

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" and, as such, is the designated authority for certain operations under the *Petroleum (Submerged Lands) Act 1967*. He is also responsible for the administration of the State Electricity Commission of Victoria, the Gas and Fuel Corporation of Victoria, and the Victorian Brown Coal Council. This latter body was established by Act of the Victorian Parliament on 1 January 1979.

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. 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 1978-79, about 80 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 5 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 12 per cent is obtained from the Snowy Mountains Hydro-Electric Scheme in New South Wales.

About 94 per cent of Victoria's petroleum refinery crude oil input comes from the State's offshore oilfields and the balance is 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. Currently it provides about 48 per cent of Victoria's secondary energy needs. Over 99 per cent of all gas used in Victoria for domestic and industrial purposes is produced from the offshore gas and oil fields 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), 1978-79**

Source	Per cent
Crude oil	2.6
Brown coal	94.6
Natural gas (including LPG)	2.6
Hydro and wood (a)	0.2
Total	100.0

(a) Compared with total resources reserves of hydro power and wood are negligible.

Source: Department of Minerals and Energy.

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 and in the south-central region at Anglesea, Bacchus Marsh, and Altona. 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 1979
(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	—	—
Total	(f)65,933	46,574	11,800	(f)124,307	(g)44,284	(f)12,890

(a) Includes 625 megatonnes excavated in the La Trobe Valley to 1 July 1979.

(b) Includes 625 megatonnes excavated in the La Trobe Valley to 1 July 1979 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 10 megatonnes from Anglesea open cut to 1 July 1979.

(e) Includes 10 megatonnes excavated from Maddingley open cut to 1 July 1979.

(f) Includes 645 megatonnes excavated to 1 July 1979. (See also footnotes (a), (d), and (e).)

(g) Includes 645 megatonnes excavated to 1 July 1979, 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 fields

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 1979. An amount of 35,754 megatonnes has been classified as economic reserves of which 11,630 megatonnes are considered readily recoverable at present day costs.

Other fields

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 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, 1978-79

During the period 1 July 1978 to 30 June 1979, 32.03 megatonnes of brown coal was mined in Victoria. Of this quantity, 30.93 megatonnes were won by the State Electricity Commission of Victoria from 3 open cuts it operates in the La Trobe Valley and an assumed 1.1 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, 27.67 megatonnes being used in 1978-79 for this purpose. Only about 3.26 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 1978-79 was 1,131,000 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.

Research and development

Victorian Brown Coal Council

In 1975, the Victorian Government established the Victorian Brown Coal Research and Development Committee to advise the Minister for Minerals and Energy on coal conversion. The Committee's broad charter was to initiate, direct, review, and report on all necessary research and development relating to the upgrading of Victoria's brown coal resources and it had as its primary objective conversion processing for the economic production of oil from brown coal.

The Committee embarked on a programme which attracted the interest of the scientific fraternity and of industrial organisations interested in obtaining oil from coal as a commercial objective. However, the programme reached the stage where it was no longer practicable to manage it on a committee-style basis and the Victorian Government accordingly established a new statutory body, called the Victorian Brown Coal Council, to succeed the Committee and provide an authority to ensure that its plans were carried out. The enacting legislation, known as the *Victorian Brown Coal Council Act 1978 No. 9249*, received Royal Assent on 19 December 1978 and was subsequently proclaimed by Order of the Governor in Council on the same date.

The Council, which commenced operation on 1 January 1979, is subject to the direction and control of the Minister for Minerals and Energy and has the responsibility for progressing the Victorian Government's programme of research and development into the conversion of brown coal into liquid fuels and other related products.

The Council's Board of Directors comprises the principal officers of the State's energy agencies, with the addition of representatives from industry. The Council's policies and programmes can therefore be integrated with Victoria's overall energy policies and programmes. The Council will also be supported by advice from specialist committees, and the experience built up by the Victorian Brown Coal Research and Development Committee during its three and a half years of activity will be a start for new developments.

The principal functions of the Council are to:

- (1) Promote and co-ordinate research into and the development of the potential uses of brown coal, primarily for the purpose of meeting future requirements for liquid fuels and including such other areas of coal conversion as the production of materials for use in metallurgical applications, feedstocks for chemical processes, special carbons or hydrocarbons for other uses, and the use of by-products arising therefrom; and

(2) promote and undertake research into the development of processes that may facilitate or extend the use of brown coal, being primarily liquefaction processes leading to the production of liquid fuels and including coal preparation, solvent refining, and pyrolysis, or gasification processes relating to the applications referred to above.

Current activities include work directed towards defining the requirements for coal conversion operations. A plant to produce synthetic transport fuels using either the CO-Steam process (which is to be investigated in collaboration with the United States Department of Energy) or the hydrogenation process that is the subject of the joint Australia/Federal Republic of Germany Coal-to-Oil Feasibility Study would require 30-40 megatonnes of raw brown coal per year. A plant to produce special products, such as Solvent Refined Coal for use in the steel industry, could require about 10 megatonnes of raw brown coal per year — two Japanese groups are interested in this application. Currently 31 megatonnes per year are extracted from the La Trobe Valley coalfields for use in power stations which supply 80 per cent of Victoria's total electricity requirements.

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

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 1979, the Commission with 19,818 personnel and capital assets of \$2,695m distributed electricity to 1,268,600 consumers throughout Victoria. In addition, eleven metropolitan municipal councils purchased electricity in bulk from the Commission for retail distribution to a further 270,000 customers. Nearly 121,000 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 1978-79, 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 37 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 45 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							
		1975-76		1976-77		1977-78		1978-79	
		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	9,132.2	50.9	9,534.3	50.1	9,228.3	47.3	9,405.8	45.2
Yallourn	521	2,360.7	13.2	2,939.5	15.4	2,183.9	11.2	2,939.0	14.1
Yallourn "W"	700	3,538.9	19.7	3,021.2	15.9	4,204.0	21.5	3,525.8	16.9
Morwell	170	1,165.3	6.5	1,159.3	6.1	830.1	4.2	1,178.5	5.7
Newport	198	133.4	0.7	270.1	1.4	306.4	1.6	373.7	1.8
Spencer Street (b)	90	1.2	—	41.1	0.2	109.9	0.6	184.1	0.9
Richmond	38	0.2	—	10.5	0.1	54.7	0.3	58.7	0.3
Jeeralang	225	—	—	—	—	—	—	478.7	2.3
Total SEC thermal	3,542	16,331.9	91.0	16,976.0	89.2	16,917.3	86.7	18,144.3	87.2
Hydro stations—									
Kiewa (c)	184	394.3	2.2	259.8	1.4	251.5	1.3	327.7	1.6
Eildon (d)	135	415.5	2.3	278.4	1.4	263.0	1.3	228.9	1.1
Total SEC hydro	319	809.8	4.5	538.2	2.8	514.5	2.6	556.6	2.7
Total SEC	3,861	17,141.7	95.5	17,514.2	92.0	17,431.8	89.3	18,700.9	89.9
Net purchases	..	803.7	4.5	1,521.7	8.0	2,077.0	10.7	2,105.9	10.1
Total	3,861	17,945.4	100.0	19,035.9	100.0	19,508.8	100.0	20,806.8	100.0

(a) At 30 June 1979.

(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 1979 comprised nearly 121,000 kilometres of power lines, 4 auto-transformation stations, 26 terminal receiving stations, 181 zone sub-stations, and over 82,000 distribution sub-stations. Main transmission is by 8,700 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.

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 expected to be in service in the early 1980s.

Newport

The Victorian Government has authorised the State Electricity Commission to build a 500 MW regulating power station at the mouth of the Yarra River and construction is almost complete. Further information on the Newport power station can be found on pages 799-800 of the *Victorian Year Book 1978*.

Jeeralang

The Commission is installing 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) came into service early in 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 planned to come into service progressively between 1983 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 1979 price levels, is estimated at \$2,800m.

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 in the summer of 1980-81.

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.

In 1978-79, 80 per cent of Victoria's electricity needs — the basis of the State's industrial progress — was generated in the La Trobe Valley. Most of the balance is supplied by hydro-electric plants at Kiewa, Eildon, and in the Snowy Scheme. The main task of the hydro stations is to come into operation quickly to meet peaks in demand for electricity.

The La Trobe Valley power stations provide the base load of electricity demand — the continuous demand that goes on day and night. Burning low-grade brown coal, they are economical to run and perform best at continuous full load.

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 in the Gippsland Basin, 1960 to 1979

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, 87 exploration wells have been drilled of which 35 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 IN THE GIPPSLAND BASIN, 1964 TO 1979

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
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

VICTORIA—COMMERCIAL EXPLORATION WELLS DRILLED BY ESSO AND
BHP IN THE GIPPSLAND BASIN, 1964 TO 1979—*continued*

Well	Date well spudded-in	Type of well (a)	Result
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 2	2. 5.77	D	Oil discovery
West Halibut 1 (e)	3. 9.78	AW	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

(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. The Gas and Fuel Corporation of Victoria in association with M.I.M. Investments Pty Ltd and Phillips Australian Oil Company has also been granted an exploration permit over offshore areas of the Otway Basin with Phillips Australian Oil Company as the operator. Geophysical surveys are to be carried out during 1980.

Offshore drilling programmes, 1978 and 1979

During 1978 and 1979, the following nine exploration wells were drilled in the Gippsland Basin by the Esso/BHP partnership using the drilling rigs Ocean Endeavour and Ocean Digger:

VICTORIA — WELLS DRILLED, 1978 AND 1979

Well	Date well spudded-in	Result
Fortescue 1	17. 6.78	Dry hole
Sweep 1	18. 7.78	Dry hole
Seahorse 1	30. 7.78	Oil show
West Halibut 1(a)	3. 9.78	Oil discovery
Fortescue 2	30.10.78	Oil discovery confirmation
Fortescue 3	26.11.78	Oil discovery confirmation
Rockling 1	27.12.78	Dry hole
Threadfin 1	22. 2.79	Dry hole
Fortescue 4	18. 3.79	Oil discovery confirmation

(a) West Halibut 1 commenced as a step out well to delineate the Halibut field but ended as the exploration well for a new and separate field subsequently called Fortescue.

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

*Development of the Gippsland fields**Completed projects, 1967 to 1979*

The initial stage of development took place between 1967 and 1971 when the four commercial fields discovered to that time were developed as an integral operation. These were the Barracouta and Marlin gas fields and the Halibut and Kingfish oilfields together with a small reservoir in the Barracouta field. Further development was carried out on the Marlin field during 1972 and 1973.

The Cobia 2 well, found in the small Cobia reservoir during 1977, was developed during the latter part of 1978 and the first half of 1979 and came on stream on 30 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 undersea pipelines to the Mackerel platform prior to transportation through the Halibut pipeline to Longford for processing to stabilised crude oil. This was also the first project where the pre-welded pipeline was laid by the spooling method from a specially adapted boat.

Current projects, 1974 to 1980

Following the proving of the Mackerel oilfield as a commercial proposition in 1973, construction began in September 1974 at the Barry Beach Marine Terminal of a platform to be erected over this field. It was set in position during April 1976 and construction was completed in January 1977. After drilling of the first development well (A1), the Mackerel field came on stream on 19 December 1977. The remainder of the planned 18 development wells are still being drilled.

Work on the construction of a platform over the Tuna oil and gasfield commenced in January 1975. It was erected on site about 56 kilometres offshore on 27 January 1977 and development drilling of the planned 18 holes commenced on 2 October 1978. Production of oil commenced on 14 June 1979. The production of gas has not yet commenced.

Additional facilities are being installed on the Marlin platform to produce oil from a small accumulation beneath the main gas reservoir and production was expected to begin towards the end of 1980. A gas pipeline was being laid between the Mackerel field and the Marlin platform. Weighting and welding of pipe commenced at Barry Beach Marine Terminal in February 1979 and offshore laying operation commenced on 31 October of that year.

Construction of the platform for the Snapper gasfield commenced at the Barry Beach Marine Terminal during 1978. The template was loaded out to site in April 1979 and was set in position on 18 May 1979. Fabrication of production facilities for the platform was 50 per cent complete in the first half of 1980 and the 600 mm pipeline from the platform to the beach head near Loch Sport was scheduled to be finished by the middle of 1980. Development drilling was scheduled to commence about the same time and the Snapper field was expected to come on stream during August 1980.

In June 1979, the Minister for Minerals and Energy authorised the construction and erection of the West Kingfish platform and fabrication of the template began at the Barry Beach Marine Terminal in November 1979.

Additional production facilities were to be installed on the Mackerel platform to handle crude oil produced by high angle wells drilled directionally about 4 kilometres from the platform to the south Mackerel field.

The pipe reel technology used in 1978 on the Cobia Subsea Completion Project was to be used to install a fuel gas pipeline from Marlin to Halibut and Mackerel.

Design work for the construction of a platform over the Flounder field was advanced. Onshore fabrication for this \$250m project was scheduled to begin during 1981 and production from the field, estimated to contain recoverable reserves of 56 million barrels of oil, should commence in 1984. Peak production rates were expected to reach just over 15,000 barrels a day.

Detailed design for the erection of Gas Plant Number 3 at Longford commenced in Melbourne in June 1979 and orders have been placed for steel and other materials. The cryogenic, similar to existing Gas Plant Number 2, was scheduled to come on stream in 1982 to supplement supply to the expanding Victorian gas market.

On 10 January 1980, Esso/BHP announced that the partnership intended to develop the Fortescue oilfield at a cost in excess of \$240m. The project entails the erection of a platform 65 kilometres offshore, 4 kilometres west of the Halibut platform in 65 metres of water. The platform was to have a capacity for 21 wells and was to be linked to Halibut by 300 mm pipeline from which point the oil flows through the existing pipeline system to Longford. The maximum production was expected to be 45,000 barrels a day. The development would also involve extension of the 100 mm fuel gas line laid from Marlin to Halibut for artificial lift and supply. Work on the platform was due to commence towards the end of 1980 and production was planned to commence in 1983.

Esso/BHP was also to continue their active exploration programme in Bass Strait which would include 3,800 seismic investigations in 1980 including 2,500 kilometres of three dimensional surveys, the first of their kind to be carried out in Australia. During the latter part of 1980, the partnership was to begin a new wild drilling cycle in Bass Strait and four exploration wells were planned to be drilled by the end of the year.

VICTORIA—CRUDE OIL PRODUCTION, 1975 TO 1979
(After processing)

Year	Barrels		Kilolitres	
	During year	Average barrels/day for year	During year	Average kilolitres/day for year
1975	136,434,598	373,793	21,693,101	59,433
1976	140,559,679	384,043	22,347,162	61,058
1977	145,187,523	397,774	23,074,930	63,219
1978	148,826,012	407,742	23,343,427	63,955
1979	149,790,661	410,385	23,790,661	65,180

Source: Esso Australia Ltd.

VICTORIA—GIPPSLAND BASIN COMMERCIAL HYDROCARBON
RESERVES AND PRODUCTION, 30 SEPTEMBER 1979

Item	trillion (10 ¹²) cubic feet			billions (10 ⁹) cubic metres		
	Initial	Produced	Remaining	Initial	Produced	Remaining
Natural gas	7.787	0.850	6.937	220.6	24.1	196.5
Crude oil	2916.7	1158	1758.7	463.7	184.1	279.6
Condensate	211.3	21.4	189.9	33.6	3.4	30.2
Liquified petroleum gas	551.0	125.8	425.2	87.6	20	67.6

NOTE: All figures are for products *after processing*.

Crude oil = C₁ + in oil reservoir; Natural gas = C₁ and C₂; Condensate = C₃ + dissolved in gas; LPG = C₄ and C₅.
1 gegalitre = 10⁶ litres.

Figures given are based on direct conversion of cubic metres or gegalitres 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	101,000 to 107,000 BSD 5,000,000 tonnes/year
(Lubricating oil plant)	Corio near Geelong 1954	2,200 BSD 100,000 tonnes/year

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

Refinery	Location in Victoria and year refinery came on stream	Primary processing capacity (a)
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 3 local refineries.

The total volume shipped by tanker during the 1978 calendar year was 64,374,164 barrels (10,234,655 kilolitres) and during 1979 was 65,677,048 barrels (10,441,834 kilolitres). The volumes of crude oil conveyed through the pipelines to local refineries during 1978 was 82,339,088 barrels (13,090,845 kilolitres) and during 1979 was 83,355,293 barrels (13,252,455 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 3,193,700 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, 1978

Item	'000 kilolitres	Tonnes	Item	'000 kilolitres	Tonnes
Aviation gasoline	20.35	—	Industrial diesel fuel —		
Motor spirit —			Inland	181.63	153,647
Super	3,709.62	—	Bunkers	131.76	113,791
Standard	436.61	—	Total	313.39	267,438
Total	4,146.23	—	Fuel oil —		
Power kerosene	6.26	—	Inland (a)	354.94	331,985
Aviation turbine fuel	419.43	—	Bunkers	560.97	529,847
Lighting kerosene	57.55	—	Total	915.91	861,832
Heating oil	422.53	—	Other petroleum fuels (b)	926.14	
Automotive distillate —			Grand total	8,441.77	—
Inland	1,174.75	—			
Bunkers	39.23	32,732			
Total	1,213.98	—			

(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 Long Island facilities produce over 75 per cent of the total production of LPG in Victoria and the principal distributor in Victoria is the Gas and Fuel Corporation of Victoria. A number of oil companies and other marketing companies distribute LPG throughout the State in accordance with the provisions of the *Gas Franchises Act 1970*. 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 merged with the Brighton Gas Company which in turn was absorbed into the Gas and Fuel Corporation of Victoria which was formed in 1950. 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 State utility.

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.

Manufactured gas has been replaced with natural gas and, where this is not available, with liquefied petroleum gas (LPG) supplied in cylinder and bulk tank or reformed LPG supplied through a local reticulation system — applicable in many country towns. The natural gas reticulation system is, however, continually being expanded to include as many provincial towns as possible and is currently accessible to more than 80 per cent of Victoria's population.

In 1978-79, gas provided 48 per cent of Victoria's total secondary energy requirements excluding transport and this figure is rising year by year.

Future sources

Approximately 140 billion cubic metres (5 trillion cubic feet) of the gas reserves in Esso/BHP's Bass Strait fields are contracted to the Corporation, 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 NL, is engaged in exploring for oil and gas in the Bass Strait area in a joint venture with Beach Petroleum NL.

The Corporation has also concluded an agreement with Phillips Australian Oil Company and M.I.M. Investments Pty Ltd for exploration in the offshore Otway Basin and the Minister for Minerals and Energy, the designated authority under the *Petroleum (Submerged Lands) Act 1967*, has granted an exploration permit to the venture.

Conservation of energy

In 1977, the Corporation embarked on a programme promoting the efficient use of energy in industry, commerce, and the home with the primary objective of conserving Victoria's fuel resources. An Energy Management Centre was set up in the Melbourne suburb of Clayton, comprising:

- (1) A school which holds courses and seminars on efficient energy utilisation;
- (2) a Consultancy Service, to advise industry and commerce on energy usage and new techniques; and
- (3) a Development Division where the latest appliances are tested and evaluated for energy efficiency.

The Gascor Home Insulation Division was established to facilitate home insulation, thus enabling householders to reduce their fuel consumption and their operating costs. Other projects included the opening of an Energy Information Centre, the sponsoring of a Low Energy House competition, and the establishment of a Solar Research Centre.

Gas supply areas

At 30 June 1979, the Corporation was supplying 771,203 consumers with gas through a network of approximately 17,235 kilometres of transmission pipelines. Of these consumers, 760,540 were receiving natural gas and 10,763 were provided with a reticulated supply based on liquefied petroleum gas.

The areas provided with a reticulated gas supply at 30 June 1979 are shown in the following table:

VICTORIA—AREAS SUPPLIED WITH GAS AT 30 JUNE 1979 (a)

Supplier	Area supplied		
	Natural gas	Tempered LPG (b)	
Gas and Fuel Corporation of Victoria	Albury	Mornington	Ararat
	Bacchus Marsh	Peninsula	Colac
	Ballan	Morwell	Hamilton
	Ballarat	Ocean Grove	Horsham
	Benalla	Pakenham	Kyneton
	Bendigo	Point Lonsdale	Portland
	Broadford	Queenscliff	Stawell
	Castlemaine	Rosedale	Warrnambool
	Churchill	Sale	
	Cranbourne	Seymour	
	Drouin	Shepparton	
	Geelong	Sunbury	
	Hastings	Trafalgar	
	Lara	Traralgon	
	Longwarry	Wangaratta	
	Maffra	Warragul	
	Melbourne	Wodonga	
	Mooroopna		
	Private suppliers—	Western Port	
	Esso Exploration and Production Australia Inc. and Hematite Petroleum Pty Ltd (BHP)	North Geelong	

(a) Excludes Esso/BHP own plant use at Longford and Long Island Point.

(b) In addition, the Gas and Fuel Corporation supplies Maryborough and Warracknabeal with bottled LPG.

Source: Gas and Fuel Corporation of Victoria.

Production and sales
**VICTORIA—PRODUCTION OF TREATED
 NATURAL GAS (a)**

Year	Quantity	
	million m ³	million ft ³
1974	2,241.743	79,167.139
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

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

Source: Department of National Development and Energy, Canberra.

VICTORIA—SALES OF GAS (a)
 (gigajoules)

Year	Gas and Fuel Corporation of Victoria
1974-75	72,253,000
1975-76	83,628,000
1976-77	95,471,000
1977-78	102,063,000
1978-79	109,138,000

(a) Includes Mt Gambier Gas Co. Ltd in South Australia.

NOTE: 1 gigajoule = 9,479 therms. For sales of gas in Victoria for the years 1970-71 to 1973-74, see table on page 335 of *Victorian Year Book 1976*.

Source: Gas and Fuel Corporation of Victoria.

Sales rose sharply following the introduction of natural gas in April 1969. During the twelve month period ending 30 June 1968, the last full year before the introduction of natural gas, sales showed an increase of only 5.5 per cent over the previous year. Sales during the twelve month period ending 30 June 1979 increased by 32.5 per cent.

As an example of market growth, customers on the space heating tariff when it was introduced in 1965 numbered 1,400. Ten years later, more than 268,300 householders have become eligible for this tariff. So great was the impact industrially that within ten years of its introduction natural gas was replacing over one million tonnes per annum of fuel oil.

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.

During the middle of 1978, the Western Mining Corporation encountered, during exploration in an area east of Benambra in north-eastern Victoria, a 25.5 metre intersection in a drill hole sited on the Wilga prospect. The intersection assayed at 4 per cent copper and 7.3 per cent zinc. Drilling to evaluate this deposit is continuing. The intersection represents the most promising intersection of base metals in Victoria and has stimulated mineral exploration particularly in areas of similar rocks in eastern Victoria.

Construction materials

Apart from crude oil and natural gas, quarrying of construction materials exceeds other mineral production, including brown coal, in both volume and value. In 1978, the production of construction materials, including clay and limestone for lime and cement, was approximately 39,000,000 tonnes, valued at \$79.8m. The larger portion of this quantity, estimated to be as much as 60 per cent, is both produced and used within the Melbourne Statistical Division.

Fossil fuel reserves

Victoria's measured geological reserves of brown coal (lignite) amount to 65,933 megatonnes, of which 64,923 megatonnes occur 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, but the State Electricity Commission estimates that the present economically extractable quantity is 44,284 megatonnes. This would contain an energy content of 442,840,000 terajoules.

The Bass Strait oil and natural gasfields will supply Victoria and other markets with natural gas for more than thirty years at the anticipated rate of consumption. It is estimated that an energy equivalent of 7,800,000 terajoules will be available if new gas fields are not discovered. The crude oil reserves, equivalent to 9,000,000 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 RECOVERABLE FOSSIL FUEL
(million terajoules)

Crude oil	Natural gas	Gas liquids	Brown coal	Total
9.0	7.8	2.1	128.9	147.8

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 subsurface mapping of the important goldfield areas, and in the 1890s studies were extended to the black coal deposits in south Gippsland. This work culminated 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 subsurface 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 1974-75 to 1977-78 is shown in the following table:

VICTORIA—MINING AND QUARRYING PRODUCTION

Particulars	1974-75		1975-76		1976-77		1977-78	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
	'000 gm	\$'000	'000 gm	\$'000	'000 gm	\$'000	'000 gm	\$'000
Metallic minerals (a)—								
Gold bullion	249	225	119	343	42	112	10	35
	tonne		tonne		tonne		tonne	
Antimony ore	2,703	34	507	11	1,227	21	443	17
Bauxite	—	—	2,366	38	5,579	r87	2,136	49
Iron ore	487	4	6,650	73	1,785	17	473	4
Tin concentrate	5	22	—	—	2	10	2	15
Non-metallic minerals—								
Diatomite	4,979	22	498	34	437	48	269	30
Fireclay	14,280	40	14,777	64	17,944	107	26,057	170
Gypsum	54,139	161	69,006	240	84,761	310	107,359	372
Kaolin, refined	26,135	1,441	16,663	1,308	18,616	1,572	23,605	2,007
Kaolin, unrefined (b)	8,077	40	414	7	276	4	7,088	30
Limestone (c)	2,139,529	n.a.	2,170,684	n.a.	2,081,201	n.a.	2,221,068	n.a.
Other clays	2,222,221	2,343	2,478,992	3,114	r2,090,000	r2,572	2,259,223	3,083
Silica	142,550	445	166,273	708	199,416	960	184,274	1,166
Fuel minerals—								
Briquettes	1,092,134	11,391	945,793	11,974	1,034,786	14,925	1,064,094	16,536
Brown coal (d)	24,641,462	40,556	26,711,090	48,346	28,231,206	55,905	27,643,837	64,925
	'000m ³		'000m ³		'000m ³		'000m ³	
Crude oil	20,930		21,795		22,647		23,083	
Liquefied petroleum gases (e)—								
Commercial butane	1,147		1,181		1,324		1,387	
Commercial propane	1,025		1,051		1,207		1,267	
	million m ³	395,311	million m ³	430,634	million m ³	458,818	million m ³	545,374
		(g)		(g)		(g)		(g)
Natural gas (f)	2,284		2,641		2,989		3,099	
Other derivatives (e)—	'000 m ³		'000 m ³		'000 m ³		'000 m ³	
Commercial ethane	63,677		73,208		103,350		110,455	
Construction materials—	'000 tonnes		'000 tonnes		'000 tonnes		'000 tonnes	
Sand	7,541	11,726	7,765	12,832	9,040	14,626	8,951	18,314
Gravel	4,732	3,986	4,095	3,304	r4,683	4,367	4,807	4,626
Crushed and broken stone	17,682	43,298	17,430	48,742	17,884	48,388	18,665	62,215
	tonne		tonne		tonne		tonne	
Dimension stone	12,283	262	10,621	256	7,867	288	12,589	516
	'000 tonnes		'000 tonnes		'000 tonnes		'000 tonnes	
Other quarry products	3,636	4,127	2,738	2,905	3,327	3,886	3,585	5,118

(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: 1974-75: 2,955,000 tonnes; 1975-76: 2,512,000 tonnes; 1976-77: 2,763,000 tonnes; 1977-78: 2,848,349 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	1973-74	1974-75	1975-76	1976-77	1977-78
Alumina (tonne)—					
Contained in bauxite	2,819	—	1,214	2,829	1,110
Antimony (tonne)—					
Contained in antimony ore	110	278	60	109	49
Gold (g)—					
Contained in antimony ore	158	—	—	—	—
Contained in gold bullion	67,783	217,794	105,582	40,175	9,238
Total gold	67,941	217,794	105,582	40,175	9,238

VICTORIA—ASSAYED CONTENT OF METALLIC MINERALS—*continued*

Metal or element and mineral in which contained	1973-74	1974-75	1975-76	1976-77	1977-78
Iron (tonne)—					
Contained in bauxite	209	—	121	324	145
Contained in iron ore	280	292	3,990	1,071	284
Total iron	489	292	4,111	1,395	429
Rutile (tonne)—					
Contained in bauxite	—	—	118	—	—
Silica (tonne)—					
Contained in bauxite	—	—	289	—	—
Tin (tonne)—					
Contained in tin concentrate	7	4	—	1	2

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	(c)	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

(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.

(c) Under \$1,000.

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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