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ENERGY AND MINING

ENERGY

Introduction

There are adequate resources of brown coal and natural gas for Victoria to be completely self-sufficient in these particular fuels. About 90 per cent of petroleum refinery input comes from Victoria's indigenous oil fields offshore in east Gippsland and 83 per cent of the State's electricity supply is produced by brown coal fired generating stations situated on the coal fields in the La Trobe valley. A further 5 per cent of the State's requirements are produced by hydro power stations in the north-eastern ranges.

About 10 per cent of Victoria's petroleum requirements are derived from crude oil imported from the Middle East and approximately 11 per cent of electricity is obtained from the Snowy Mountains Hydro-Electric Scheme in south-eastern New South Wales.

Natural gas is assuming an increasingly important role in the supply of energy in Victoria. Prior to 1969 there was a small but steady increase each year in the supply of towns gas comprising a blend of Lurgi gas from brown coal, refinery gas, tempered or reformed liquefied petroleum gas (LPG), water gas, oil gas, and gas from black coal and coke. The blends varied in different parts of the State according to supply of feedstocks and type of gas making plant installed. Since 1969, however, the advent of natural gas has caused sales to increase very sharply.

Recent increases in the sales of electricity and gas, the production of brown coal, and the volume of petroleum products used as a fuel, are illustrated in the graphs on page 333.

Ministry of Fuel and Power

The Ministry of Fuel and Power was formed in December 1965 following the passing of the *Fuel and Power Act* 1965. This Act made the Minister for Fuel and Power responsible for determining the means by which the present and future supplies and sources of fuel and power in Victoria can best be developed and utilised. The Act also established the administrative machinery of the Ministry and made the Minister responsible for the State Electricity Commission of Victoria and the Gas and Fuel Corporation of Victoria. The broad terms of the Act also enable the Minister to deal with legislative and other problems concerned with the production and marketing of energy which may be referred to him by private oil and gas companies.

VICTORIAN ENERGY TRENDS, 1964–1974

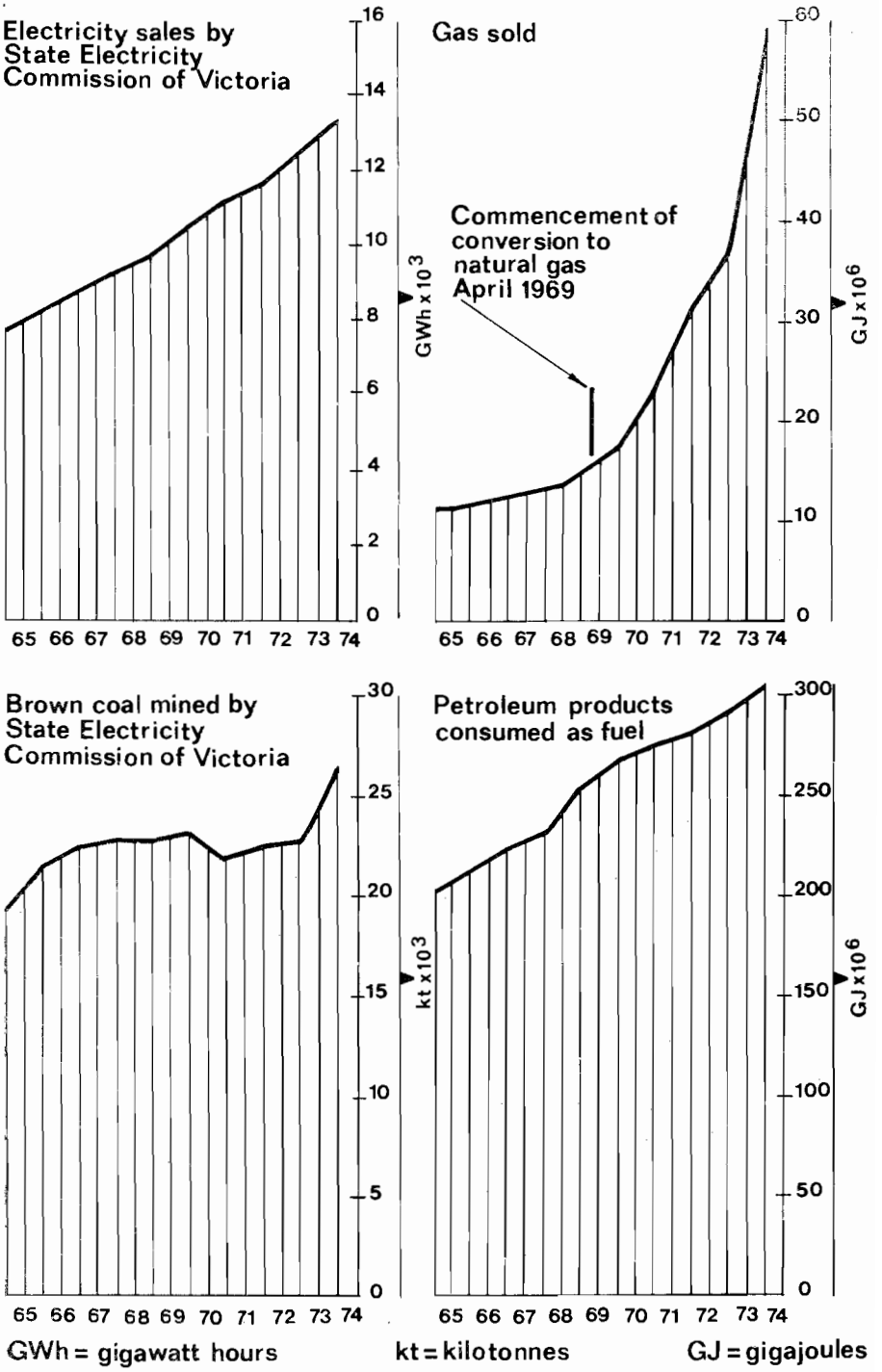


FIGURE 8. Victorian energy trends, 1964–1974.

Since 1966 the Minister has determined policy and legislative matters relating to the utilisation of the oil and gas discovered in Victoria's Gippsland fields, the establishment of a Pipelines Commission in 1966 and its subsequent incorporation in 1971 into the Gas and Fuel Corporation of Victoria, the taking over of private gas companies by the Gas and Fuel Corporation between 1966 and 1973, the utilisation of brown coal, and the erection of power stations. In accordance with the provisions of the *Pipelines Act* 1967 it is also responsible for determining the routes of major pipelines conveying hydrocarbons throughout the State.

Further reference, 1974

Brown coal

Location

Victoria's largest resources of fossil fuels, which form the bulk of energy available in the State, are the huge deposits of brown coal, among the largest in the world, located in the La Trobe valley about 130–180 kilometres east of Melbourne in central Gippsland. Smaller deposits also exist in other areas in the south of the State at Gelliondale, Anglesea, Bacchus Marsh, and Altona but, although extensive, these do not compare in magnitude and importance with those in the La Trobe valley.

The brown coal seams in the La Trobe valley range from Eocene to Early Miocene in geological age and are thus between 50 and 20 million years old.

Early history

The first recorded discovery of brown coal in Victoria was made in 1857 at Lal Lal, about 26 kilometres south-east of Ballarat. By 1864 brown coal was being transported to Melbourne and provincial centres, but difficulties were experienced in marketing it in competition with other fuels. Subsequent investigations have shown that the commercially recoverable deposits of brown coal are confined to the south of Victoria, the chief areas being the La Trobe valley, Gelliondale, Bacchus Marsh, and Anglesea.

An investigation of the economic possibilities of the State's immense brown coal resources was recommended by a Royal Commission appointed in 1889 to examine means of developing Victoria's coal industry. The Royal Commission recommended that the Victorian Government should offer a bonus to the first person or company to manufacture 102,000 tonnes of briquettes. The Great Morwell Coal Mining Company produced about 5,100 tonnes of raw coal from the northern bank of the La Trobe River in 1891 and erected a locally built, one-press briquetting plant of German design. This plant commenced operating in 1894 but was destroyed by a bushfire during the following year. A second factory, erected in 1896, made about 2,040 tonnes of briquettes of good quality. However, the new fuel could still not compete economically with black coal and the company ceased operations in 1899.

Reserves

The reserves of brown coal in Victoria, re-assessed during 1974, are set out in the following table :

VICTORIA—RESERVES OF BROWN COAL, 1974
(megatonnes)

Major coalfields	Proven geological reserves	Readily recoverable reserves		
		Main areas	Marginal areas	Total
La Trobe valley—				
Yallourn–Maryvale	12,400	2,500	300	2,800
Morwell–Narracan	6,800	2,200	1,100	3,300
Loy Yang Flynn	21,300	3,400	1,300	4,700
Sub-total—main fields	40,500	8,100	2,700	10,800
Gormandale	4,000	400	200	600
Holey plains–Coolungoolum	2,500	100	100	200
Other areas	17,900	..	..	..
Total La Trobe valley	64,900	8,600	3,000	11,600
South Gippsland—				
Gelliondale	1,300	200	200	400
Won Wron	2	..	..	..
Total South Gippsland	1,302	200	200	400
Total Central Gippsland	66,200	8,800	3,200	12,000
Other (Bacchus Marsh, Altona, and Anglesea)	500	100	100	200
GRAND TOTAL	66,700	8,900	3,300	12,200

In addition to the 66,700 megatonnes of proven geological reserves in Victoria there are further inferred geological reserves of 47,000 megatonnes making an overall total of proven plus inferred reserves of 113,700 megatonnes. Of this total, 113,000 megatonnes are in central Gippsland of which 108,000 megatonnes are situated in the La Trobe valley.

Recoverable deposits

About 35,000 megatonnes, or 54 per cent of the proved deposits, occur in areas where the overburden over the uppermost seam is less than 30.5 metres, while 62,000 megatonnes or 95 per cent lie in areas with less than 91.4 metres of overburden. The inferred reserves of 43,000 megatonnes in the La Trobe valley are mostly deeper and less accessible with about 75 per cent occurring in areas with less than 30.5 metres of overburden. Thick coal seams occur close to the surface in two large areas. One of these is the Yallourn/Morwell coal field where the large, base load power stations are located and the other is the Loy Yang coal field which is presently being evaluated for early future use for power generation.

Electricity generation

The brown coal mined from the La Trobe valley deposits in central Gippsland is used to fuel the base load power stations providing over 80 per cent of Victoria's electricity. It is also the feedstock for the production of briquettes, a solid fuel made from brown coal by removal of most of the moisture and then subsequent compression into different sizes of rectangular pellets for use as a fuel in industry and homes and to generate electricity principally at the peak load power station at Newport, near Melbourne.

With its high moisture content and difficult burning characteristics, brown coal is less suitable than black coal for power generation. On the other

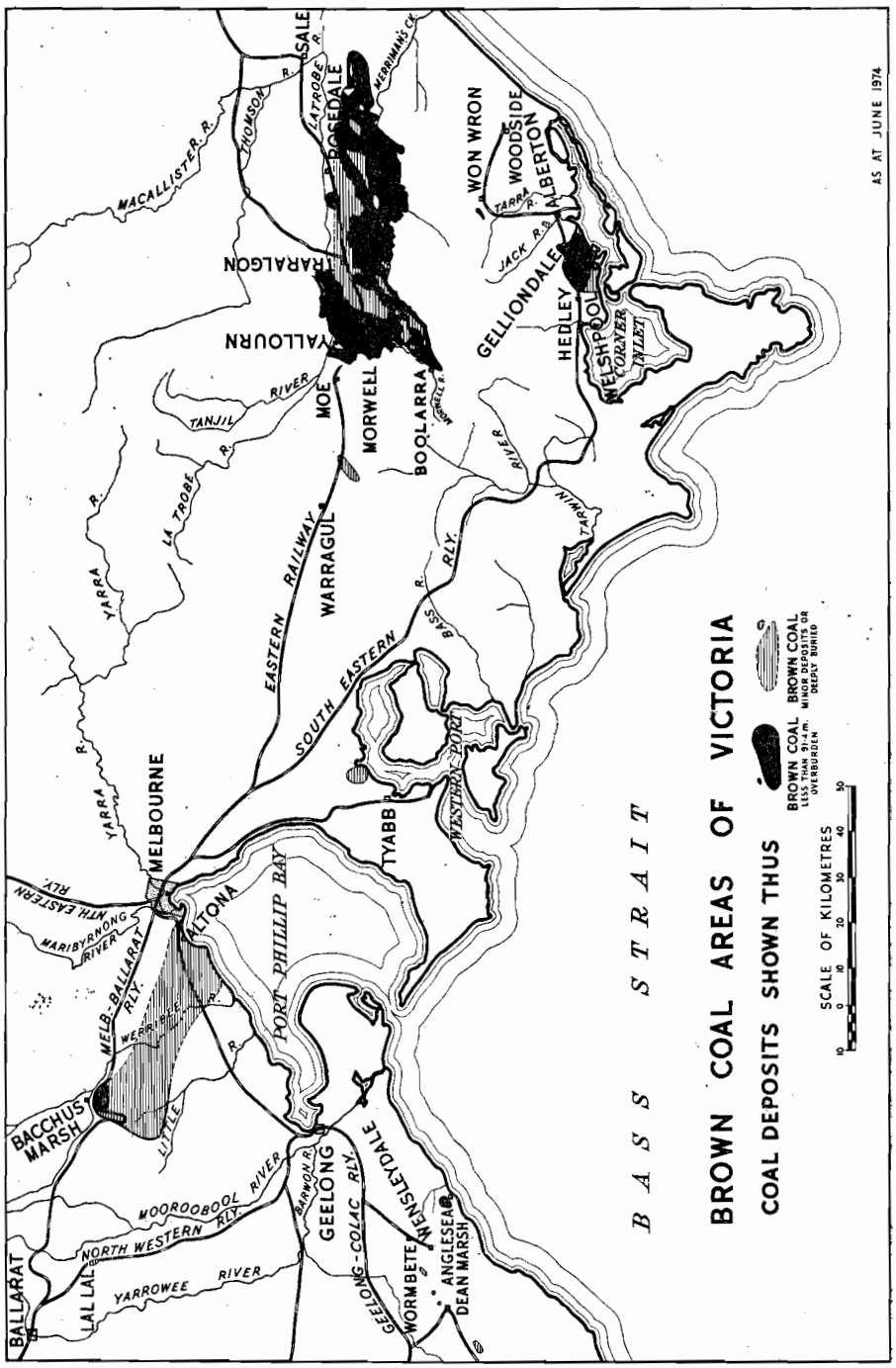


FIGURE 9. Brown coal areas of Victoria, June 1974.

hand, it is in ample supply, conveniently located, and cheap to mine. The nature of the coal has, until recent times, restricted the size of the boilers in which it could be fired but constantly improving technology, particularly since the Second World War, has ensured its continuing economic use for the generation of electricity.

Following a study by the Electricity Commissioners between 1918 and 1920, the practicability of using brown coal for the generation of electricity was confirmed. Following the formation of the State Electricity Commission of Victoria in 1921, work began on the excavation of an open cut at Yallourn for mining of brown coal for use in a power station to be built nearby.

Yallourn open cut now covers nearly 810 hectares in area, is currently producing coal at the rate of about 10 megatonnes a year, and since 1926 has shown a total yield of about 334 megatonnes. The highest grade remaining seams lie under the township of Yallourn which will be gradually dismantled in the 1980s and 1990s as the demand for fuel for the new Yallourn " W " power station, now nearly completed, increases.

In the late 1950s full-scale production of brown coal began from a new open cut at Morwell, a few kilometres east of Yallourn, for use in the recently erected combined power station and briquetting factory complex. Working at several levels, large dredges with a capacity of mining up to 92,000 tonnes a day have produced about 124 megatonnes from this open cut to date. Currently the rate of production is 14.7 megatonnes a year. The coal is taken by conveyor belts to the Morwell complex and to the recently completed Hazelwood 1,600 MW power station. Up to 30 June 1974 a total of about 480 megatonnes of brown coal had been produced from open cuts in the La Trobe valley.

In addition to being used as a fuel in power stations in the La Trobe valley, brown coal is mined by open cut methods in two other localities in Victoria. The most important of these is at Anglesea, about 130 kilometres south-west of Melbourne, where Alcoa of Australia Ltd excavates the coal for fuel in a 150 MW power station built by the company and commissioned in 1969. This station produces electricity for use at Alcoa's alumina smelter at Point Henry, near Geelong, about 56 kilometres distant. The Anglesea field contains reserves estimated at 117 megatonnes and consumption is about 1.0 megatonnnes a year. Some brown coal is also produced at Bacchus Marsh for industrial use.

Briquettes

Briquettes are pellets of brown coal which have been compressed into various sizes capable of being transported and stored economically for industrial and domestic use. During the processing the moisture in the brown coal is reduced from about 66 per cent to 15 per cent, according to the source of the coal used. Coal from the Yallourn open cut can be made into briquettes relatively easily by drying and pressing finely crushed raw coal without any need for a binding agent in contrast to the coal from the Morwell open cut. The Morwell coal contains boiler fouling constituents and has poor weathering characteristics. Only coal from the Yallourn cut is now used for the production of briquettes. The Yallourn briquette factory commenced production in 1924 and ceased in 1971. Manufacture continues, however, at the Morwell factory. Annual production reached a peak of 1.92

megatonnes during the mid-1960s but declined to 1.16 megatonnes in 1973–74.

Briquettes are also used as a feedstock in the production of char and could be used to produce oil from brown coal. Between 1956 and 1969 up to 0.23 megatonnes of briquettes a year were converted into towns gas at the Lurgi plant at Morwell, owned and operated by the Gas and Fuel Corporation of Victoria and piped to Melbourne. Gas ceased to be produced at the plant in November 1969 during the conversion of the State's source of supply to natural gas.

The most recent development based on brown coal has been the production of a high grade industrial carbon called char from briquettes. Char is a form of high grade carbon made by the carbonisation of brown coal that can be used as a source of carbon or as a reducing agent in chemical and metallurgical industries. In the conversion process, brown coal, generally in the form of briquettes, is heated in an inert atmosphere to temperatures in the range 600°C–1,000°C to distil off the volatile constituents and leave a carbon residue or char. For each tonne of chair produced, 2.2 tonnes of Yallourn briquettes are required and some 150 litres (or kilogrammes) of tars are produced, together with a surplus of low calorific value gas. The quality and yields of char and tar vary depending on the coal quality and some aspects of the actual process system used. The low calorific value gas can be used to provide the heat required for carbonisation, while the surplus, could be used as a fuel in other processes. Tars from the plant would be suitable for hydrogenation to petroleum product grade.

At Traralgon, a plant has been constructed to carbonise briquettes and produce a carbon for use in burning cement clinker in vertical kilns in addition to providing heat for drying the marl. It also produces some char for specialised purposes such as recarburising iron in foundries and in glass manufacturing processes. A larger char plant with a nominal char production capacity of 60,000 tonnes per annum (140,000 tonnes briquettes) has been constructed at Morwell and most of its output is exported. In addition, some gas production retorts at Footscray, near Melbourne, have been converted to char production. This char is mildly steam activated and marketed as active carbon.

Oil from brown coal

The most ambitious proposal to utilise brown coal, other than for electricity production, currently under review is the possibility of producing a range of oils from brown coal. The Victorian Government in co-operation with experts from the German Democratic Republic is currently evaluating certain proposals and methods of production.

VICTORIA—PRODUCTION OF BROWN COAL
(megatonnes)

Period	Production	Period	Production	Period	Production
1926–1930	1.540	1956–1960	12.392	1969–70	24.316
1931–1935	2.485	1961–1965	18.611	1970–71	23.185
1936–1940	3.668	1966	22.138	1971–72	23.636
1941–1945	5.099	1967	23.765	1972–73	22.936
1946–1950	6.756	1968	23.345	1973–74	25.148
1951–1955	8.870	1968–69	23.504		

NOTE. Figures for five-yearly periods are annual totals averaged over each such period.

Electricity

The most widely used and extensively distributed form of energy supplied in Victoria is electricity, which is controlled by the State Electricity Commission of Victoria, a public utility formed by Act of Parliament in 1921. At 30 June 1974, the Commission, with 18,519 personnel and capital assets of $1,641m, distributed electricity to 1,146,000 customers throughout the State and to a further 256,000 customers through eleven metropolitan councils which purchase electricity in bulk for retail distribution. The S.E.C. and municipal networks comprise over 112,000 kilometres of power lines.

Early history

Pioneer electrical development in Melbourne dates from 1878 and 1879 when two firms, Sands and McDougall and the Apollo Candle Company, each imported an arc lamp and generating equipment, and produced power for commercial lighting. The State's first commercial electricity company, the Victorian Electric Light Company, was formed in 1880. It erected a small generating station to supply the central part of the City of Melbourne with electric light. During the next thirty years a number of other electricity supply companies were formed and gradually the supply spread to the suburbs of Melbourne and the larger provincial cities. During this period electricity began to be used for operating tramway services.

In 1894 the Melbourne City Council started to generate electricity at a power station in Spencer Street for domestic and industrial consumption and for lighting the streets. To cater for a constantly increasing demand the Council progressively developed its power station, which by 1967 had an installed capacity of 109 megawatts. This station now forms part of the State Electricity Commission's generating and supply system, although still owned by the Council. At Bendigo and Ballarat the Electric Supply Company of Victoria was granted a franchise to generate and distribute electricity for domestic and industrial purposes and for the operation of the tramways. The company purchased the assets of existing undertakings and began operations at Bendigo in 1903 and Ballarat in 1905. Tramway services were established in both cities. In 1934 these undertakings and the tramways were acquired by the State Electricity Commission. In 1972 the tramways were phased out of regular operation as being uneconomical, but are still partly used as a tourist attraction.

During the first forty years of operation in Victoria the sole fuel used for the generation of electricity was black coal, the bulk of which was imported from New South Wales. During this period a number of municipalities formed electricity branches as adjuncts to normal municipal services. While the various independent electricity undertakings operating prior to 1918 did valuable pioneering work there was no uniformity of systems, voltages, and tariffs. Companies and syndicates operated without regulation or restriction until the Victorian Parliament passed the *Electric Light and Power Act* 1896.

State Electricity Commission of Victoria

In 1918 the Victorian Government passed legislation which provided for the appointment of three persons known as the Electricity Commis-

sioners. This Act, proclaimed on 7 January 1919, was prompted by the urgency of the electricity supply situation, particularly in the metropolitan area where a shortage of power was imminent, the inadequacy of Victoria's black coal resources, and the threat to the continuity of supply of black coal from New South Wales due to recurring industrial disputes.

The practicability of utilising the huge brown coal deposits known to exist in the La Trobe valley for electricity generation had been under study for nearly twenty years and the newly appointed Electricity Commissioners' first task was to submit a " scheme for coal mining for an electrical undertaking in the neighbourhood of Morwell, and the distribution of electricity therefrom ; and also a report setting forth the results of an enquiry into the relative practicability of utilising water power for electrical undertakings ". Following a recommendation to the Minister by the Commissioners in 1920, legislation was enacted in January 1921 establishing the State Electricity Commission of Victoria and naming Sir John Monash as the first full-time chairman of the Commission.

Since 1921 the Commission has been headed by a full-time chairman and three part-time commissioners. It functions in accordance with the provisions of the *State Electricity Commission Act* 1958, and its principal duty is to co-ordinate and extend, on an economic basis, the supply of electricity throughout Victoria. For this purpose it is vested with power to erect, own, and operate power stations and other electrical plant and installations ; supply electricity either direct to individual customers or in bulk to any corporation or public institution ; acquire electricity undertakings and incorporate them into its own system ; develop, own, and operate brown coal open cuts and briquetting works ; and develop the State's hydro-electric resources.

From its own revenues, which it controls, the Commission must meet all expenditure in the operation of its power, fuel, and subsidiary undertakings ; and all interest and other charges incurred in the service of its loans and other capital commitments.

Under the provisions of the *Electric Light and Power Act* 1958 the Commission is the controlling authority for all electrical undertakings in Victoria. It is responsible for the registration of electrical contractors, the licensing of electrical mechanics, the control of installation methods and quality of materials used, and the testing and approval of electrical equipment and appliances.

Electricity generation

The State Electricity Commission has expanded and co-ordinated the production and supply of electricity on a State-wide basis to the point where its system now produces all of the electricity generated in Victoria available for public supply.

The development of Victoria's electricity system is based on the utilisation for both power and fuel of Victoria's extensive brown coal resources in the La Trobe valley in central Gippsland, about 130 kilometres east of Melbourne, with supplementary development of the hydro-electric potential in north-eastern Victoria. Victoria is entitled to one third (New South Wales receives two thirds) of the electricity from the Snowy Mountains Hydro-Electric Scheme after the Australian 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.

By far the greater part of the State's electricity is generated from brown coal, used mainly in its raw state, but which is also manufactured into a high quality fuel in the form of briquettes. The two functions, production of fuel and generation of electricity, are therefore closely integrated. Apart from the large proportion of brown coal and briquette fuel consumed in the power stations, the process of briquette manufacture results also in the generation of electricity, since the steam needed for processing the raw coal into briquettes is first used to operate turbo-generators.

Electricity generated in the State system or purchased by it totalled 16,041 million kWh in 1973–74. The system comprises a series of thermal and hydro-electric power stations. Inclusive of generator capacity both within the State and available to the Victorian system from outside the State, the total installed generator capacity at 30 June 1974 was 4,330 MW. The power stations are interconnected and feed electricity into a common pool for general supply.

The major station in this interconnected system is the 1,600 MW brown coal fuelled power station at Hazelwood, which alone generates 53 per cent of Victoria's electricity. Other power stations in the interconnected system comprise the two other base load power stations—Yallourn (which contributes 15 per cent) and Morwell; the first set of a new base load power station, Yallourn "W"; steam stations in Melbourne (Newport, Richmond, and Spencer Street); and hydro-electric stations at Kiewa, Eildon, on the Rubicon and Royston Rivers near Eildon, and at Cairn Curran on Eppalock Reservoir on the Campaspe River near Bendigo. All major power stations within Victoria are owned by the Commission except the Spencer Street power station which remains the property of the Melbourne City Council, although operated as a unit in the interconnected system.

Base load stations

Yallourn

Subsequent to their establishment in 1919, the Electricity Commissioners reported that the generation of electricity through the use of brown coal as a fuel to fire the boilers was practicable. The Commissioners' successor—the State Electricity Commission of Victoria—acquired rights over land in the La Trobe valley under which the deposits were located, established the township of Yallourn, and in 1922 commenced excavation of an open cut at North Yallourn to recover the coal. Work was commenced on building a power station adjacent to the open cut and the erection of a 132 kV transmission line to Melbourne. Two years later in 1924, the first electricity generated from brown coal in Victoria reached Melbourne and marked the beginning of the vast generating, transmission, and distribution system which today covers Victoria, and is linked to New South Wales and South Australia. Standard tariffs are charged throughout the State.

Gradually over the years the State Electricity Commission became the State's principal generating and supply authority under the provisions of its enabling legislation, and it acquired many private companies and municipal

undertakings, including the associated local power stations. Among these was the large, peak load station at Newport, acquired in 1951 from the Victorian Railways. At Yallourn, more power stations were built over the years with the generating capacity increasing as the technology of utilising brown coal as a fuel improved and demand for electricity increased. The last of the currently operating generating units at the Yallourn complex installed in 1962 had a capacity of 120 MW, a most evident increase over the early 12.5 MW sets installed in 1924. The Yallourn complex of stations currently produces about 2,500 million kilowatt hours a year or 15 per cent of total requirements.

Morwell

Strikes and shortages in the New South Wales black coal industry between 1946 and 1950, together with the necessity to provide for the enormous expansion in the demand for electricity and solid fuels—a world-wide trend—led to the Victorian Government authorising the Commission to establish a second complex in the La Trobe valley. Accordingly, at Morwell, a few kilometres east of Yallourn, the Commission opened up a second large coal field and erected a combined power station and briquetting factory. This power station, with an installed capacity of 170 MW, was commissioned in December 1958, and currently produces about 1,200 million kilowatt hours a year or 7 per cent of total requirements. The associated briquetting factory produced 1,164 kilotonnes of briquettes during 1973–74.

Hazelwood

To cope with the expected demands of the late 1960s and early 1970s, the Commission began the construction of a new power station in 1959 in the La Trobe valley at Hazelwood, located about three kilometres south of Morwell and 145 kilometres east of Melbourne. It was the third power development on the brown coal fields of the La Trobe valley, and is currently the largest generating project yet constructed by the Commission, and a major development by world standards.

The Hazelwood project was approved by the Victorian Parliament in 1959. Site works commenced in 1960, and the power station was completed in early 1971 at a capital cost of $237m. It has a capacity of 1,600 MW or about 37 per cent of all the generating capacity available to Victoria in 1974. It comprises eight 200 MW turbo-generators, each having a single boiler burning brown coal supplied from the adjacent Morwell open cut. The Yallourn, Morwell, and Hazelwood power stations currently produce about 76 per cent (85 per cent including Yallourn " W ") of Victoria's annual electricity requirements.

Each of Hazelwood's eight turbo-generators is designed to produce 1,400 million kWh of electricity annually, and has its own steam-raising boiler capable of burning 270 tonnes of brown coal an hour. Coal consumption for each kWh of electricity generated is less than half the average rate of consumption in plant in the La Trobe valley prior to 1939.

Coal from the open cut is supplied to a 30,000 tonne storage bunker by an elaborate conveyor system directed from an electronically equipped control centre. Operations within the power station are also highly automated with four control rooms each operating a pair of generators and their associated boilers. Sixty men a shift are able to operate the entire power

station. Cooling water for the station's steam condensers is drawn from a large artificial pondage which is about five square kilometres in area and holds 31 million cubic metres of constantly circulating water.

Yallourn " W "

Designed as a base load power station of 1,450 MW capacity, this is currently being built in two stages at Yallourn West in the La Trobe valley. The station was originally planned to comprise only 2 x 350 MW when approved by the Victorian Government in 1965. The first unit was commissioned during the winter of 1973, and the second is expected to come into service by the winter of 1975.

In 1972 the Victorian Parliament approved a proposal to extend the Yallourn " W " power station by the addition of two more generating units. Each unit will have a capacity of 375 MW. The two new generators will be needed to meet the growth in Victoria's requirements after 1978. The third unit is scheduled to be commissioned in 1979 and the fourth in 1980. Site works are planned to begin in 1975. The total cost of the station is estimated to be $385m.

The Yallourn " W" boilers are among the largest in the world designed for the combustion of raw brown coal. Each boiler is more than 80 metres high and contains 200 kilometres of steam tubing and 137 kilometres of water tubing. At full load each boiler can consume 600 tonnes of coal an hour.

Hydro-generated power

The water resources in the mountainous region of the Australian Alps in north-eastern Victoria attracted the attention of the Commission during

VICTORIA—POWER STATIONS :
LOCATION, RATING, AND PRODUCTION

Station	Maximum continuous rating (*a*)	Electricity production				
		1971–72	1972–73		1973–74	
			Quantity	Percentage of production	Quantity	Percentage of production
	MW	Mill kWh	Mill kWh		Mill kWh	
Thermal stations—						
Hazelwood	1,600	8,134.8	8,550.4	57.2	8,510.6	53.1
Yallourn (*b*)	546	2,685.1	2,659.2	17.8	2,480.1	15.4
Yallourn " W "	350	..	4.8	..	1,475.1	9.2
Morwell	170	1,129.8	1,134.5	7.6	1,196.9	7.5
Newport	198	279.6	140.5	0.9	181.6	1.1
Spencer Street (*c*)	90	55.4	15.2	0.1	12.7	0.1
Richmond	38	27.4	5.2	..	7.2	..
Provincial stations (*d*)	16	0.6	0.6	..	0.5	..
Total—S.E.C. thermal	3,008	12,312.7	12,510.4	83.6	13,864.7	86.4
Hydro stations—						
Kiewa (*e*)	183	346.9	286.1	1.9	452.0	2.8
Eildon (*f*)	135	340.8	306.4	2.1	320.7	2.0
Total—S.E.C. hydro	318	687.7	592.5	4.0	772.7	4.8
Total—S.E.C.	3,326	13,000.4	13,102.9	87.6	14,637.4	91.2
Other public supply generation	..	..	..	..	..	..
Total—public supply undertakings	..	13,000.4	13,102.9	87.6	14,637.4	91.2
Net purchases	..	1,012.9	1,853.8	12.4	1,404.3	8.8
Total	3,326	14,013.3	14,956.7	100.0	16,041.7	100.0

Source : State Electricity Commission of Victoria.
(*a*) At 30 June 1972.
(*b*) Including briquette factory.
(*c*) Melbourne City Council station.
(*d*) Geelong, Ballarat, and Red Cliffs.
(*e*) McKay Creek, West Kiewa, and Clover.
(*f*) Eildon, Rubicon, Lower Rubicon, Royston, Rubicon Falls, and Cairn Curran.

the 1920s and 1930s and small stations were installed in the region between 1926 and 1929. In 1938 work commenced on the Kiewa Hydro-Electric Scheme, but a total only of 184 MW generating capacity was installed in the three hydro power stations built, one of which was underground. The then imminent availability of power from the large Snowy Mountains Hydro-Electric Scheme in higher alpine areas in New South Wales, about 85 kilometres to the north-east, made any further expansion uneconomic.

The most important source of hydro-generated power for use in Victoria is the Snowy Mountains Hydro-Electric Scheme. The first electricity from this scheme was transmitted to Victoria in 1959 and at present total purchases on interchange agreements between Victoria and New South Wales, of which the Snowy scheme is the principal one, account for about 9 per cent of the Commission's total requirements. The total ratio of electricity supplied from hydro-generated sources comprises about only 15 per cent of the Commission's total needs.

Transmission and distribution

Electrification of Victoria has been virtually completed. Only some isolated properties in remote parts of Victoria are without a supply from the Commission's system. The number of customers receiving power from the Commission was 1,146,000 at 30 June 1974. In addition 256,000 customers receive supply from the eleven municipalities which distribute supply to customers in the metropolitan area.

The Commission supplies electricity in bulk to the eleven municipal undertakings which operate as supply authorities under franchise granted before the Commission was established. Bulk supply is also being provided at present to several New South Wales municipalities and irrigation settlements bordering the Murray River. The number of customers served by the Commission's system outside the Melbourne metropolitan area is 696,000. Supply is administered through the metropolitan electricity supply branch and nine country branches.

Two 330 kV transmission lines link the Victorian system with the Snowy Mountains undertaking and also provide facilities for interconnection between the Victorian and New South Wales State generating systems. Also linked with the Victorian interconnected system is the hydro station at Hume Reservoir on the Murray River. This power station is operated by the Electricity Commission of New South Wales. Output and operating costs are shared equally by Victoria and New South Wales.

In meeting the total demand on the system, which fluctuates throughout the day and from month to month, each group of stations in the interconnected system is assigned a predetermined function dependent upon the availability of power from each group and the economics of generation. The various stations are utilised in the combination which will meet the system load most economically at a given time.

The electrical transmission and distribution system in the State supply network at 30 June 1974 comprised 105,000 kilometres of power lines, four auto-transformation stations, 26 terminal receiving stations, 168 zone sub-stations, and nearly 70,000 distribution sub-stations. Main transmission is by 500 kV, 330 kV, 220 kV, and 66 kV power lines, which supply the principal distribution centres and also provide interconnection between the power stations. These four systems total 7,800 route kilometres.

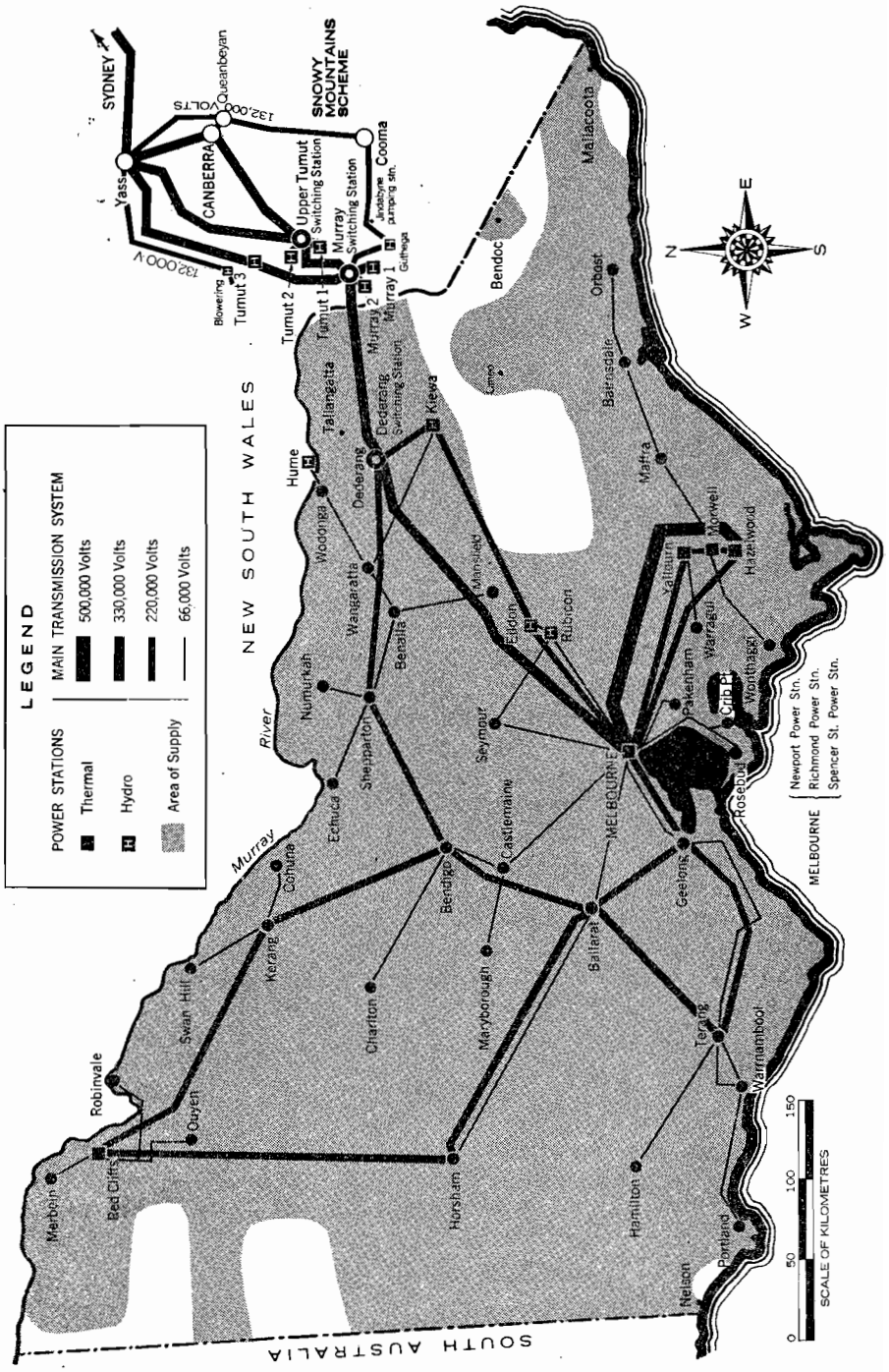


FIGURE 10. Victoria's main power transmission system, 30 June 1974.

The transmission of energy from Hazelwood at 500 kV is the highest voltage for electricity transmission in the southern hemisphere.

Other distributors

In accordance with the provisions of a number of Acts of Parliament dating between 1896 and 1915, electricity is now purchased in bulk by eleven municipalities from the State Electricity Commission and distributed to customers within the municipalities' franchise areas through their own distribution networks. The municipalities (which originally generated their own electricity) are the City of Melbourne and the Cities of Footscray, Preston, Brunswick, Port Melbourne, Heidelberg, Coburg, Box Hill, Williamstown, Doncaster and Templestowe, and Northcote. Electricity tariffs are uniform for all customers irrespective of whether they receive supply from the Commission or a municipality.

Electricity is also generated by Alcoa of Australia Ltd at a 150 MW power station at its Anglesea brown coal field and taken by the company's own transmission line to its alumina smelter and fabrication plant at Point Henry to satisfy part of its need for this particular form of energy. The company purchases the remainder of its requirements from the State Electricity Commission.

Future development

Apart from the proposed extension of the Yallourn " W " station in the La Trobe valley, one of the most important developments during the coming decade is the 1,000 MW regulating station planned to be built at Newport near the mouth of the Yarra River at an estimated cost of about $200m. Following an official inquiry the Environment Protection Authority issued licences for the operation of the station. Appeals to the Environment Protection Authority Third Party Appeal Tribunal in 1974 and to the Environment Protection Appeals Board in 1974 have been disallowed and the granting of licences upheld. Conditions of the licences impose stringent guidelines on the operation of the station and the Commission must observe all the conditions laid down. Construction, however, is being delayed by groups opposed to the project.

The construction of a new hydro-electric power station comprising a single 150 MW generating set is planned for Dartmouth in north-eastern Victoria to be operated in association with the irrigation storage now being built on the Mitta Mitta River. The station is scheduled to commence operations in 1979.

In 1973 the Commission announced its intention to carry out an extensive investigation into the possible development of a new major base load generating project of about 4,000 MW capacity at Loy Yang in the La Trobe valley to begin operating in the early 1980s. In order to minimise the consumption of water, natural draught towers, similar to those used at Yallourn " W ", will be used to cool water used in the station, thus avoiding the development of a large water reservoir.

Further reference, 1974

Petroleum

Early history

Petroleum products were first imported into Victoria during the latter years of the nineteenth century and initially the principal one was kerosene.

However, as the use of the motor car grew during the early years of the present century, the demand for petrol gradually overtook and passed that for kerosene and it became necessary to construct bulk storage facilities (now known as tank farms) at Newport, Williamstown, and Port Melbourne to hold reserves of the quantities required and to install special discharging facilities at adjacent wharves where the then rather primitive tanker could unload its highly inflammable cargo. As the demand for motor spirit grew during the 1920s tank farms were erected at Geelong and Portland; and Commonwealth Oil Refineries (later to be sold by the Australian Government to the British Petroleum Company) erected Victoria's first refinery at Laverton, about 19 kilometres south-west of Melbourne.

Refineries

Victoria's second refinery, operated by Standard Vacuum, opened at Altona in 1949 and five years later was expanded into a full-scale, modern plant. This resulted in the operation of the nearby Commonwealth Oil Refineries refinery at Laverton becoming uneconomic and it was closed in 1955. The Shell Company of Australia opened a refinery, now the most extensive in Australia, at Corio near Geelong during the same year, and laid Victoria's first long distance oil pipeline, 200 millimetres in diameter and 53 kilometres in length, to convey refined petroleum products (white) to the company's distribution installations at Newport.

The establishment of these two refineries resulted in an increase in the range of finished and semi-finished petroleum products and made available for the first time in Victoria products such as refinery gas and liquefied petroleum gas, which were highly suitable for use in the gas industry after blending with gases produced from black coal, brown coal, and oil. When a third large refinery was erected at Crib Point on Western Port by BP Australia Ltd in the mid-1960s, almost the whole of Victoria's petroleum products requirements could be satisfied from local refineries.

Refined products from the BP refinery were taken to the company's distribution terminal at Dandenong, about 32 kilometres south-east of Melbourne, through a 37 kilometre, 200 millimetre pipeline. The first duplication of an existing long distance oil pipeline occurred in 1965 when Shell laid its second pipeline from its refinery at Corio to its storage and distribution facilities at Newport for the purposes of conveying fuel and furnace (black) oils.

At this time the base stock for refining was imported crude oil of a heavy type which resulted in large volumes of fuel oil, industrial diesel fuel, and automotive distillate becoming available to make a highly significant contribution to the State's energy requirements. This position, however, changed during the early 1970s when the lighter indigenous Gippsland crudes became available to Victoria's three refineries. The result was an increased production of lighter or " white " products such as petrol and aviation turbine fuel and kerosene. However the importation of some Middle East and Indonesian crude oil continued to be necessary to produce asphalt or bitumen and heavier or " black " fuels of an industrial and fuel oil type.

Gippsland Basin oil fields

Indigenous crude oil in commercially recoverable quantities was first discovered in Victoria in 1967 when two oil fields were located between

61 kilometres and 80 kilometres offshore in about 80 metres of water in eastern Bass Strait.

Programmes were quickly evolved for expanding the gas processing plant at Longford to enable the extraction of the dissolved gases and LPG from the gas saturated oil, for the fabrication of additional platforms, and for building a storage facility at Long Island Point on Western Port Bay. The entire development of the gas and oil fields now became an integrated operation.

The large 24 well capacity Halibut platform was erected early in 1968 about 61 kilometres from the shore in water 73 metres deep and 21 wells were drilled, of which 19 became oil producers. During 1968 and 1969, the jackets and decks for the two single jacket Kingfish platforms were fabricated and in March 1969 erection of the Kingfish A platform began about 77 kilometres from the coast in 77 metres of water.

Erection of the Kingfish B platform began in June 1969 about 3 kilometres east of the Kingfish A platform in almost the same depth of water. The platforms are of the same design and each has a capacity of 21 wells. Development drilling on Kingfish A was completed in February 1971 and on Kingfish B in October of that year.

While development drilling was being undertaken, undersea and onshore pipelines were laid to the Longford processing plant and a pipeline 188 kilometres, 700 millimetres in diameter was laid to a newly erected tank farm and jetty loading facilities at Long Island Point about 72 kilometres south-west of Melbourne.

The Barracouta oil reservoir, discovered during gas development drilling programmes in 1968 came on stream in October 1969, the Halibut field in April 1970, and the Kingfish field in March 1971. From the tank farm at Long Island Point, crude oil from the Gippsland basin fields is taken by tanker to refineries in Sydney and Brisbane and by pipeline to Victoria's three local refineries. The following table sets out the production of stabilised crude oil since the fields first came on stream in 1969–70 :

VICTORIA—PRODUCTION OF STABILISED CRUDE OIL

Year	Barrels during year	Progressive production at 31 December	Average B/D for year
1970 (*a*)	47,360,270	47,360,270	129,753
1971	95,668,066	143,028,336	262,104
1972	103,262,110	246,290,446	282,136
1973	127,089,311	373,379,757	348,190
1974 (*b*)	64,035,340	437,415,097	(*c*) 353,786

(*a*) First consignment of crude (Barracouta) reached Long Island Point on 22 December 1969, but is included in 1970 figures.
(*b*) To 30 June 1974.
(*c*) First six months of year only.

The first shipment of Gippsland crude was made from the Long Island Point jetty late in March 1970 and initially tankers transported Gippsland crude to all of Victoria's three refineries. The first one to be supplied by pipeline was the BP refinery at Crib Point, which was connected in May 1969 by a 1,050 millimetre diameter pipeline eleven kilometres in length with the Long Island Point tank farm. At the same time connection was made to the north berth of the adjacent jetty and the first tanker of Gippsland crude was loaded there early in July of that year.

Construction of the second principal crude oil distribution line to Victoria's refineries began in September 1971 when Shell as the operator for W.A.G. Pipeline Pty Ltd, a joint Shell–Mobil–Esso enterprise, commenced laying a 135 kilometre pipeline to Victoria's two other refineries. This line comprised 82 kilometres of 600 millimetre diameter pipe from Western Port to the Altona refinery operated by Petroleum Refineries (Australia) Pty Ltd, and a further 53 kilometres of 400 millimetre diameter pipe to the Shell refinery at Corio near Geelong. It commenced operating on 27 August 1972 and to 30 June 1974 had conveyed 89,564,253 barrels of oil.

The three Victorian refineries are now absorbing Gippsland crude oil wholly through pipelines at an average rate of approximately 170,000 barrels a day, or about 52 per cent of the total available from the Gippsland fields. Western Port is now the second busiest port in Victoria as a result of tankers loading crude oil for delivery to refineries and LPG for overseas markets as well as steel products to and from the nearby steel mill of John Lysaght (Australia) Pty Ltd.

VICTORIA—GIPPSLAND BASIN : RECOVERABLE TREATED HYDROCARBON RESERVES, TO 30 JUNE 1974

Field (*a*)	Natural gas			Crude oil			Condensate and LPG initial reserves only (*c*)	
	Initial 14 June 1974 (*b*)	Used 30 June 1974	Remaining	Initial 14 June 1974 (*b*)	Used 30 June 1974	Remaining	Condensate	LPG
	Tcf	Tcf	Tcf	million barrels	million barrels	million barrels	million barrels	million barrels
Barracouta	1.214	actual ratio for each field unknown		10	known only for platform barrels or unstabilised crude		18	35
Marlin	2.714			3			87	113
Halibut	0.027			640			..	32
Kingfish	0.205			952			..	104
Tuna	0.500	..	whole	84	..	whole	..	33
Mackerel	0.021	..	whole	256	..	whole	11	21
Snapper	2.500	..	whole	..	..	..	..	..
Golden Beach (*d*)	0.100	..	whole	..	..	..	..	..
Total	7.281	0.2	7.081	1,945	433	1,512	116	338

(*a*) Esso/B.H.P. fields.
(*b*) 14 June 1974 was the date on which Esso/B.H.P. announced revision of estimates of reserves.
(*c*) At 14 June 1974. All figures are for products after processing.
(*d*) Golden Beach field of Woodside-Burmah.

Refining of petroleum products

The introduction of Gippsland crude in 1969 caused some refineries to modify their refining process and in some instances to install new plant. Until that time output had been designed for the processing of heavy crudes from the Middle East and Indonesia blended with small volumes of light indigenous crudes from the Moonie and Barrow Island fields. All Australian crudes are light with low sulphur content containing mainly fractionations suitable for the production of petroleum, jet fuel, and diesel oils. The BP refinery needed only very minor modifications but Shell and P.R.A. installed additional plant and modified their processes to overcome the problems encountered. The Shell refinery at Corio erected an alkylation plant during 1970 at a cost of about $6m and nearly doubled its electricity generation plant, while the P.R.A. refinery at Altona carried out a big expansion and modification programme, including additional pipelines, costing about $26m.

After the work had been completed the Shell refinery had increased its processing capacity to between 104,100 and 110,000 barrels a stream day (BSD) according to the blend of indigenous and imported crude oils used. Production at the P.R.A. refinery using almost 100 per cent Gippsland crude is now rated at 96,000 BSD while the BP refinery at Crib Point almost wholly using Gippsland crude has raised its output to 60,000 BSD. The total refining capacity is 12,495,000 tonnes a year. The various expansion and conversion programmes cost about $50m and increased Victoria's maximum refinery capacity to 263,000 BSD or about 36 per cent of Australia's total. Shell also operates a lubricating oil refinery at Corio and imported crudes are used for the production of special oils and for bitumen, asphalt, and certain other " heavy ends " products.

Transportation

About 70 per cent of Australia's refined petroleum products, principally the light ends, are made from Australian crude oils. The balance is derived from imported crudes, the bulk of which come from the Middle East (Persian Gulf) with lesser amounts from Indonesia and Brunei. The three refineries in Victoria obtain crude oil feedstocks from the Gippsland fields and from the Persian Gulf, import wholly or partially refined products into the State from either overseas or other States, and export considerable volumes of wholly or partially refined products either to other States or overseas countries.

During 1973–74 the three refineries obtained by pipeline 64,704,314 barrels of Gippsland crude, and imported 15,004,000 barrels of crude oil from the Persian Gulf, making a total supply of 79,708,314 barrels of crude oil feedstocks.

During 1974 Victorian refineries imported by ship 4,383,000 barrels of wholly or partially refined products from overseas or other States in Australia, and exported by ship 27,918,000 barrels of wholly or partially refined products to overseas destinations such as New Zealand or the Pacific islands, and to other States in Australia.

Marketing

Motor spirit in two grades—98 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 4,757 retail outlets (31 December 1973), the majority of which are operated by the nine major oil companies. Victoria had a capacity to store in bulk (at 31 December 1973) 704,528,000 gallons of crude oil and petroleum products at 22 installations in Melbourne (15), Geelong (1), Crib Point (1), Long Island Point (1), and Portland (4), including refineries.

The quantities detailed in the following table total 1,430,981,000 gallons or 25 per cent of the Australian total of the main petroleum fuels.

The principal petroleum products marketed in Victoria's marketing area for 1973–74 are shown in the following table:

VICTORIA—PRINCIPAL PETROLEUM PRODUCTS MARKETED, 1973–74

Item	Quantity
	'000 barrels
Aviation gasolene	106
Motor spirit—	
Super	18,354
Standard	3,753
Total	22,107
Power kerosene	91
Aviation turbine fuel	2,329
Lighting kerosene	382
Heating oil	2,563
Automotive distillate—	
Inland	4,773
Bunkers	229
Total	5,002
Industrial diesel fuel—	
Inland	2,451
Bunkers	621
Total	3,072
Fuel oil—	
Inland (*a*)	4,721
Bunkers	3,920
Total	8,641
Other petroleum fuels (*b*)	7,441
GRAND TOTAL	51,734

Source : Petroleum Branch, Department of Minerals and Energy.
(*a*) Excluding refinery fuel.
(*b*) Including refinery fuel.

Propane, butane (LPG), and ethane

Liquefied petroleum gas (LPG) comprising almost wholly propane and butane is a fuel assuming significance in the petroleum industry in Victoria. While some LPG is produced at each of the three refineries in the State, the largest quantity is produced at the Esso/B.H.P. fractionation plant at Long Island Point. This plant was erected between 1968 and 1970 for the purpose of treating the gas liquids remaining after processing the natural gas and stabilising the crude oil from the Gippsland fields. It is conveyed in a mixed stream to the plant at Long Island Point through a 190 kilometre, 250 millimetre pipeline from Longford. After treatment of the gas liquids, marketable propane and butane are stored in refrigerated storage tanks at the plant to await shipment to overseas markets—principally Japan.

On 5 July 1970 the first load of propane and butane was exported from Long Island Point in a refrigerated carrier to Japan. Since then many tankers have been loaded for destinations outside Victoria. About two thirds of the overseas shipments have been made to markets in Japan. Some has also been shipped to Argentina, Spain, and the Pacific islands. The balance of the shipments have been made in small pressure carriers to ports in Australia.

To 30 June 1974, 1,325,888 tonnes of propane and 1,783,725 tonnes of butane had been shipped. These volumes also contribute about 2 per cent of the revenue from petroleum royalties.

Ethane gas, the third product, was first conveyed on 31 December 1972 through a pipeline 250 millimetres in diameter and 79 kilometres in length to the Altona Petrochemical Company Ltd. Following the completion of separate contracts with Esso and B.H.P. assuring ethane shipments spread over several years, the company commenced an expansion programme in 1969. This programme provided for the erection of ethane cracking facilities to produce ethylene, a raw material used in production of a wide range of plastics.

Esso and B.H.P. are currently expanding the production facilities at Long Island Point and arrangements are currently being examined for the extension of supply of ethane gas to plants in the Brooklyn–Footscray area.

Further reference, 1974

Gas industry

The gas industry, one of Victoria's oldest energy industries, has been revitalised during the past five years due to the introduction of natural gas. It has changed from being operated by a large number of privately owned companies and small municipal undertakings to being controlled by a single public utility—the Gas and Fuel Corporation of Victoria, a State instrumentality with a percentage of private shareholdings.

At 30 June 1974 gas was being supplied to 631,168 customers in Victoria through a network of approximately 13,500 kilometres of transmission pipelines and reticulation mains. About 98 per cent of the total supplied is natural gas. All reticulated gas in Victoria is distributed by the State's gas authority—the Gas and Fuel Corporation of Victoria.

Early history

The first gas company in Victoria, known as the City of Melbourne Gas and Coke Company, was formed on 4 November 1850. It was later authorised by an Act which came into operation on 12 January 1853. The company was amalgamated, with two other metropolitan companies, into the Metropolitan Gas Company by Act of Parliament in 1877. This latter company ceased operations on 1 July 1951 when it was absorbed into the newly created Gas and Fuel Corporation of Victoria.

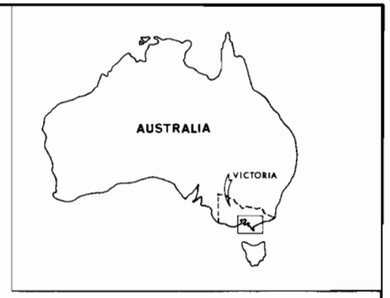
Gas companies were also established through Acts of Parliament in a number of country towns during the latter half of the nineteenth century. These included The Ballarat Gas Company in 1857, The Geelong Gas Company in 1858, and The Bendigo Gas Company in 1860. In many of the larger towns in the State, gas works were constructed by local municipal authorities between 1860 and 1900. During the late nineteenth century The Colonial Gas Association Ltd became established in Victoria. Originally incorporated in England in 1888 as the Australasian Gas Association Ltd, the company built works at Warragul, Seymour, Maldon, Shepparton, Wangaratta, and Box Hill between 1888 and 1890. In 1893 it changed its name to The Colonial Gas Association Ltd.

Gas and Fuel Corporation of Victoria

The Gas and Fuel Corporation was created by the *Gas and Fuel Corporation Act* 1950, which established it as a joint enterprise combining the State of Victoria with the shareholders of the Metropolitan Gas Company

MINISTRY OF FUEL AND POWER
VICTORIA

PETROLEUM AND NATURAL GAS PIPELINES AND FACILITIES IN VICTORIA 1974



BENDIGO
CASTLEMAINE
6 in
BALLARAT
6 in.
BALLAN
8 in.
13 m. SYSTEM – GAS
MELTON
to WODONGA – ALBURY GAS
GAS & FUEL CORPORATION FRANCHISE AREA
MELBOURNE
CRAIGIEBURN
16m Gas
51 m. 18 in. Gas
A.P.M. FAIRFIELD
NEWPORT PET. INDUSTRY TERMINAL
WERRIBEE
Gas
32 m. 14 in.
35m 6in.
49m. 10 in. Ethane
P.R.A. REFINERY ALTONA
PORT PHILLIP BAY
LARA
H
EDITHVALE
7m. 6 in. Gas
CARRUM
FRANKSTON
MORNINGTON
AUST. PORTLAND CEMENT
SHELL REFINERY CORIO
ALCOA ALUMINA REFINERY
83m 10in.
GEELONG
VIC PORTLAND CEMENT
19m. SYSTEM GAS
QUEENSCLIFF
GAS & FUEL CORPORATION FRANCHISED AREA
21.6m 12 in. Gas
22m. 18 in. Gas
5.4m 12 in. Gas
B
30 in. Gas
A
G.F.C. DANDENONG TERMINAL AND DISTRIBUTION STATION
BP TERMINAL
79m. 18 in. Gas
23m. 12 in. Gas
8m. 6in. Gas
WESTERNPORT
HASTINGS
FRENCH IS.
7m. 42 in. Oil
BAY
ESSO/BHP LONG ISLAND POINT FRACTIONATION PLANT, CRUDE STORAGE FACILITY AND LIQUIDS JETTY
BP REFINERY AND LIQUIDS JETTY, CRIB POINT
GAS & FUEL CORPORATION FRANCHISE AREA
108m. 30 in. Gas
Latrobe Valley
WARRAGUL
117 m. 28 in. Oil
118 m. 10 in. Gas Liquids
TRAFALGAR
A.P.M. MARYVALE
MORWELL
K
TRARALGON
7 m. 3 in. Gas
3·4 m. 6 in Gas
GFC METERING AND TESTING STATION
MAFFRA
19m. 4in. Gas
SALE
GAS & FUEL CORPORATION FRANCHISE AREA
Brown Coalfields
ESSO/BHP GIPPSLAND GAS PROCESSING AND CRUDE OIL STABILISATION PLANT, LONGFORD
34·3 m. 20 in. Gas
15·2 m. 18 in. Oil
14 m. 6 in. Oil
15·2 m. 18 in. Gas
19 m. 6 in. Oil
BARRACOUTA
LAKES ENTRANCE
35m. 26 in. Oil
34·6m. 30 in. Crude Loop
33 m. 20 in. Gas
47 m. 24 in. Oil
SNAPPER
TUNA
Gas & Oil
MARLIN
HALIBUT
Oil
2·3 m. 16 in. Oil
15·7 m. 20 in. Oil
MACKEREL
KINGFISH A
KINGFISH B
ESSO / BHP FACILITIES
GIPPSLAND BASIN
ESSO/BHP BARRY BEACH MARINE TERMINAL
BASS STRAIT

LEGEND

GFC	GAS AND FUEL CORP. OF VICTORIA
■	PLANTS AND REFINERIES
♦	OIL INDUSTRY DISTRIBUTION TERMINALS AND BUNKERING STATIONS
———	CRUDE OIL AND NATURAL GAS PIPELINES
·····	W.A.G. CRUDE PIPELINE
– – – –	GAS PIPELINES – PLANNED OR UNDER CONSTRUCTION
–·–·–	OIL AND FINISHED PRODUCTS PIPELINES
●	GATE STATIONS, ETC
A	CITY GATE STATION – DANDENONG
B	GATE STATION – OAKLEIGH
C	GATE STATION – RINGWOOD
D	DISTRIBUTION STATION – VERMONT
E	GATE STATION – FOOTSCRAY
F	REGULATOR STATION – WEST MELBOURNE
G	METERING STATION – BROOKLYN
H	GATE STATION – CORIO
J	ALTONA PETROCHEMICAL CO LTD
K	SITE OF LURGI GASIFICATION PLANT, MORWELL (not now operating)

SCALE OF MILES
8 6 4 2 0 4 8 16 24

Drawn by the Gas and Fuel Corporation of Victoria for the Ministry of Fuel and Power.
Ed. No. 5 – 1-7-74

and the Brighton Gas Company. It is controlled by a Board of seven directors comprising the chairman and three directors appointed by the Victorian Government, and three directors elected by the preference shareholders. The purpose of the legislation was to provide the means for developing a method of using Victorian brown coal instead of New South Wales black coal for the production of gas, thereby freeing the State from repeated gas rationing and to consolidate and rationalise the gas industry by providing for the takeover or absorption of other gas utilities. The new Corporation commenced operating on 1 January 1951. By 1974 it had, through subsequent enabling legislation, become the sole authority for the distribution of reticulated gas throughout Victoria.

Using the Lurgi high pressure process developed in Germany in the 1930s the Corporation commenced the production of gas from brown coal briquettes in 1956 at a newly built plant at Morwell and laid Australia's first long distance gas pipeline 450 millimetres in diameter over a total distance of 161 kilometres from Morwell to the West Melbourne gas works. The country centres of Morwell, Warragul, and Trafalgar were connected to gas during 1959 and 1960 and a small diameter line was laid to Traralgon, 11 kilometres to the east.

The Gas and Fuel Corporation of Victoria during the years 1956 to 1971 exercised its powers to acquire other gas undertakings in the State and with the acquisition by takeover in 1973 of Colonial Gas Holdings Ltd, of which The Colonial Gas Association Ltd was a subsidiary (the last privately owned undertaking in the State), it is now the sole distributor of gas in Victoria except for liquefied petroleum gas sold by oil companies in certain areas in the State as provided for in the *Gas Franchises Act* 1970.

Gas, made in retorts from black coal shipped initially from Scotland and later from New South Wales, was used in homes and for street lighting, for cooking, and in light industry. The resulting by-product, coke, was used in furnaces in industry and in hospitals, offices, etc., for producing hot water and for steam raising, and in homes for heating rooms.

Using only black coal to produce towns gas, the industry in Victoria changed considerably during the period 1955 to 1969. Refinery and liquefied petroleum gases were introduced in 1955 following the erection of oil refineries at Altona and Geelong during that year ; production of Lurgi gas made from brown coal briquettes began in 1956 ; gas was made from oil following the installation of Onia–Gegi plants in 1962 ; and finally, more refinery gas and LPG became available when the new BP refinery at Crib Point came on stream in 1966. Thus, prior to the introduction of natural gas in April 1969, towns gas comprised, through reforming and blending techniques, a mixture of black coal gas, Lurgi brown coal gas, water gas, oil gas, and liquefied petroleum gas, and refinery gases.

Natural gas

In 1965 occurred an event which was to prove to be of great significance in the history of the gas industry in Victoria. Natural gas in commercially recoverable quantities was discovered in eastern Bass Strait in the Gippsland Basin about 22 kilometres offshore in waters about 50 metres deep. A second and even larger field was found a year later. These two events introduced a new era in the gas industry in this State.

Discovery and development

The development of the Gippsland fields began in 1960 when The Broken Hill Proprietary Company Ltd was advised to take out petroleum exploration permits over areas of Bass Strait, particularly the offshore part of Gippsland, in the belief that petroleum bearing rocks could exist in the young sediments of that region.

The company, through its subsidiary Hematite Petroleum Pty Ltd, carried out geophysical surveys during the next three years and, due to the encouraging evidence revealed, entered into a farm-out agreement with Esso Exploration and Production Australia Inc. The original agreement provided for Esso, as the operator, to carry-out further seismic surveys and to drill five exploratory wells in the Gippsland Basin ; and for Hematite to elect, in the case of a successful discovery, to take either a 12.5 per cent royalty or to share on an equal basis the costs and profits of any development enterprise. Hematite subsequently elected to take the latter course in all the commercial discoveries.

Success was immediate. The first well drilled by Global Marine's *Glomar* III drill ship found natural gas early in 1965. An assessment well was drilled and the Barracouta field was declared commercial. A second and larger field, Marlin, was discovered early in 1966 and suddenly Victoria found itself in the fortunate position of having over four trillion cubic feet of recoverable natural gas in two fields awaiting development and utilisation. (For reserves see section on petroleum, pages 346–52.)

The initial step in the development of the fields was to establish a marine terminal at Barry Beach in southern Gippsland, about 193 kilometres south-east of Melbourne and 145 kilometres west of the fields. This terminal, built between 1966 and 1968, became a general operational base for both exploration activities and the development projects, the most immediate of which was the fabrication of jackets and decks for the platforms from which the natural gas development wells would be drilled.

Negotiations with the Gas and Fuel Corporation of Victoria for the sale of the natural gas to the State's gas utilities were virtually completed early in 1967 when agreement was reached on terms involving the payment, over a contract period of 20 years, of a fixed maximum price of 3.2 cents a therm and a minimum of 2.58 cents. A market for the gas was now assured.

While these events were taking place, a number of legislative measures were being passed by the Victorian Parliament. The first of these was activated by a report by the Canadian consultant, Chas E. Hetherington and Co. of Calgary, on the orderly development of petroleum in Victoria. The Government, late in 1966, established the Victorian Pipelines Commission whose primary task was to lay a natural gas trunkline to Melbourne's city gate at Dandenong from Longford where Esso and Hematite had selected a site for a plant to process the natural gas into a high quality, saleable product.

In 1967, realising that a number of pipelines would be needed to transport and distribute natural gas, the Government introduced Australia's first general pipelines enactment, the *Pipelines Act* 1967. This Act has since regulated the granting of permits and licences for gas and oil pipelines in the State.

Drafting of legislation which was to be of great significance to Australia, and which has served as a model to other countries, was expedited. After years of discussions between the Australian Government and all the States, the various enabling enactments applicable to each State and Australia were passed by the respective Parliaments in October 1967 and came into operation on 1 April 1968. Entitled the *Petroleum (Submerged Lands) Act* 1967, this legislation provided for uniformity in granting offshore petroleum exploration permits and production licences, the imposition of royalties, and the laying of submarine pipelines.

The Barracouta platform was erected early in 1968 about 24 kilometres offshore in water 46 metres deep, and later in that year construction of the Marlin platform about 52 kilometres offshore in deeper waters was completed. By the end of January 1969, the planned ten wells had been drilled from the Barracouta platform—six being completed as oil producers to drain the seven million barrel reservoir discovered in 1968 during development drilling, and the remaining four to provide gas. Since then three of the oil wells have been converted to gas production.

Development drilling from the Marlin platform commenced in August 1968 but ceased on 2 December 1968 when a gas blowout occurred and only four wells were subsequently completed as gas producers. Drilling from the platform resumed on 12 June 1972 and on 5 August 1973 had been completed with the drilling of 21 wells.

Two pipelines were laid from the platforms to the Longford plant during 1968 and 1969. The first was the 48 kilometre, 457 millimetre diameter Barracouta line, followed by the 109 kilometre, 508 millimetre Marlin line—about half of each pipeline being under the sea.

Construction of the gas processing facilities at Longford, a few kilometres south of Sale in east Gippsland, commenced late in 1967 and was at a sufficiently advanced stage in March 1969 to treat the first gas from the Barracouta field. The facilities comprised a twin-train, refrigerated absorption plant designed to process 400 million cubic feet a day (mmcf/d) of raw, wet gas. It was capable of removing about 35 per cent of ethane and all heavier hydrocarbons.

On 2 February 1973 the Esso/B.H.P. partnership announced that it would erect a new natural gas processing plant at Longford adjacent to and to be a part of the existing facilities. The new plant will be known as the Gippsland Gas Processing Plant No. 2. Current design is for it to be capable of producing 300 million cubic feet a day of treated gas. Construction began late in 1973 and is expected to be completed by late 1975 at a cost of approximately $26m. The new plant will be a cryogenic type whereas the existing plant is an absorption type. The expansion is required to meet expected peak demands of the Gas and Fuel Corporation of Victoria during the latter part of the current decade.

Distribution

In order to provide means of transporting contract specification natural gas between Esso/B.H.P.'s treatment plant at Longford and the Gas and Fuel Corporation's principal distribution terminal at Dandenong, 32 kilometres south-east of Melbourne, the Victorian Government in 1966 created the Victorian Pipelines Commission to build gas trunklines in Victoria.

The Commission constructed a 174 kilometre, 750 millimetre diameter pipeline in 1968 and 1969 between Longford and Dandenong and natural gas first reached the latter point on 31 March 1969. From the metering and regulating station at Dandenong the Corporation commenced distributing natural gas to its own customers in April 1969 and to The Colonial Gas Association Ltd during the following month.

When it was realised that natural gas would become available to the Victorian gas industry both the Gas and Fuel Corporation and The Colonial Gas Association Ltd commenced planning for its introduction. The first two tasks were to ensure that there was an adequate system of pipelines to distribute gas to customers and, because the combustion characteristics of natural gas vary considerably from those of manufactured gas, to convert the existing gas appliances of consumers to burn natural gas correctly and efficiently.

During the late 1960s the Gas and Fuel Corporation commenced the construction of a ring main around Melbourne initially to cope with normal expansion of gas supply to the rapidly developing suburban areas and subsequently for the distribution of natural gas to its own customers and The Colonial Gas Association Ltd. The northern section of the ring main—82 kilometres in length and 450 millimetres in diameter—passing through the eastern and northern suburbs, was completed late in 1969 and the 35 kilometre, 750 millimetre diameter southern section direct from the Dandenong city gate to West Melbourne came fully into operation in May 1970. Built at a cost of $11m, this 118 kilometre long pipeline now forms an essential part of the Corporation's entire metropolitan distribution system and supplies gas to Geelong, Ballarat, and Bendigo and will provide supply to Shepparton, Seymour, Wangaratta, Benalla, Wodonga, and Albury by the winter of 1976.

Conversion of appliances

The conversion of existing gas appliances in the Melbourne metropolitan area by the gas utilities was completed in December 1970. The towns in central Gippsland already supplied by the Gas and Fuel Corporation received natural gas during the closing months of 1969. In Geelong conversion finished near the end of 1971, about five months after commencement. By the time conversion had been completed the Lurgi plant at Morwell and the gas making plants at West Melbourne, Highett, Footscray, and Box Hill in the metropolitan area had closed down.

Following the laying of a 196 kilometre system to Ballarat and Bendigo during 1972 and 1973 the former city first received natural gas on 14 April 1973. The conversion programme involving over 36,000 appliances used by about 17,000 customers was carried out in these two cities and at Castlemaine and Bacchus Marsh by the Corporation's own staff during 1973 at a cost of about $1.6m. A further 2,649 appliances owned by 934 customers were converted at Melton during 1974. At 30 June 1974 a total of 1,375,000 appliances owned by 564,667 customers had been converted in the State.

Gas supply areas

At 30 June 1974 there was a total of 616,069 customers receiving natural gas in Victoria. A further 15,096 customers were using other reticulated gases, mainly tempered or reformed liquid petroleum gas, making a total of 631,165 customers.

The areas supplied with reticulated gas and the supplier concerned are shown in the following table :

VICTORIA—AREAS SUPPLIED WITH GAS AT 30 JUNE 1974 (*a*)

Supplier	Area supplied with	
	Natural gas	Other gases (*b*)
Public utilities—		
Gas and Fuel Corporation of Victoria	Bacchus Marsh Ballarat Bendigo Castlemaine Geelong Maffra Melbourne Morwell Sale Trafalgar Traralgon Warragul	Ararat Benalla Colac Hamilton Horsham Kyneton Lara Melton Portland Queenscliff Seymour Shepparton Stawell Warrnambool Wangaratta Wodonga
Private suppliers—		
Esso Exploration and Production Australia Inc. and Hematite Petroleum Pty Ltd (B.H.P.)	Western Port North Geelong	

Source : Ministry of Fuel and Power.
(*a*) Excludes Esso/B.H.P. plant use at Longford and Long Island Point.
(*b*) In addition the Gas and Fuel Corporation of Victoria supplies Maryborough and Warracknabeal with bottled LPG, with on-site filling being used at the latter town.
NOTE. The Corporation supplies 616,069 consumers with natural gas and 15,096 with other gas, and private suppliers supply 3 consumers (2 at Western Port and 1 at North Geelong).

Gas is supplied to consumers in Victoria by the Gas and Fuel Corporation of Victoria, which in addition transports gas to three companies which purchase directly from Esso Exploration and Production Australia Inc. and Hematite Petroleum Pty Ltd at Western Port and Geelong; and to the partnership's fractionation plant at Long Island Point.

Liquefied petroleum gas is also supplied to over 100,000 customers from reticulation and cylinder by the Gas and Fuel Corporation and from cylinder by oil companies or subsidiary LPG marketing companies in accordance with the provisions of the *Gas Franchises Act* 1970.

Legislation, 1969 to 1973

The *Gas and Fuel Corporation Act* 1958 empowers the Corporation, the State's sole public gas authority, to acquire or take over other gas undertakings operated in the State and by 1 January 1974 all had been incorporated into the Corporation by this means. As a result of agreements, later ratified by Acts of Parliament in 1969 and 1970, the Corporation purchased from The Gas Supply Co. Ltd all of its gas installations in Victoria, including the one at Sale in 1969 and those at Ballarat and a number of other country towns in 1970. During the early part of 1971 Victoria passed an Act authorising the Corporation to make an offer to the shareholders in The Geelong Gas Company to purchase their shares. The bid was successful and in June of that year ownership of the company passed to the Corporation. The Corporation also took over in 1971, through enabling legislation, the functions and assets of the Victorian Pipelines Commission, originally formed early in 1967. The ownership and operation

of the 174 kilometre natural gas trunkline from Longford to Dandenong and the 53 kilometre transmission line from Brooklyn to Corio, passed to the Corporation on 1 July 1971.

Late in 1970 the Victorian Government, believing that the expenditure totalling about $80m incurred by the Gas and Fuel Corporation and The Colonial Gas Association Ltd in introducing natural gas in the Melbourne metropolitan area and in a number of country centres in the State should be safeguarded, passed the *Gas Franchises Act* 1970. This legislation established the rights of the two utilities to supply reticulated gas and, subject to certain conditions, to sell liquefied petroleum gas in bulk, within geographical areas defined in the Act. A further Act passed by the Victorian Parliament late in 1972 extended the provisions of the *Gas Franchises Act* 1970 to the Geelong area, enlarged the geographical boundaries of the areas of supply, and provided for the dissolution of The Geelong Gas Company, the last of the original private gas companies formed by Act of Parliament dating back to 1858. This company was dissolved on 1 January 1974.

On 19 December 1972 the Gas and Fuel Corporation announced its intention to submit an offer to acquire all the issued capital of Colonial Gas Holdings Ltd. The formal offer was submitted to shareholders on 15 January 1973 after it had been unanimously recommended by the directors of the company and on 3 April 1973 an Act passed by the Victorian Parliament entitled the *Gas and Fuel Corporation (Colonial Gas Holdings Limited) Act* 1973, came into operation. Ownership of Colonial Gas Holdings Ltd, of which The Colonial Gas Association Ltd is a subsidiary, passed to the Corporation and a new Board was elected on 18 April 1973. The company was dissolved on 1 January 1974 and The Colonial Gas Association Ltd registered in the United Kingdom, was vested in the Corporation on that date.

Production and sales

Since the Gippsland fields first came on stream in March 1969 the production of treated natural gas at Esso/B.H.P.'s plant at Longford has increased markedly as shown in the following table :

VICTORIA—PRODUCTION OF TREATED NATURAL GAS (*a*)
(mmcf)

Year	Quantity
1969	4,476.909
1970	22,089.221
1971	35,756.710
1972	42,479.756
1973	63,338.363
1974 (*b*)	35,421.424
Total	203,562.383

(*a*) Includes sales, field, and plant usage.
(*b*) For six month period 1 January 1974 to 30 June 1974.
mmcf : million cubic feet.

Sales rose sharply following the introduction of natural gas in April 1969. During the 12 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. Although the Corporation's sales areas were

enlarged through the purchase of undertakings in several country towns during the next three years, the ratio of additional consumers in these areas was relatively small compared with the total. Sales during the 12 month period ending 30 June 1974 increased by 58.4 per cent.

VICTORIA—SALES OF GAS

Year	Gas and Fuel Corporation		Colonial Gas Association	
	Sales in millions of therms	Increase over previous period	Sales in millions of therms	Increase over previous period
		per cent		per cent
1969–70	129,966	20.3	23,331	29.0
1970–71	(*a*) 178,669	37.5	35,365	51.6
1971–72	247,011	38.3	49,692	40.5
1972–73	337,911	36.8	64,607	30.0
1973–74	(*b*) 59,674,000	67.4	(*c*)	(*c*)

Source : Ministry of Fuel and Power.
(*a*) Includes the undertakings purchased from The Gas Supply Co. Ltd from December 1970 and The Geelong Gas Co., acquired in June 1971, for the whole of the 1970–71 period.
(*b*) In gigajoules. Includes Mount Gambier Gas Co. Ltd in South Australia. 1 gigajoule = 9.479 therms.
(*c*) Incorporated into the Gas and Fuel Corporation.

The Victorian utilities realised at a very early stage that successful and economical marketing of natural gas depended on capturing large loads in the industrial sector. Industrial sales by the Gas and Fuel Corporation rose from 17,100,000 therms in 1968 to 37,421,000 gigajoules (1 gigajoule = 9.479 therms) in 1974. The principal industries concerned included paper and board manufacturers; cement works; brick, tile, and pipe works; food processors; metal fabrication and finishing; alumina smelting and fabrication; and for operations ancillary to the treatment of sewerage.

On 8 January 1973 the Gas and Fuel Corporation and Alcoa of Australia Ltd jointly announced the conclusion of a multi-million dollar contract for the supply of natural gas to Alcoa's alumina smelter and fabrication plant at Point Henry near Geelong. Natural gas will replace fuel oils and LPG for certain processes. A pipeline, part of which was laid in 1970, has now been extended to the plant and supply commenced on 20 August 1973. Arrangements have also been made for the Corporation to supply natural gas to Victorian Portland Cement Co. Pty Ltd at Waurn Ponds near Geelong and a 13.5 kilometre, 250 millimetre pipeline will be laid during 1975 for supply to commence during the third quarter of that year.

Extension to country areas

Natural gas became available in the Gippsland towns of Sale, Maffra, Traralgon, Morwell, Trafalgar, and Warragul in 1969, at Geelong in 1971, and at Bendigo, Ballarat, Castlemaine, and Bacchus Marsh in 1973. A 201 kilometre pipeline system was completed during the first half of 1973 and in April 1973 Ballarat commenced being supplied with gas. Conversion followed progressively in Bendigo, Castlemaine, and Bacchus Marsh. The laying of a spur pipeline to the township of Melton, about 32 kilometres west of Melbourne, and which is adjacent to the pipeline route to Ballarat, has been completed and natural gas became available there in May 1974. The conversion of appliances programme was completed two months later.

Further reference, 1974; Natural gas and crude oil development, 1961–1972; Discovery and development of crude oil in Victoria, 1974

MINING

Mines Department

The traditional role of the Mines Department has been to promote the exploration of the mineral resources of the State, including oil, gas, and groundwater ; to administer a system of leases and licences to enable the extraction and to regulate the extraction to ensure that it is carried out in an efficient and safe manner. The Department also carries out geological research and surveys for mineral resources and publishes the results in geological maps and reports. In addition to assisting in mineral exploration, these maps and reports provide basic information for soil survey, land-use, and environmental surveys and engineering undertakings. They are also of assistance to educational institutions and the general public.

The legislation administered by the Department includes the *Mines Act* 1958, *Petroleum Act* 1958, *Extractive Industries Act* 1966, *Petroleum (Submerged Lands) Act* 1967, *Groundwater Act* 1969 ; the Department also plays an important role in the functioning of the *Environment Protection Act* 1970 and the *Land Conservation Act* 1970.

The *Extractive Industries Act* 1966, which provides for the regulation of quarries by leases and licences, also involves the Department in Town and Country Planning Schemes where the location and protection of deposits of " stone " are involved. " Stone " as defined by the Act includes basic construction materials such as hard rock for aggregates, sand, gravel, clay, limestone, etc. The Department's responsibility is to assist with the location of deposits of " stone " and to negotiate with the various planning authorities to obtain an adequate form of zoning to protect the deposit. Sources of construction materials are an essential requirement to maintain the development of housing, schools, factories, roads, dams, and sewerage systems, but with increasing public awareness on environmental issues, there often appears to be conflict between the respective interests. The planning authorities and the Department have a responsibility to plan for the future to ensure that valuable deposits of " stone " are not sterilised by other land-use, particularly if the resource is in short supply. The siting of extractive operations can generally be planned, taking into account the aesthetic interests and the material needs of the community.

The *Land Conservation Act* 1970 set up a Land Conservation Council to publish reports in relation to the future use of Crown lands. The Council instigates studies of areas through study groups comprised of professional officers from State departments and authorities. Mines Department geologists work on the study groups to prepare reports on the physiography, geology, hydrogeology, and mineral resources of the study areas. Because important mineralised areas, deposits of " stone ", and important aquifer systems often occur in Crown lands, the Department's contribution to the study groups is to point out where aquifer systems occur, where proven mineral deposits exist, or where potentially important minerals may be found. The Department then seeks provisions to permit exploration and mining should the need arise in the future. Some particular mineral may become of strategic significance at a later date and access to mineralised areas may be of vital importance.

Through the *Petroleum Act* 1958 and the *Petroleum (Submerged Lands) Act* 1967, the Department regulates the exploration by companies

for oil and gas deposits in onshore and offshore areas. Leases and permits are issued and through a regular system of inspection of operations and of reporting from the companies, a high standard of professional efficiency and safety is maintained. On the development side the installation of production facilities and the production and transmission of the oil and gas by pipeline are rigidly controlled. Through the 1970s the exploration for petroleum and gas and the community's increasing dependence on a local source will place great emphasis on exploration and development. The Department's role will be to encourage and stimulate continuing exploration and assist as much as possible with expert technical advice and publications on geological and engineering matters. The Department, in collaboration with the South Australian Mines Department, carried out a major sedimentary basin study on the onshore Otway Basin during the 1960s and a comparable study is in progress on the onshore Gippsland Basin and the Port Phillip area.

The *Groundwater Act* 1969 confirmed the Department's long-standing role in the investigation and assessment of the State's groundwater resources and provided for the control, construction, and maintenance of water bores. The Act made explicit provisions for the protection of groundwater from pollution from the surface or by material injected underground. To carry out this part of the Act, the Department is required to report on any existing or proposed disposal sites for soluble solid or liquid domestic or industrial wastes, which may overlie unconfined aquifer systems or be sited in important aquifer intake areas. Under the Act, " bore " is defined in such a way that any quarries, sandpits, or comparable excavations are included. Several geologists are now working continuously on problems related to groundwater pollution and also investigating sites where disposal dumps and depots are established.

The Department's responsibilities under the *Groundwater Act* 1969 in relation to pollution increased with the passing of the Environment Protection Act in 1970. The Department is now an investigating agent of the Environment Protection Authority in matters relating to groundwater and programmes of groundwater pollution monitoring are being jointly undertaken. The Department is not only concerned with pollutant seeping laterally or vertically into unconfined aquifers from disposal bores or waste disposal depots, but also with the quality of surface waters flowing in streams. In an unconfined aquifer system a percentage of recharge is from the surface drainage system. Unconfined aquifer systems around the shores of bays such as Western Port and Port Phillip also discharge eventually into the bays, and the investigations in the next few years will be concentrated on methods of preventing polluted groundwaters eventually reaching the shallow bays or lakes.

Because of the Department's work on groundwater and groundwater pollution, the studies will be increasingly integrated with environmental studies of areas such as Western Port Bay, Port Phillip Bay, and the Gippsland Lakes. No study of surface waters can be carried out effectively without a detailed study of the groundwater regime in relation to the geological and hydrological environment.

The major mineral resources of the State are described on pages 366–7 of the *Victorian Year Book* 1967. A further article on the State's minerals appears on pages 1–29 of the *Victorian Year Book* 1970.

Geological Survey of Victoria

Research activities

The Geological Survey of Victoria was formally established in 1852 following the first reported discovery of alluvial gold the previous year. The establishment followed an appeal by Governor La Trobe to the Colonial Office in London for urgent expert geological assistance. A.R.C. Selwyn arrived in Melbourne in 1852 to become the founding Director of Geological Survey. Selwyn immediately initiated a programme of geological mapping and mineral resource surveys to assess the distribution and nature of the gold bearing formations. In 1867 the Geological Survey was brought under the control of the Minister of Mines and at the present time functions as a Branch of the Mines Department.

The early work of the Survey included detailed surface and subsurface mapping of the important gold field 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 coal field in the early 1900s.

In the period 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 coal fields as a source of fuel prior to this responsibility being transferred to the State Electricity Commission 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 by the Geological Survey on the Tertiary stratigraphy and micropalaeontology of the onshore Gippsland Basin set a basis for the discovery of the oil and gas fields of Bass Strait during the middle 1960s.

In summary, the main objectives of the Geological Survey are to investigate the State's geological structure, mineral, petroleum, groundwater resources, and engineering geology, and provide basic information on these matters in the form of geological maps, reports, and advice to industry, the public, and other Victorian and Australian Government departments. The Survey also serves as geological consultant to government agencies when required, and provides a scientific basis for the appraisal, development, and conservation of Victoria's subsurface resources.

Present day activities

1. *Mineral resource surveys.* These surveys include the use of mineralogical, petrological, geochemical, and geophysical methods to assess the potential of mineral deposits within Victoria. The surveys include research on the location, stratigraphy, and structural relationships of metallic and non-metallic mineral deposits.

2. *Hydrogeology.* This involves geological and hydrogeological investigation of the major sedimentary basins and the highland areas of Victoria to assess the groundwater resources. The characteristics of important aquifer systems are studied by means of systematic drilling programmes, pump tests, and regular monitoring of observation bores. Computers are used to analyse the data to estimate the discharge and recharge rates and the safe

yield of the aquifer systems for the future management of groundwater resources.

3. *Groundwater pollution.* Detailed studies are being carried out on the aquifer systems beneath residential and industrial areas to ascertain whether pollution has occurred, the nature of the pollutants, and their distribution. Research is being undertaken to measure the rates of dispersion and decay of pollutants in groundwater by using detailed temperature measurements and regular chemical analysis.

4. *Regional geology.* Detailed geological mapping of the State is carried out, producing maps at 1:1,000,000, 1:250,000, and 1:63,360. Regional studies are undertaken to elucidate the stratigraphic and structural relationships of the geological formations of the State and to ascertain their relative significance in the location of mineral deposits.

5. *Engineering geology.* Studies are undertaken on the chemical, physical, and mechanical stability of rock formations in relation to the siting and construction of dams, bridges, roads, freeways, sewer tunnels, underground railways, and multi-storied buildings. Studies are also being made of coastal geological features in relation to problems of harbour silting, beach erosion, and the disruptive influence of man-made constructions.

6. *Sedimentary basin studies.* Studies are conducted by petrological, mineralogical, geochemical, and geophysical methods on the geological successions of the major sedimentary basins of Victoria. The studies seek particularly to ascertain the distribution and importance of these formations in respect to the habitat of coal, phosphate, oil, and natural gas deposits.

7. *Palaeontological studies.* Areas covered are :

(i) *Micro-palaeontological.* Research on micro-fossils such as foraminifera to make age determinations and assist in the elucidation of the stratigraphic relationships between surface and subsurface formations.

(ii) *Palynological and palaeobotanical.* Studies of fossilised plant material found within the sedimentary rock formations as a means of establishing geological sequences. This work, together with (i), is directly applicable to hydrogeological studies and oil and gas exploration.

(iii) *Macro-palaeontological.* Study of the macro-fossils found in the Palaeozoic rock formations in Victoria to ascertain the age of the formations and their structural relationships. The Palaeozoic formations are host rocks for the deposits of gold, antimony, and base metals.

8. *Environmental geology.* The location and exploration of mineral deposits including groundwater, to ensure that for future planning valuable deposits are reserved and protected from other forms of land usage. The studies are directed towards controlled extraction of the resource so that conservation interests are considered and the extraction only takes place in the community's interest. The studies of groundwater pollution are particularly related to environmental geology because resources of high quality water must be protected.

Mineral exploration

Mineral exploration consists in the search for, and/or appraisal of, new ore occurrences and known deposits of minerals (including extensions to deposits being worked) by geological, geophysical, geochemical, and other

methods (including drilling). Exploration activity takes mainly two forms—exploration carried out in areas where production is current, that is, on a production lease; and exploration in other licensed areas, that is, in areas covered by exploration licences, authorities to enter, and authorities to prospect.

In addition to the above two forms of exploration activity, there is also general exploration activity such as general surveys, aerial surveys, report writing, map preparation, and other off-site activities not directly attributable to a particular lease or licence area. Information regarding all forms of mineral exploration (other than for petroleum) in Victoria and covering both metallic and non-metallic minerals, fuels, and construction materials is collected by the Australian Bureau of Statistics from every company or organisation engaged in exploration whether under licence, lease, or otherwise.

Details of exploration expenditure as reported by informants in the Annual Mineral Exploration Census (excluding petroleum exploration) conducted by the Australian Bureau of Statistics is set out in the following table :

VICTORIA—MINERAL EXPLORATION (OTHER THAN FOR PETROLEUM) EXPENDITURE
($'000)

Particulars	Mineral exploration on—			
	Production leases	Other licensed areas	Other	Total
1967—Drilling	548	321	..	869
Other	108	524	..	632
Total	656	845	..	1,501
1968—Drilling	350	476	..	826
Other	181	465	80	726
Total	531	941	80	1,552
1968-69—Drilling	173	372	..	545
Other	436	581	52	1,069
Total	609	953	52	1,614
1969-70—Drilling	191	496	..	687
Other	800	640	254	1,694
Total	991	1,135	254	2,381
1970-71—Drilling	194	119	..	313
Other	922	491	149	1,562
Total	1,117	610	149	1,875
1971-72—Drilling	113	142	..	255
Other	264	452	323	1,039
Total	377	594	323	1,294

Extractive industries

Urban development in and around Melbourne after the Second World War enclosed and restricted the expansion of several quarrying operations ; this created the situation where urban growth was actually suppressing one of its own basic ingredients. Following a conference in 1956 to examine the position of all quarrying operations in relation to the future development of Victoria, the State Development Committee examined the problems of the expansion of Melbourne over the sites of the existing brickworks, sand pits, and stone quarries, the shortage or availability of various materials, and the despoiling of rural land near Melbourne. The Committee's report was presented in 1958.

In 1961 the subject of extractive industries was again referred to the State Development Committee which received evidence from further witnesses. Shortages of self-bonded moulding sands and of special types of plastic clays used in the manufacture of terra-cotta roofing tiles, agricultural drain pipes, and cream bricks were still apparent. Industrialists attempting to expand their operations into other suitable areas near Melbourne found municipal councils unwilling to grant permits for extractive industries within their boundaries, or reluctant to permit the extension of the established industries. After inquiries had been made into proposals submitted by the Mines Department, 35 recommendations were made, of which the most important was that legislation concerning the leasing, licensing, and regulation of extractive industries, and the fencing and reclamation of extractive industrial sites, should be enacted. In 1966 the Extractive Industries Act was passed, defining extractive industry as " the extraction from land down to a depth of more than six feet below the natural surface of the land of stone for commercial purposes and, where stone is treated or bricks, tiles, pottery or cement products are manufactured substantially from stone on or adjacent to the land from which the stone was extracted, includes that treatment or manufacture."

Prior to the introduction of this legislation the industry had been governed by the Mines Act. This was not necessarily appropriate, as the extractive industry and mining each have different characteristics. Mining involves the exploitation of minerals generally occurring in low concentrations; extractive industry involves the removal and treatment of the common substances of the earth.

The Extractive Industries Act defines the rights and responsibilities of owners of land used for quarrying, with particular reference to reclamation. It also defines the responsibilities of the quarry operator regarding progressive reclamation (the terms for which are the subject of the regulations and the licence conditions), and it provides for penalties for non-observance of these and other terms of the Act. Under the Act the Extractive Industries Advisory Committee was established; it comprises two permanent members (the State Mining Engineer and the Director of the Geological Survey) together with part-time members representing planning authorities and municipalities. Besides advising government authorities, State instrumentalities, and municipalities on matters concerning extractive industries, the Committee also conducts surveys for materials resources, prepares reports and recommendations, considers submissions for extractive industry leases and licences and determines the conditions for operation, and considers amending legislation. A Quarry Managers Board has been proclaimed and gazetted, training courses have been established, and several applicants have been approved as quarry managers.

As a result of this legislation the status of the industry has improved; it is being catered for by planners, and its needs are being considered by the authorities generally. Accidents, which had previously been of concern in the industry, have been reduced and now average less than one fifth of the figure prior to the legislation.

Mining and quarrying production

The mining and quarrying production of the State from lands occupied under the Mines Act and the Extractive Industries Act is recorded by the Victorian Mines Department, and from other lands by the Australian Bureau of Statistics. The production from both sources for the years 1970–71 to 1972–73 is shown in the following table:

VICTORIA—MINING AND QUARRYING PRODUCTION

Particulars	1970–71		1971–72		1972–73	
	Quantity	Value	Quantity	Value	Quantity	Value
	'000 gm	$'000	'000 gm	$'000	'000 gm	$'000
Metallic minerals (*a*)—						
Gold bullion	r 171	(*b*) 180	r 208	(*b*) 223	148	(*b*) 138
	tonne		tonne		tonne	
Antimony concentrate	276	33	96	n.a.	..	..
Antimony ore	2,337	63	n.a.	n.a.	n.a.	n.a.
Bauxite	7,902	58	..	..	4,222	36
Copper concentrate	91	17	..	..	..	..
Copper ore	1,085	22	..	..	..	..
Iron ore	290	1	123	1	596	3
Lead concentrate	2	(*c*)	..	..	..	..
Tin concentrate	6	11	30	42	10	20
Wolfram ore	..	..	..	..	12	n.a.
Non-metallic minerals—						
Diatomite	4	(*c*)	4	(*c*)	2,279	12
Fireclay	42,083	110	17,274	53	22,658	56
Fluorspar	946	30	380	22	1,700	79
Gypsum	46,304	151	42,063	128	43,694	154
Kaolin, refined	24,261	520	20,918	r 526	13,809	671
Kaolin, unrefined (*d*)	758	9	13,683	34	10,714	41
Limestone (*e*)	2,075,165	n.a.	2,158,991	n.a.	2,162,770	n.a.
Other clays	2,012,911	1,556	2,106,382	1,754	2,186,698	1,858
Silica	108,104	319	98,791	316	109,019	339
Fuel minerals—						
Briquettes	1,391,294	10,614	1,328,630	11,280	1,228,005	9,173
Coal, black	20	(*c*)	..	..	..	..
Coal, brown (*f*)	23,180,539	19,052	23,630,467	25,706	24,121,155	23,763
	'000 cub m		'000 cub m		'000 cub m	
Crude oil	12,124	n.a.	16,356	n.a.	18,190	n.a.
Liquefied petroleum gases (*g*)—						
Commercial butane	393	n.a.	4,662	n.a.	988	n.a.
Commercial propane	347	n.a.	576	n.a.	798	n.a.
	million cub m		million cub m		million cub m	
Natural gas (*h*)	864	n.a.	1,097	n.a.	1,473	n.a.
Other derivatives (*g*)—						
	'000 cub m		'000 cub m		'000 cub m	
Commercial ethane	5,380	n.a.	3,087	n.a.	27,436	n.a
	'000 tonnes		'000 tonnes		'000 tonnes	
Construction materials—						
Sand	5,747	6,130	5,619	8,004	6,659	8,945
Gravel	3,599	1,727	3,486	2,121	3,633	2,401
Crushed and broken stone	17,505	31,828	r 16,057	32,908	15,805	31,985
	tonne		tonne		tonne	
Dimension stone	11,601	184	13,066	200	14,515	284
	'000 tonnes		'000 tonnes		'000 tonnes	
Other quarry products	3,728	2,421	3,053	2,484	8,180	2,758

Source : Victorian Mines Department, Department of Minerals and Energy—Fuel Branch, and Australian Bureau of Statistics.

(*a*) See subsequent table for assayed content.
(*b*) Includes gold subsidy of $1,979 in 1970–71, $9,101 in 1971–72, and $36,361 in 1972–73.
(*c*) Under $1,000.
(*d*) Excludes unrefined kaolin used in producing kaolin at or near mine.
(*e*) Excludes limestone used as construction material.
(*f*) Excludes brown coal used in production of briquettes : 1970–71 : 4,012,000 tonnes ; 1971–72 : 3,632,000 tonnes ; and 1972–73 : 3,199,000 tonnes.
(*g*) Excludes manufactured liquefied petroleum gases and other derivatives from petroleum refining.
(*h*) Includes commercial gas and gas for field usage.

The assayed content of metallic minerals produced in the years 1970–71 to 1972–73 is shown in the following table :

VICTORIA—ASSAYED CONTENT OF METALLIC MINERALS

Metal or element and mineral in which contained	1970–71	1971–72	1972–73
Alumina (tonne)—			
Contained in bauxite	3,373	..	1,977
Antimony (tonne)—			
Contained in antimony concentrate	93	n.a.	..
Contained in antimony ore	259	n.a.	n.a.
Total antimony	352	59	n.a.
Copper (tonne)—			
Contained in copper concentrate	18	..	..
Contained in copper ore	22	..	..
Total copper	40	..	..
Gold (gm)—			
Contained in antimony concentrate	19,035	1,586	..
Contained in copper concentrate	715	..	..
Contained in gold bullion	163,076	191,970	141,054
Total gold	182,826	193,556	141,054
Iron (tonne)—			
Contained in bauxite	390	..	310
Contained in iron ore	172	71	322
Total iron	562	71	632
Lead (tonne)—			
Contained in lead concentrate	1	..	..
Palladium (gm)—			
Contained in copper concentrate	1,757	..	..
Platinum (gm)—			
Contained in copper concentrate	1,190	..	..
Silver (gm)—			
Contained in copper concentrate	5,412	..	..
Contained in gold bullion	218	8,305	3,732
Total silver	5,630	8,305	3,732
Tin (tonne)—			
Contained in tin concentrate	3	18	7

Source : Victorian Mines Department and Australian Bureau of Statistics.

The following table shows the average annual production and value of black and brown coal for each of the five year periods from 1926 to 1965 and the production and value for the years ended 31 December 1966 to 1968 and the years ended 30 June 1969 to 1973 :

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

(*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, 1965–1974; Mining in Victoria, 1964; Underground water, 1964; Groundwater in Victoria, 1969; Victorian clays, 1970; Brown coal, 1971; Minerals in Victoria, 1970; History of the Mines Department, 1970; Natural gas and crude oil development, 1972; Mineral exploration, 1972