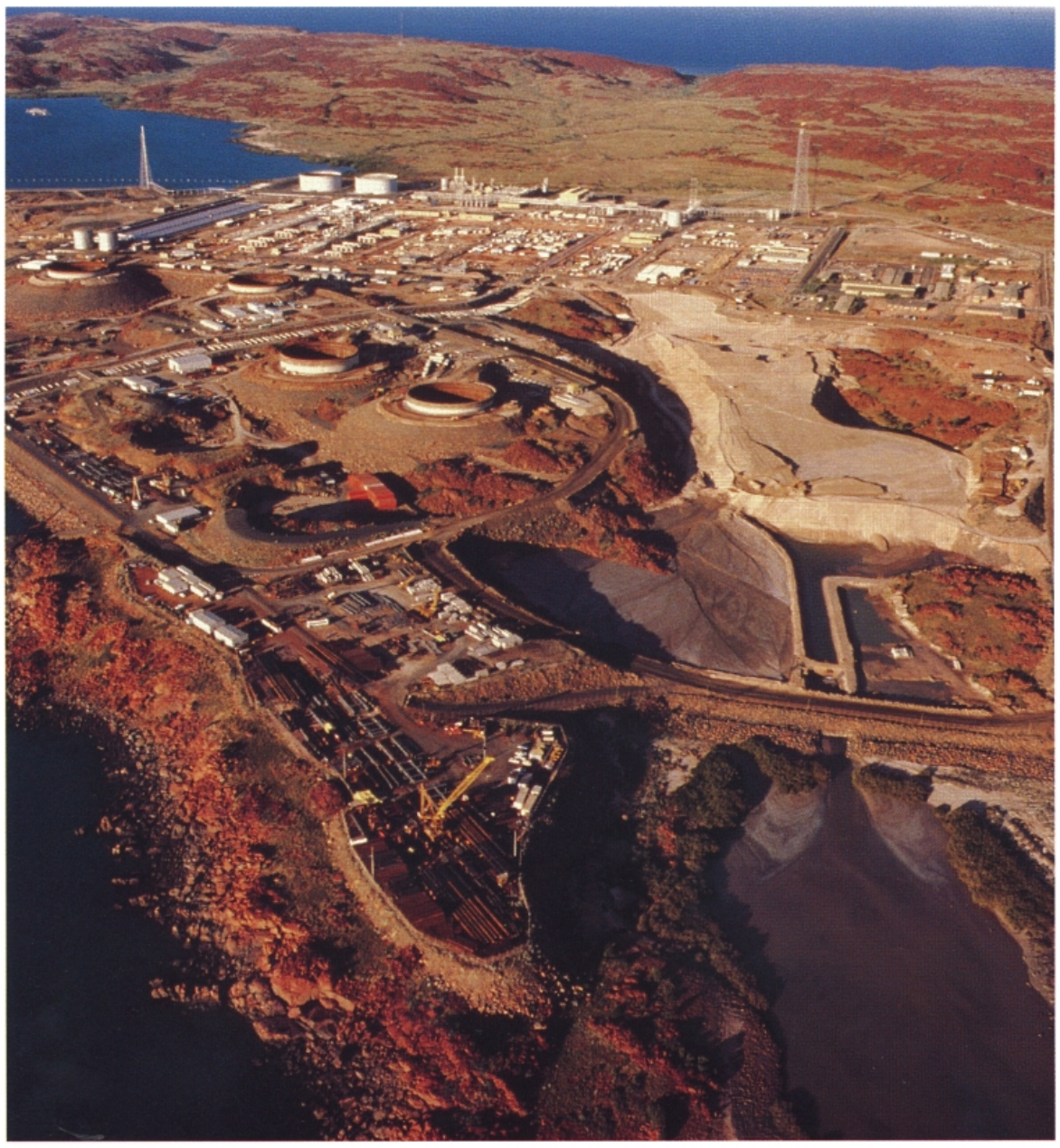

Liquefied natural gas plant under construction at Withnell Bay, Burrup Peninsula (W.A.)

This plant is an integral part of the giant North West Shelf natural gas project, based on the shipment of 6 Mt of LNG annually to Japan for at least 20 years.

Petroleum
(crude oil and natural gas)

Overall, Australia is currently about 90% self-sufficient in petroleum. Self-sufficiency in natural gas is likely to continue well into the future, given the vast known resources and projected level of domestic requirements. Australia also produces all of its requirements for light crude oil although the heavy crude oil required for fuel oil and lubricating feedstock needs to be imported.

Australia's demonstrated petroleum resources as at the end of 1986 are summarised in Table 11. Recent production by individual states is shown in Table 12.

The demand for light crude oil suitable for automotive consumption has been wholly met over the last few years by domestic output, principally from the Bass Strait oilfields off the coast of south-eastern Australia. However, production is expected to fall significantly after the end of the decade and, if new discoveries are not made beforehand, the current level of exports and self-sufficiency in light crude oil are unlikely to be maintained.

Before 1965 Australia depended almost entirely on imports of crude oil and petroleum products. Furthermore, natural gas was not available to any of the capital cities even though it had been used to generate electricity in Roma (Qld) since 1961.

Aided by the *Commonwealth Petroleum Search Subsidy Act*, in force from 1958 to 1974, active exploration in the 1960s resulted in the discovery of commercially viable oil and gas fields. Oil from Australia's first commercial field, discovered at **Moonie** in south-eastern Queensland in 1961, began flowing to Brisbane by pipeline in 1964 and the **Barrow Island** oilfield, off the north-west coast of Western Australia, commenced production in 1967. By 1969 pipelines linked natural gas fields in the **Roma area** to Brisbane and fields in the **Moomba area** to Adelaide. Two years later natural gas began flowing from the **Dongara area** to Perth.

The most important discoveries, however, were made in the **Bass Strait** area of the *GIPPSLAND BASIN*, where in 1964 the first well drilled intersected the **Barracouta** gas field in 46 m of water. Over the next few years significant oil and gas discoveries were made, including the large **Halibut** and **Kingfish** oilfields, and since 1969 Melbourne has been supplied with natural gas from Bass Strait.

Currently an estimated 50 000 t of crude oil and 15 million m^3 of natural gas are piped ashore each day to the **Longford** gas processing and crude oil stabilisation plant. The ethane and liquefied petroleum gas (LPG) removed from natural gas at Longford are piped to the **Long Island Point** fractionation plant on Western Port Bay for separation into propane, butane and ethane. Most of the propane and butane is exported to Japan while the ethane is sent to the Altona petrochemical complex by a submarine pipeline across Port Phillip Bay. Crude oil and condensate are also piped from Longford to Long Island Point. From here some is exported though most is shipped to refineries in other states or sent via an onshore pipeline to the refineries at **Altona** and **Geelong.**

Presently around 78% of domestically produced oil comes from the Bass Strait fields. However, more recent finds in the area have generally been much smaller than the early discoveries.

In the early 1960s impressive gas strikes were made in the *COOPER BASIN* in far north-eastern South Australia (**Moomba area**). Pipelines were built to connect gas fields in the area to Adelaide (1969) and to Sydney (1976). A branch line from the Moomba–Sydney pipeline to Canberra was completed in 1981.

The *COOPER* and *EROMANGA BASINS* are now the second largest producers of petroleum liquids in Australia, after Bass Strait. Oil and gas liquids from the Moomba area are transported by pipeline to **Port Bonython** on Spencer Gulf, where a fractionation plant has been established to separate LPG from crude oil and condensate. Commercial production of oil from the Jackson field in south-western Queensland commenced in 1981. A pipeline completed in 1984 now connects various fields in the **Jackson area** to Moonie, and on to Brisbane where the crude is refined.

In 1971 and 1972, after several years of exploration drilling, large natural gas fields were discovered along the North West Shelf off the Western Australian coast. These now include the **North Rankin**, **Goodwyn**, **Angel**, **Gorgon** and **West Tryal Rocks** fields in the *CARNARVON BASIN* and the **Scott Reef** and Brecknock fields in the *BROWSE BASIN*. As at the end of 1986 economically recoverable sales gas resources were estimated at 438 billion m^3 and subeconomic resources at a further 1083 billion m^3. In addition there are appreciable resources of condensate and LPG.

Because of the remoteness of the North West Shelf fields and the technical difficulties inherent in developing offshore resources in water as deep as that encountered in this area, production did not commence until 1984, when gas from North Rankin was first delivered to Perth via a 1600 km pipeline. The second phase of the North West Shelf Project, the largest single resource development in Australia's history, is scheduled to come on stream in late 1989 and is based on the export of up to 6 Mt a year of liquefied natural gas (LNG) from the North Rankin and Goodwyn fields to Japan for up to 25 years. By late 1987 expenditure on the LPG phase had already surpassed $2 billion.

The presence of substantial reserves of natural gas in the *AMADEUS BASIN* of the Northern Territory was proved in the mid 1960s but the remoteness of the area hindered development for many years. It was not until 1984 that **Palm Valley** began supplying gas by pipeline to Alice Springs. Since early 1987 natural gas has also flowed north to Darwin along a 1500 km pipeline from the Palm Valley and nearby **Mereenie** fields, initially to fuel the new Channel Island power station. Around the same time Mereenie oil began flowing by pipeline to Alice Springs for processing.

There have been several other notable petroleum developments and discoveries in Australia recently. Australia's most distant offshore oilfield—**Jabiru**, in the Timor Sea 600 km west of Darwin—began producing and exporting oil towards the end of 1986; planning is proceeding for development of the nearby **Challis** field. The small offshore **Harriet** oilfield, north-east of Barrow Island, began producing in early 1986; the South Pepper and North Herald oilfields, south-west of Barrow Island, are currently being developed.

On the opposite side of the continent the construction of a pipeline carrying natural gas from the Denison Trough gas fields in the *BOWEN–SURAT BASINS* to the alumina refinery at Gladstone has been approved.

Exploration has also indicated gas reserves with potential for future development in the **Petrel** and **Tern** fields in Joseph Bonaparte Gulf off the northern Australian coast.

Australia's eight oil refineries are all located in or close to the five largest capital cities. They have a combined daily primary processing capacity of between 110 500 and 118 300 m^3, the actual capacity at any particular time depending on the type of crude oil being processed. About a quarter of the oil (mostly heavy crude) consumed by domestic refineries is imported from overseas.

Hydrocarbon processing centre at Moomba, 750 km north of Adelaide (S.A.) *Moomba is the focal point of the Cooper Basin Liquids Project. Since 1969 a natural gas plant has processed gas from nearby fields for piping to Adelaide and subsequently, Sydney–Newcastle–Wollongong and Canberra. The more recent development of adjacent oilfields, and 'wet' gas fields containing a high proportion of condensate, has led to the establishment of additional treatment facilities including a crude stabilisation plant and a liquids recovery plant. Gas, crude oil and natural gas liquids are separated and stabilised; the liquids are then piped south to Port Bonython.*

Table 11. Australia's petroleum resources, 1986*

Basin	*Crude oil* (million m^3)	*Natural gas* (billion m^3)	*Condensate* (million m^3)	*LPG* (million m^3)
Economic				
Amadeus/Bonaparte	10	187	3	12
Bowen	—	1	—	—
Canning	1	—	—	—
Carnarvon	24	438	84	28
Cooper	4	85	7	14
Eromanga	11	2	—	—
Gippsland	192	186	22	45
Perth	—	2	—	—
Surat	—	1	—	—
Sub-total	242	902	116	99
Subeconomic				
Adavale	—	1	—	—
Amadeus	—	10	—	1
Bass	1	8	8	5
Bonaparte	1	44	7	3
Bowen	—	5	—	—
Browse	—	683	45	—
Carnarvon	6	400	4	2
Cooper	—	15	2	2
Gippsland	11	21	—	—
Perth	1	—	—	—
Sub-total	20	1 187	66	13
Total	**262**	**2 089**	**182**	**112**

*Demonstrated recoverable resources as at December 1986

Table 12. Field production of petroleum products, 1984–86

	Crude oil (thousand tonnes)			*Natural gas** (million m^3)			*Condensate* (thousand tonnes)			*LPG*† (thousand m^3)		
State	*1984*	*1985*	*1986*	*1984*	*1985*	*1986*	*1984*	*1985*	*1986*	*1984*	*1985*	*1986*
Queensland	618	1 171	1 386	449	490	512	19	36	44	—	51	76
Victoria	19 586	22 022	17 882	5 703	5 276	5 638	636	545	559	3091	3110	2859
South Australia	796	994	1 187	5 022	5 281	5 365	339	578	590	299	969	995
Western Australia	984	984	1 305	1 414	2 393	3 147	64	207	320	2	1	—
Northern Territory	20	106	414	13	30	46	—	—	—	—	—	—
Total	**22 004**	**25 277**	**22 174**	**12 601**	**13 470**	**14 708**	**1058**	**1366**	**1513**	**3392**	**4132**	**3931**

* Sales gas and gas used in field and plant operations
† Includes field and plant use

Economic demonstrated resources are resources judged to be economically extractable. The quantity and quality are computed partly from specific measurements and partly from extrapolation for a reasonable distance on geological evidence.

Subeconomic demonstrated resources are similar to economic demonstrated resources in terms of certainty of occurrence. Though they are considered to be potentially economic in the foreseeable future they are judged to be subeconomic at present.

Petroleum occurs naturally as a gas (natural gas), a liquid (crude oil) or a solid (bitumen). It is composed of chemical compounds of hydrogen and carbon (hydrocarbons).

Crude oil is petroleum that exists as a liquid in natural underground reservoirs and remains liquid in atmospheric conditions. The chief product from crude oil, when it is refined, is petrol. Other products include diesel fuel, aviation turbine fuel, oils, greases, and raw materials for plastics, detergents, paints, weed killers, etc.

Natural gas exists as a gas or in solution in crude oil in natural underground reservoirs. It consists mainly of methane and ethane, together with some LPG, condensate, nitrogen and carbon dioxide. In addition to being a valuable domestic and industrial fuel, natural gas is used as a feedstock in the petrochemical industry.

Liquefied petroleum gas (LPG) is a mixture of heavy hydrocarbon gases and consists mainly of propane and butane. LPG is either naturally occurring (that is, derived by separation during field production of crude oil or natural gas) or a by-product of oil refining. LPG can be easily compressed into its liquid form for storage and transport to markets. LPG is widely used in Australia and it is also exported.

Condensate is a liquid consisting mainly of pentanes and heavier hydrocarbons. It exists as a part of the natural gas in the reservoir but is liquid at surface temperatures and pressures.

Liquefied natural gas (LNG). For natural gas to be readily transportable to overseas markets it is necessary to reduce its volume, as is the case with LPG. However, the liquefying of natural gas is a difficult and expensive operation involving lowering its temperature to −240°C in large scale refrigeration plants. The first installation of its kind in Australia for this purpose is being built at **Withnell Bay** near Dampier (W.A.) to supply LNG from the North West Shelf fields to Japan.