19,035.9	100.0	19,508.8	100.0	20,806.8	100.0	21,373.9	100.0

(a) At 30 June 1980.

(b) Melbourne City Council station.

(c) McKay Creek, West Kiewa, and Clover.

(d) Eildon, Rubicon, Lower Rubicon, Royston, Rubicon Falls, and Cairn Curran.

Source: State Electricity Commission of Victoria.

### Transmission and distribution

The distribution of electricity throughout Victoria has been virtually completed except for some isolated properties in remote parts of Victoria. The Commission supplies electricity in bulk to eleven municipal undertakings which operate as separate supply authorities under franchises granted before the Commission was established.

The electrical transmission and distribution system in the State supply network at 30 June 1980 comprised nearly 115,000 kilometres of power lines, 4 auto-transformation stations, 26 terminal receiving stations, 180 zone sub-stations, and over 84,000 distribution sub-stations. Main transmission is by 8,900 route kilometres of 500 kV, 330 kV, 220 kV, and 66 kV power lines which supply the principal distribution centres and also provide interconnection between generating sources. Electricity from Hazelwood is transmitted to the Melbourne area at 500 kV. A map of Victoria's main power transmission system can be found on page 301 of the *Victorian Year Book* 1978.

### New generating projects

#### Yallourn "W"

Designed as a base load power station of 1,450 MW capacity, this station is being built in two stages at Yallourn West in the La Trobe Valley. It was originally planned to comprise only 2 x 350 MW units when approved by the Victorian Government in 1965. The first was commissioned during the winter of 1973 and the second during the winter of 1975. These units are now in operation.

In 1972, the Victorian Parliament approved a proposal to extend the Yallourn "W" power station by the addition of two generating units. Each will have a capacity of 375

MW. Site works commenced in 1975 and the two new generators are scheduled to begin operating in 1981 and 1982.

#### *Newport*

The Victorian Government authorised the State Electricity Commission to build a 500 MW regulating power station at the mouth of the Yarra River. This station commenced generating electricity during 1980 while the final stages of construction were being completed. Further information on the Newport power station can be found on pages 799-800 of the *Victorian Year Book 1978*.

#### *Jeeralang*

The Commission has installed 465 MW of gas turbine plant using natural gas at Jeeralang, near Morwell in the La Trobe Valley, to provide additional generating capacity to compensate for the expected shortage in supply which will be caused through the delay in building the new Newport Station. Stage 1 (225 MW) came into service in 1979 and Stage 2 (240 MW) has been put into service progressively during 1980.

#### *Dartmouth*

The Commission is constructing a new hydro-electric power station comprising a single 150 MW generator at Dartmouth on the Mitta Mitta River in north-eastern Victoria. The station is scheduled to commence operating in early 1981.

### *Loy Yang power station and open cut project*

The brown coal of the La Trobe Valley is a young, relatively soft coal, but by the use of specialised mechanical plant it is won continuously in great quantities and at low cost. It is one of the largest single deposits of brown coal in the world, with continuous coal up to several hundred metres thick and in many places less than 15 metres below the surface.

As the raw coal has a moisture content of from 60 to 70 per cent, it is expensive to transport, as every tonne of combustible material would also contain two tonnes of water. For this reason the SEC's major power stations are located near the brown coal deposits.

In 1976, the Victorian Government gave the State Electricity Commission authority to go ahead with the development of Loy Yang. Construction work started on access roads and associated earthworks in February 1977. The Loy Yang project is the largest single engineering project undertaken in Australia and will require a gradual build up in the workforce to 2,000 persons in 1981.

The first stage of the project, comprising the Loy Yang A 2,000 MW power station, the open cut, and engineering services, is expected to come into service progressively between 1984 and 1987, and the second stage, comprising a further 2,000 MW station Loy Yang B, between 1988 and 1991. The direct capital cost of the project, at 1980 price levels, is estimated at more than \$3,000m.

Operation of the power station and open cut will require more than 1,300 employees for the initial 2,000 MW Loy Yang A and some 2,000 employees for the full 4,000 MW development.

The two Loy Yang power stations will be built about five kilometres south-east of Traralgon, on the southern side of the open cut. The first 2,000 MW station, Loy Yang A, will comprise four 500 MW generating units. The turbine house will be about 400 metres long and 36 metres wide and nearly 35 metres high. Boiler house buildings will be about 115 metres high and each pair of boilers will be served by a single chimney 260 metres high.

Natural draught cooling towers, similar to those in service at the nearby Yallourn "W" power station, will be 113 metres high and 92 metres wide at the base. Cooling water circulating through the towers will be used over and over again.

The second 2,000 MW station, Loy Yang B, which is also planned to have 500 MW units, will be located east of the Loy Yang A station.

The Loy Yang open cut will be established between the valleys of the Traralgon and Sheepwash Creeks and extend from the southern boundary of the coalfield towards Traralgon. Overburden removal by the first large bucket wheel excavator (Dredger No. 14) will begin late in 1981.

Coal for the first 2,000 MW stage will be won by three dredgers each with a capacity of about 60,000 tonnes a day — about twice that of the largest dredgers now used by the SEC at Yallourn and Morwell. A fourth dredger of similar capacity will be brought into service for the second 2,000 MW stage. Coal will be transported from the dredgers by large conveyors to a coal storage bunker between the two Loy Yang power stations.

Initially, overburden will be placed in an area south of the coalfield. Later, as coal winning progresses, the overburden removed will be put in the worked-out area of the open cut. The external overburden dump will be landscaped to blend into the surrounding countryside and progressively covered with trees, shrubs, and grasses. By careful design, construction, and operational procedures, the SEC will ensure that any injurious effect of Loy Yang on the environment is kept to a minimum.

In evidence to the public inquiry into the project, the Environment Protection Authority said that there was no reason that waste discharge licences, with appropriate conditions, should not be issued and, in its report, the Parliamentary Public Works Committee concluded that the SEC had the ways and means to comply with these licences and conditions and to minimise adverse environmental effects.

The main works area will be surrounded by a buffer zone varying from 300 metres to 1,000 metres in width. This will screen operations, provide the site with a fire protection break, and give added protection to Traralgon residents from noise, dust, and earth movement.

### Petroleum

Petroleum products were first imported into Victoria from the United States of America, in drums, during the last few years of the nineteenth century. Victoria's first refinery, a small one erected at Laverton, was closed in 1955. In order to cope with a rapidly increasing demand for petroleum products after the Second World War, two major refineries were erected. The first of these was Shell Australia's refinery at Corio, near Geelong, which was commissioned in 1954, and the second was the Standard Vacuum refinery — now Petroleum Refineries (Australia) Pty Ltd, which commenced full scale operations at Altona in 1955. This latter event led to the closure of the small Laverton refinery. A third major refinery was built by BP Refinery (Westernport) Pty Ltd, at Crib Point in 1965. These three refineries, all of which are within a radius of 75 kilometres from the centre of Melbourne, currently satisfy almost the whole of Victoria's market for refined products.

#### *Discovery and development of indigenous gas and oilfields*

##### *Exploration offshore in the Gippsland Basin, 1960 to 1980*

Exploration for petroleum has been carried out almost continuously in the offshore waters of the Gippsland Basin in eastern Bass Strait since 1960, principally by the partnership of Hematite Petroleum Pty Ltd (a wholly owned subsidiary of The Broken Hill Proprietary Co. Ltd) and Esso Exploration and Production Australia Inc., with Esso Australia Ltd as the operator. During this period, 79 exploration wells have been drilled of which 40 have proved to be of commercial significance. The latter are set out in the following table:

VICTORIA—COMMERCIAL EXPLORATION WELLS DRILLED BY ESSO AND BHP OFFSHORE IN THE GIPPSLAND BASIN, 1964 TO 1980

Well	Date well spudded-in	Type of well (a)	Result
Barracouta 1	27.12.64	W	Gas discovery
Barracouta 2	8. 6.65	A	Gas discovery confirmation
Barracouta 3	3. 8.69	A	Gas discovery confirmation
Barracouta A-3 (b)	20. 4.68	D	Oil discovery
Barracouta 4	30. 3.77	A	Oil and gas confirmation



VICTORIA—COMMERCIAL EXPLORATION WELLS DRILLED BY ESSO AND  
BHP OFFSHORE IN THE GIPPSLAND BASIN, 1964 TO 1980—*continued*

Well	Date well spudded-in	Type of well (a)	Result
Marlin 1	5.12.65	W	Gas discovery and oil show
Marlin 2	31. 5.66	A	Gas discovery confirmation
Marlin 3	16.12.66	A	Gas discovery and oil show confirmation
Marlin A-6 (c)	11. 8.68	D	Gas discovery confirmation
Marlin A-24 (d)	16. 5.73	D	Gas discovery confirmation
Halibut 1	20. 6.67	W	Oil discovery
Kingfish 1	6. 4.67	W	Oil discovery
Kingfish 2	28.11.67	A	Oil discovery confirmation
Kingfish 3	2. 2.68	A	Oil discovery confirmation
Kingfish 4	15.11.73	A	Oil discovery confirmation
Kingfish 7	26. 5.77	A	Oil discovery confirmation
Tuna 1	7. 5.68	W	Gas and oil discovery
Tuna 2	30.10.68	A	Gas and oil discovery confirmation
Tuna 3	18. 2.70	A	Gas and oil discovery confirmation
Snapper 1	8. 5.68	W	Gas discovery and oil show
Snapper 2	16. 6.69	A	Gas discovery confirmation
Snapper 3	24.11.69	A	Gas discovery confirmation
Mackerel 1	27. 3.69	W	Oil discovery
Mackerel 2	14. 2.72	A	Oil discovery confirmation
Mackerel 3	1. 4.72	A	Oil discovery confirmation
Mackerel 4	11. 2.73	A	Oil discovery confirmation
Cobia 1	4. 8.72	W	Oil discovery
Cobia 2	2. 5.77	D	Oil discovery; subsequent production
West Halibut 1 (e)	3. 9.78	A,W	Oil discovery
Fortescue 2	30.10.78	A	Oil discovery confirmation
Fortescue 3	26.11.78	A	Oil discovery confirmation
Fortescue 4	18. 3.79	A	Oil discovery confirmation
Flounder 1	10. 7.68	W	Oil discovery
Flounder 2	19. 2.69	A	Oil discovery confirmation
Flounder 3	24. 4.69	A	Oil discovery confirmation
Flounder 4	28.12.72	A	Oil discovery confirmation and gas discovery
Flounder 6	12. 7.77	A	Oil and gas discovery confirmation
Bream 2	23. 2.69	W	Gas and oil discovery
Bream 3	16.11.69	A	Gas and oil confirmation
Seahorse 1	30. 7.78	W	Oil discovery

(a) W = wildcat, A = appraisal well, D = development well.

(b) Drilled during development drilling on Barracouta platform in 1968 — deep well probe.

(c) Drilled during development drilling (first stage) on Marlin platform 1968 — deep well probe.

(d) Drilled during development drilling (second stage) on Marlin platform in 1973 — deep well probe.

(e) West Halibut 1 commenced as a step out for the Halibut field but ended as the exploration well for a new field called Fortescue.

Source: The Broken Hill Proprietary Co. Ltd, 1980.

Four other companies (B.O.C. of Australia Ltd, Endeavour Oil NL, NSW Oil and Gas Co. NL, and Shell Development (Aust.) Pty Ltd) drilled seven wells during the 1970s but without success.

Following the surrender by Esso-BHP of exploration rights over certain blocks in the waters of the Gippsland Basin, the Minister for Minerals and Energy during 1979 granted to the Gas and Fuel Corporation of Victoria and Beach Petroleum NL, working as a joint venture, an exploration permit over waters adjacent to the Lakes Entrance area of Bass Strait, with Beach Petroleum NL as the operator. Geophysical exploration work has been carried out and the results are still being evaluated.

#### *Drilling programmes, 1979 and 1980*

During 1979 and 1980, the following wells were drilled in the Gippsland and Otway Basins:

## VICTORIA—EXPLORATION WELLS DRILLED, 1979 AND 1980

Well	Date well spudded-in	Basin	Result
Threadfin 1	22. 2.79	Offshore Gippsland	Dry hole
Fortescue 4	18. 3.79	Offshore Gippsland	Oil discovery confirmation
North Paaratte 1	31.10.79	Onshore Otway	Gas discovery
North Paaratte 3	29. 5.80	Onshore Otway	Dry hole
East Seacombe 1	29. 6.80	Onshore Gippsland	Dry hole

Source: Department of Minerals and Energy.

*Tenement holders, 1980*

At the end of 1980, tenement holders for exploration in the Gippsland, Murray, and Otway Basins were:

## VICTORIA—TENEMENT HOLDERS, 1980

Name of company	Onshore exploration			Offshore exploration	
	Murray Basin	Otway Basin	Gippsland Basin	Otway Basin	Gippsland Basin
Hematite Petroleum Pty. Ltd and Esso Exploration and Production Aust. Pty Ltd					Vic./L1 to L11
Hematite Petroleum Pty Ltd					Vic./P1
Gas and Fuel Exploration N.L. and Beach Petroleum N.L.					Vic./P11
Cultus Pacific N.L., York Resources N.L., Metramer Minerals Ltd, and Archean Investments Ltd					Vic./P12
Bass Strait Oil and Gas N.L., Bass Oil and Gas Participants Pty Ltd, Youngblood Holdings Pty Ltd, Hampton Oil and Gas Group Pty Ltd, and Idlewild Securities Pty Ltd					Vic./P13
Phillips Australian Oil Co., Gas and Fuel Exploration N.L., MIM Investments Pty Ltd				Vic./P14	
Esso Exploration and Production Aust. Inc.				Vic./P15	
Oil and Minerals Quest N.L., Mincorp Ltd, Central Energy Pty Ltd, Zanex Ltd., and Otway Oil and Gas N.L.				Vic./P16	
Beach Petroleum N.L.		P.E.P. 93	P.E.P. 94		
Western Mining Corporation Ltd		P.E.P. 95			
Conserv (No. 779) Pty Ltd	P.E.P. 96 and 97				
Mincorp Ltd, Southern Oil Pty Ltd, and Alan Robert Burns and Derek Rose Gascoine			P.E.P. 98		
Victor Petroleum and Resources Ltd			P.E.P. 99		
Gas and Fuel Exploration N.L.		P.E.P. 100			
Siberia Oil and Gas N.L., Scomeld Pty Ltd, and Girvan Oil and Gas Pty Ltd		P.E.P. 101			

P.E.P. = Petroleum Exploration Permit; Vic./L = Victorian Licence; Vic./P = Victorian Permit

Source: Department of Minerals and Energy

*Development of the Gippsland fields*

The initial stage of development took place between 1967 and 1971, when the four commercial fields discovered to that time were developed as an integrated system. These were the Barracouta and Marlin gasfields and the Halibut and Kingfish oilfields, together with a small oil reservoir in the Barracouta field. This resulted in the construction of the five first-generation platforms listed below:

(1) Barracouta platform, over the Barracouta gas and oilfield, with eight gas wells and two oil wells. Production started in March 1969.

(2) Marlin platform, over the Marlin gasfield, with seventeen gas wells and four oil wells. Gas production started in January 1970. The four oil wells were expected to be brought into production in 1981 after the installation of production facilities to produce oil from a small accumulation beneath the main gas reservoir.

(3) Halibut platform, over the Halibut oilfield, with twenty oil wells. Oil production started in March 1970.

(4) Kingfish "A" platform, over the Kingfish oilfield, with twenty-one oil wells. Oil production started in April 1971.

(5) Kingfish "B" platform, over the Kingfish oilfield, with twenty-one oil wells. Oil production started in November 1971.

The second stage of development took place from 1973 onwards with construction of the following second-generation platforms and one sub-sea completion:

(1) Mackerel platform, over the Mackerel oilfield, with eighteen oil wells. Two of the eighteen wells are high-angle wells drilled directionally to drain the south end of the Mackerel field about 4 kilometres from the platform. Oil production started in December 1977. Drilling was completed in November 1980.

(2) Sub-sea Cobia 2 oil well, over the Cobia oilfield, came on stream in June 1979. This was the first sub-sea well completed in the Gippsland Basin fields and the crude oil from this well is conveyed by two 100 mm submarine pipelines to the Mackerel platform. This was also the first project where the pre-welded pipeline was laid by the spooling method from a specially adapted ship.

(3) Tuna platform, over the Tuna gas and oilfield, with eighteen wells planned. Oil production started in June 1979; gas production commenced in September 1979. Twelve of the planned eighteen wells were completed by the end of 1980.

(4) Snapper platform, over the Snapper gas and oilfield. The platform was erected in May 1979 and development drilling of the planned twenty-seven wells was scheduled to commence in January 1981. Production was expected to start soon afterwards after completion of the first well.

Four more second-generation platforms have been planned and are in various stages of development. These are:

(1) West Kingfish platform, over the western end of the Kingfish oilfield, with twenty-seven wells planned. The onshore construction was completed by the end of 1980.

(2) Cobia platform, over the Cobia oilfield, with twenty-one wells planned. The onshore construction was approximately 75 per cent complete at the end of 1980.

(3) Fortescue platform, over the Fortescue oilfield, with twenty-one wells planned. Fabrication of components for the template was in an advanced stage at the end of 1980.

(4) Flounder platform, over the Flounder gas and oilfield, with twenty-four wells planned. Steel production for the template was complete at the end of 1980.

The completion of these four new platforms will bring the total number of platforms in Bass Strait to twelve.

The laying of a gas pipeline from the Marlin platform to the Mackerel platform via the Halibut platform, using the pipe-lay reel method as used for the Cobia 2 submarine pipeline, was completed during 1980. Hooking up to the platforms was underway at the end of 1980.

The design of Gas Plant 3 at Longford was completed by the end of 1980 and on-site construction had started. Gas Plant 3 was expected to come on stream in 1982 to supplement supply to the expanding Victorian gas market.

**VICTORIA—CRUDE OIL PRODUCTION, 1976 TO 1980**  
(After processing)

Year	Barrels		Kilolitres	
	During year	Average barrels/day for year	During year	Average kilolitres/day for year
1976	140,559,679	384,043	22,347,162	61,058
1977	145,187,523	397,774	23,074,930	63,219
1978	146,826,012	407,742	23,343,427	63,955
1979	149,790,661	410,385	23,790,661	65,180
1980	128,993,885	352,442	20,508,424	56,033

Source: Esso Australia Ltd.

**VICTORIA—GIPPSLAND BASIN COMMERCIAL HYDROCARBON  
RESERVES AND PRODUCTION, 30 SEPTEMBER 1980**

Item	trillion (10 <sup>12</sup> ) cubic feet			billions (10 <sup>9</sup> ) cubic metres		
	Initial	Produced	Remaining	Initial	Produced	Remaining
Natural gas	7.783	1.018	6.765	220.4	28.8	191.6
Crude oil	2,930.2	1,287.8	1,642.4	465.8	204.7	261.1
Condensate	216.6	26.5	190.1	34.4	4.2	30.2
Liquefied petroleum gas	558.3	142.9	415.4	88.7	22.7	66.0

NOTE. All figures are for products after processing.

1 gigalitre = 10<sup>9</sup> litres.

Figures given are based on direct conversion of cubic metres or gigalitres and may be + or - actual production.

### *Refining*

There are three refineries in Victoria: the Shell Refining (Australia) Pty Ltd at Corio near Geelong, the Petroleum Refineries (Australia) Pty Ltd at Altona, and the BP Refinery (Western Port) Pty Ltd at Crib Point, Western Port. Shell Refining (Australia) Pty Ltd also operates a plant at its Corio refinery for the production of lubricating oil. Refining capacity at 1 December 1979 is set out in the following table:

**VICTORIA—REFINING CAPACITY AT 1 DECEMBER 1979**

Refinery	Location in Victoria and year refinery came on stream	Primary processing capacity (a)
Shell Refining (Australia) Pty Ltd	Corio near Geelong 1954	116,000 to 132,000 BSD 5,657,500 tonnes/year
(Lubricating oil plant)	Corio near Geelong 1954	2,200 BSD 100,000 tonnes/year
Petroleum Refineries (Australia) Pty Ltd	Altona near Melbourne 1954	100,000 BSD 4,600,000 tonnes/year
BP Refinery (Western Port) Pty Ltd	Crib Point on Western Port Bay 1966	60,000 BSD 2,500,000 tonnes/year

(a) BSD: barrels per stream day.

Source: *Oil and Australia*, Australian Institute of Petroleum Ltd, 1979.

Each refinery also imports crude oil from the Middle East for the production of special products including bitumen, asphalt, and certain other heavy products. A certain amount of light ends such as motor spirit and aviation jet fuel are also produced in the process of treating these imported crude oils.

### *Transportation*

Indigenous processed crude oil is shipped by tanker from the Long Island Point and Crib Point jetties at Western Port to refineries in Sydney and Brisbane and by pipeline to Victoria's three local refineries.

The total volume shipped by tanker during the 1980 calendar year was 59,089,003 barrels (9,394,417 kilolitres). The volumes of crude oil conveyed through the pipelines to local refineries during 1980 was 89,623,209 barrels (14,248,976 kilolitres).

The three refineries in Victoria also import between 4.5 and 5 million barrels (0.7–0.8 million kilolitres) of crude oil each year from the Persian Gulf and also import approximately 1.3 million barrels (0.2 million kilolitres) of wholly or partially refined products from overseas or from other States in Australia. Approximately 35 million barrels (5.6 million kilolitres) of wholly or partially refined products are exported to overseas destinations such as New Zealand or the Pacific Islands or transported to other States within Australia.

### *Marketing*

Motor spirit in two grades — 97 octane (super grade) and 89 octane (standard grade) — and a wide range of other petroleum products are marketed in Victoria through a number

of industry terminals and depots and 3,541 retail outlets (30 June 1979), the majority of which are operated by the nine major oil companies. At 30 June 1979, Victoria had the capacity to store 3,246,200 kilolitres of crude oil and petroleum products in bulk at 21 installations; in Melbourne (14), Geelong (1), Crib Point (1), Long Island Point (1), and Portland (4), including refineries.

VICTORIA—PRINCIPAL PETROLEUM PRODUCTS MARKETED, 1979

Item	megalitres	Tonnes	Item	megalitres	Tonnes
Aviation gasoline	19.93	—	Industrial diesel fuel —		
Motor spirit —			Inland	154.00	130,192
Super	3,780.94	—	Bunkers	107.71	93,007
Standard	427.68	—			
			Total	261.71	223,199
Total	4,208.62	—	Fuel oil —		
Power kerosene	6.35	—	Inland (a)	349.36	327,128
Aviation turbine fuel	412.27	—	Bunkers	490.22	463,869
Lighting kerosene	49.68	—			
Heating oil	317.86	—	Total	839.58	790,997
Automotive distillate —			Other petroleum fuels (b)	1,055.26	
Inland	1,246.35	—	Grand total	8,485.30	—
Bunkers	67.69	56,368			
Total	1,314.04	—			

(a) Excluding refinery fuel.

(b) Including refinery fuel.

Source: Oil and Gas Division, Department of National Development and Energy, Canberra.

*Liquefied petroleum gas (propane and butane)*

Liquefied petroleum gas (LPG) is produced at the Esso-BHP fractionation plant at Long Island Point and by Victoria's three refineries. The principal distributor in Victoria is the Gas and Fuel Corporation of Victoria. A number of oil companies and other marketing companies also distribute LPG throughout the State in accordance with the provisions of the *Gas Franchises Act 1970*.

The Long Island facilities produce over 75 per cent of the total production of LPG in Victoria. The establishment of the Long Island facilities is described in the 1977 and earlier editions of the *Victorian Year Book*.

Annual production of propane and butane at the Long Island Point plant is now approximately 1.8 million tonnes. The total storage capacity at the plant comprises six tanks, each of 10,000 tonnes capacity of either butane or propane and a 20,000 tonne capacity tank to store butane. Nearly all the production at Long Island Point is shipped to Japan.

*Ethane gas*

Ethane gas is produced at the Long Island Point Fractionation Plant and has since 1972 been conveyed through a pipeline to the Altona Petrochemical Company Limited at Altona. A new plant using ethane gas as a feedstock and conveyed by pipeline from Altona has been built for Hydrocarbon Products Proprietary Limited at West Footscray at a cost of \$60m and is now in production.

Further reference: *Discovery and development of crude oil in Victoria, Victorian Year Book 1974, pp. 382-5*

**Gas industry**

*Introduction*

The gas industry in Victoria dates from the formation of the City of Melbourne Gas and Coke Company in 1850 with the objective of lighting the City of Melbourne by gas. Many other gas companies were formed in the more heavily populated suburbs of Melbourne and country towns of the State during the second half of the nineteenth century, many by municipal authorities.

### *Gas and Fuel Corporation of Victoria*

In 1877, the Metropolitan Gas Company was formed by the amalgamation of three companies, one of which was the City of Melbourne Gas and Coke Company. The former company subsequently joined with the Brighton Gas Company and the State to form the Gas and Fuel Corporation of Victoria. Since then, the structure of the industry changed from multiple privately-owned utilities to gradual unification under the Gas and Fuel Corporation of Victoria — a public authority of the State owned jointly by the Victorian Government and private shareholders.

With the purchase of the Gas Supply Company's Victorian undertakings in 1970, The Geelong Gas Company in 1971, and Colonial Gas Holdings Limited in 1973, complete unification of the gas industry was achieved. The acquisition of The Albury Gas Company Ltd in 1974 made it possible for the Corporation to extend natural gas supply to the Albury/Wodonga Development Project. The Gas and Fuel Corporation of Victoria is now the sole distributor of gas in Victoria.

During the 1970s, the Corporation progressively extended its natural gas supply system to the point where 99 per cent of the reticulated gas supplied in Victoria is natural gas, and this fuel is currently accessible to more than 80 per cent of the State's population. In 1979-80, natural gas provided over 48 per cent of Victoria's total secondary energy requirements, excluding transport.

In areas where it is not economic to supply natural gas, the Corporation meets the community demand for gaseous fuel either by providing a reticulated gas supply based on liquefied petroleum gas (LPG) or by supplying LPG in cylinders or bulk.

### *Future sources*

Approximately 5.3 billion gigajoules (50 billion therms) of the gas reserves in Esso-BHP's Bass Strait fields were contractually dedicated to the Corporation from 1 January 1975, with an option on a similar quantity from any further reserves established in Victoria by the partners.

In keeping with its responsibility to meet the needs of its consumers and ensure continuing security of gas supply, the Corporation, through a fully-owned subsidiary company, Gas and Fuel Exploration N.L., is engaged in exploring for oil and gas in the Bass Strait area in joint ventures with Beach Petroleum N.L. in the offshore Gippsland Basin, and with Phillips Australian Oil Company and M.I.M. Investments Pty Ltd in offshore Otway Basin.

### *Conservation of energy*

In 1977, the Corporation established Australia's first Energy Management Centre to advise industry and commerce on the efficient use of energy. This Centre comprises:

- (1) An Energy Management School providing courses and seminars on efficient energy utilisation for plant engineers and senior management;
- (2) a consultative service offering advice on the most effective way to gain optimum results from energy used; and
- (3) a Development Division which tests and evaluates new equipment from local and overseas sources.

In 1978, the Corporation established an Energy Information Centre at 151 Flinders Street, Melbourne to provide information to the general public on all aspects of the use of energy. It also promotes low energy housing and, in 1976, it initiated a home insulation programme resulting in insulation in Victorian homes increasing from 27 per cent to 52 per cent.

### *Gas supply areas*

At 30 June 1980, the Corporation was supplying 821,297 consumers with gas through a network of approximately 17,900 kilometres of mains. Of these consumers, 809,211 were receiving natural gas and 12,086 were provided with a reticulated supply based on liquefied petroleum gas.

The areas provided with a reticulated gas supply at 30 June 1980 are shown in the following table:

## VICTORIA—AREAS SUPPLIED WITH GAS AT 30 JUNE 1980 (a)

Supplier	Area supplied			
	Natural gas			Tempered LPG
Gas and Fuel Corporation of Victoria	Bacchus Marsh	Longwarry	Queenscliff	Ararat
	Ballan	Maffra	Rosedale	Colac
	Ballarat	Maryborough	Sale	Hamilton
	Benalla	Melbourne	Seymour	Horsham
	Bendigo	Melton	Shepparton	Kyneton
	Broadford	Moe	Sunbury	Portland
	Castlemaine	Mooroopna	Trafalgar	Stawell
	Churchill	Mornington	Traralgon	Warrnambool
	Cranbourne	Peninsula	Wangaratta	
	Drouin	Morwell	Warragul	
	Geelong	Ocean Grove	Wodonga	
	Hastings	Pakenham		
	Lara	Point Lonsdale		

(a) In addition, the Gas and Fuel Corporation provides a reticulated gas supply in Albury, New South Wales, through its wholly owned subsidiary, the Albury Gas Company Limited.

Source: Gas and Fuel Corporation of Victoria.

*Sales*

The degree to which natural gas has penetrated the competitive energy market in Victoria is reflected by the fact that total gas sales have risen from 12.8 million gigajoules in 1967-68 — the last full year of manufactured gas supply — to a total of 116.1 million gigajoules in 1979-80. While the introduction of natural gas has resulted in a four-fold increase in the domestic market, from 8.8 million gigajoules in 1967-68 to 36.8 million gigajoules in 1979-80, its greatest impact has been in the industrial market where sales have risen from 2.5 million gigajoules in 1967-68 to 70.0 million gigajoules in 1979-80.

## VICTORIA—COMMERCIAL SALES OF NATURAL GAS (a)

Year	Quantity	
	million m <sup>3</sup>	million ft <sup>3</sup>
1975	2,565.355	90,557.032
1976	3,038.522	107,259.827
1977	3,256.752	114,963.346
1978	3,461.135	122,178.065
1979	4,020.826	141,993.360

(a) Includes sales, field, and plant usage.

Source: Department of National Development and Energy, Canberra.

## VICTORIA—SALES OF GAS ('000 gigajoules)

Year	Gas and Fuel Corporation of Victoria
1975-76	83,494
1976-77	95,396
1977-78	101,943
1978-79	108,757
1979-80	116,146

## MINERALS

## Economic natural resources

*Introduction*

Mineral discoveries in Victoria in the past have had an important effect both on the State and Australia as a whole. The first major mineral development occurred in the 1850s with the gold discoveries and the subsequent gold rushes in various parts of the State. A less spectacular development, but one equally important for Victoria's economy, was the commencement of the utilisation of the La Trobe Valley brown coal deposits for power generation in the 1920s. Of equal significance were the oil and gas discoveries in eastern

Bass Strait during the 1960s from which Victoria now supplies about 68 per cent of Australia's crude oil requirements and the whole of the State's gas needs.

The recent world energy crisis has emphasised that liquid fuel deposits are not infinite and that in the future, liquid hydrocarbons may have to be manufactured from coal. Victoria, with its vast reserves of brown coal, may be in an excellent position to continue to supply a substantial part of Australia's liquid fuel requirements in the future.

Following the discovery of a copper-zinc deposit by the Western Mining Corporation in an area west of Benambra during the middle of 1978, further drilling in the area has established the existence of two separate ore bodies containing copper and zinc, in the Wilga and Currawong prospects. Drilling to evaluate these deposits is in progress. The two ore bodies constitute the most important finds of base metals in Victoria and have stimulated exploration in the State.

#### *Construction materials*

Quarry products have maintained their place in Victoria's economy. In 1978-79, the production of construction materials, including clay and limestone for lime and cement, was approximately 37,600,000 tonnes, valued at \$107.8m. Slightly less than half of this quantity is produced and used in the Melbourne Statistical Division.

#### *Fossil fuel reserves*

At July 1980, Victoria's measured geological resources of brown coal (lignite) amounted to 65,933 megatonnes, of which 64,923 megatonnes occurred in the extensive coalfields of the La Trobe Valley. The total geological resources down to depths at present uneconomic to mine, amount to 124,307 megatonnes. State Electricity Commission estimates have classified 44,284 megatonnes as *economic reserves* and of these, 12,890 megatonnes could be mined from large-scale open cut operations at about present-day costs. The energy contents of economic and readily recoverable brown coal reserves are 442,840,000 and 128,900,000 terajoules, respectively.

The Bass Strait oil and natural gasfields will supply Victoria and other markets with natural gas until well into the twenty-first century at the anticipated rate of consumption. It is estimated that an energy equivalent of 7,400,000 terajoules will be available if new gasfields are not discovered. The crude oil reserves, equivalent to 9,600,000 terajoules, will be seriously depleted by the late 1980s unless new discoveries are made in Victoria and Australia during the next few years.

#### VICTORIA—ENERGY EQUIVALENT OF ECONOMICALLY RECOVERABLE FOSSIL FUEL RESERVES (million terajoules)

Crude oil	Natural gas	Gas liquids	Brown coal	Total
9.6 (a)	7.4 (a)	2.7 (a)	442.8 (b)	462.5

(a) Proven economically recoverable reserves at 30 September 1980

(b) Economically recoverable at 1 July 1979

The crude oil from the Bass Strait oilfields is deficient in the heavier lubricating fractions and the main commercial derivatives are light petroleum liquids ranging from heating oil to motor spirit. Victoria and Australia still depend on overseas crude oil for production of medium to heavy lubricating oils.

#### *Metallic minerals*

Only minor amounts of metallic minerals are produced in Victoria. The most valuable of these is gold. These minerals contribute only about 0.5 per cent of the value of mineral products.

#### **Geological Survey of Victoria**

The Geological Survey of Victoria, formally established in 1852 following the first reported discovery of alluvial gold in the previous year, was in 1867 brought under the control of the Minister of Mines and since 1 September 1977 has functioned as a division in the Department of Minerals and Energy.

The early work of the Survey included detailed surface and sub-surface mapping of the important goldfield areas. In the 1890s, studies were extended to the black coal deposits in



south Gippsland, culminating in the discovery of the Wonthaggi coalfield in the early 1900s.

In the period from 1910 to 1920, the Survey intensified the mapping programmes and undertook surveys of the brown coal deposits of the La Trobe Valley. The Department initiated the re-opening of the Morwell open cut at Yallourn North and developed the brown coalfields as a source of fuel before this responsibility was transferred to the State Electricity Commission of Victoria in 1920.

After the Second World War, the activities of the Survey were diversified with the growing interest in petroleum exploration, groundwater investigation, engineering geology, and the extractive industries. The studies carried out on the Tertiary stratigraphy and micropalaeontology of the onshore Gippsland Basin set a basis for the discovery of the oil and gasfields of Bass Strait during the middle 1960s.

In summary, the main activities of the Survey are the investigation of Victoria's geological structure, and mineral, petroleum, and groundwater resources; engineering geology; and the provision of basic information on these matters in the form of geological maps, reports, and advice to industry, the public, and Commonwealth and Victorian Government departments. The Survey also serves as geological consultant to government agencies when required, and provides scientific information for the appraisal, development, and conservation of Victoria's sub-surface resources.

### Mining and quarry production

The mining and quarrying production of Victoria from lands occupied under the Mines Act and the Extractive Industries Act is recorded by the Victorian Department of Minerals and Energy, and from other lands by the Australian Bureau of Statistics. The production from both sources for the years 1975-76 to 1978-79 is shown in the following table:

VICTORIA—MINING AND QUARRYING PRODUCTION

Particulars	1975-76		1976-77		1977-78		1978-79	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
<b>Metallic minerals (a)—</b>								
Gold bullion	119	343	42	112	10	35	26	129
	tonne		tonne		tonne		tonne	
Antimony ore	507	11	1,227	21	443	17	—	—
Bauxite	2,366	38	5,579	87	2,136	49	1,965	n.p.
Iron ore	6,650	73	1,785	17	473	4	8,409	n.p.
Tin concentrate	—	—	2	10	2	15	1	n.p.
<b>Non-metallic minerals—</b>								
Diatomite	498	34	437	48	269	30	378	35
Fireclay	14,777	64	17,944	107	26,057	170	12,580	85
Gypsum	69,006	240	84,761	310	107,359	372	201,205	601
Kaolin, refined	16,663	1,308	18,616	1,572	23,605	2,007	30,723	2,728
Kaolin, unrefined (b)	414	7	276	4	7,088	30	5,969	25
Limestone (c)	2,170,684	n.a.	2,081,201	n.a.	2,221,068	n.a.	2,141,251	7810
Other clays	2,478,992	3,114	2,090,000	2,572	2,259,223	3,083	1,583,347	2,217
Silica	166,273	708	199,416	960	184,274	1,166	196,175	1,542
<b>Fuel minerals—</b>								
Briquettes	945,793	11,974	1,034,786	14,925	1,064,094	16,536	1,131,001	25,063
Brown coal (d)	26,711,090	48,346	28,231,206	55,905	27,643,837	64,925	29,094,740	79,630
	'000m <sup>3</sup>		'000m <sup>3</sup>		'000m <sup>3</sup>		'000m <sup>3</sup>	
Crude oil	21,795		22,647		23,475		23,074	
Liquefied petroleum gases (e)—								
Commercial butane	1,181		1,324		1,387		1,687	
Commercial propane	1,051		1,207		1,267		1,542	
	million m <sup>3</sup>	430,634	million m <sup>3</sup>	458,818	million m <sup>3</sup>	545,374	million m <sup>3</sup>	774,886
		(g)		(g)		(g)		(g)
Natural gas (f)	2,641		2,989		3,247		3,715	
Other derivatives (e)—								
Commercial ethane	73,208		103,350		110,455		144,025	
	'000 m <sup>3</sup>		'000 m <sup>3</sup>		'000 m <sup>3</sup>		'000 m <sup>3</sup>	
<b>Construction materials—</b>								
Sand	7,765	12,832	9,040	14,626	8,951	18,314	8,287	19,146
Gravel	4,095	3,304	4,683	4,367	4,807	4,626	4,759	5,387
Crushed and broken stone	17,430	48,742	17,884	48,388	18,665	62,215	18,845	68,616
	'000 tonnes		'000 tonnes		'000 tonnes		'000 tonnes	
Dimension stone	10,621	256	7,867	288	12,589	516	7,107	287
	tonne		tonne		tonne		tonne	
Other quarry products	2,738	2,905	3,327	3,886	3,551	5,113	2,482	3,987
	'000 tonnes		'000 tonnes		'000 tonnes		'000 tonnes	

(a) See next table for assayed content.

(b) Excludes unrefined kaolin used in producing refined kaolin at or near mine.

(c) Excludes limestone used as a construction material.

(d) Excludes brown coal used in production of briquettes: 1975-76: 2,512,000 tonnes; 1976-77: 2,763,000 tonnes; 1977-78: 2,848,349 tonnes; 1978-79: 3,006,289 tonnes.

(e) Excludes manufactured liquefied petroleum gases and other derivatives from petroleum refining.

(f) Includes commercial gas and gas for field usage.

(g) Value shown is an estimate based on prices prescribed in legislation, quoted market prices, and information from government departments. Values of individual petroleum products are not available for publication.

Sources: Department of Minerals and Energy, Victoria; Fuel Branch, Commonwealth Department of National Development; and Australian Bureau of Statistics.

### VICTORIA—ASSAYED CONTENT OF METALLIC MINERALS

Metal or element and mineral in which contained	1974-75	1975-76	1976-77	1977-78	1978-79
Alumina (tonne)—					
Contained in bauxite	—	1,214	2,829	1,110	963
Antimony (tonne)—					
Contained in antimony ore	278	60	109	49	—
Gold (gm)—					
Contained in antimony ore	—	—	—	—	—
Contained in gold bullion	217,794	105,582	40,175	9,238	21,752
Total gold	217,794	105,582	40,175	9,238	21,752
Iron (tonne)—					
Contained in bauxite	—	121	324	145	138
Contained in iron ore	292	3,990	1,071	284	5,045
Total iron	292	4,111	1,395	429	5,183
Rutile (tonne)—					
Contained in bauxite	—	118	—	—	—
Silica (tonne)—					
Contained in bauxite	—	289	—	—	—
Tin (tonne)—					
Contained in tin concentrate	4	—	1	2	1

Sources: Department of Minerals and Energy, Victoria, and Australian Bureau of Statistics.

### VICTORIA—COAL PRODUCTION AND VALUE (a)

Period (b)	Black coal		Brown coal	
	Production	Value	Production	Value
	tonnes	\$'000	tonnes	\$'000
1926-1930	678,901	1,786	1,539,917	386
1931-1935	479,606	888	2,484,461	512
1936-1940	330,118	568	3,666,671	712
1941-1945	290,872	818	5,090,974	1,052
1946-1950	158,798	722	6,755,137	2,404
1951-1955	145,838	1,590	8,868,202	7,186
1956-1960	102,512	1,050	12,389,332	11,302
1961-1965	53,418	599	18,607,269	16,605
1966	36,089	497	22,132,593	20,064
1967	32,581	251	23,758,913	20,686
1968	26,736	209	23,339,331	21,555
1968-69	13,312	105	23,499,703	20,879
1969-70	407	6	24,310,900	22,131
1970-71	20	—	23,180,539	22,975
1971-72	—	—	23,630,467	25,706
1972-73	—	—	24,121,155	28,555
1973-74	—	—	26,354,577	31,532
1974-75	—	—	27,541,462	45,341
1975-76	—	—	29,211,090	52,871
1976-77	—	—	30,994,476	61,598
1977-78	—	—	30,492,186	73,183
1978-79	—	—	32,896,279	79,630

(a) Value of output at the mine. This is essentially the unit selling price of the commodity, less any unit transport costs from the mine or associated treatment works, multiplied by the production. Where a commodity is transferred to another location for further processing without being sold, the unit value is based on production costs plus an allowance for overhead and profit.

(b) Figures for five-yearly periods are annual averages.

Further references: *Groundwater in Victoria*, Victorian Year Book 1969, pp. 384-6; *Victorian clays 1970*, pp. 376-8; *History of the Mines Department, 1970*, pp. 105-8; *Minerals in Victoria, 1970*, pp. 1-29; *Mineral exploration, 1972*, pp. 363-7; *Geological Survey of Victoria, 1975*, pp. 362-3; *Extractive industries, 1975*, pp. 364-5; *Mineral deposits in Victoria, 1976*, pp. 362-3; *Mines Department, 1977*, pp. 367-9; *History of mining, 1979*, p. 287

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