CHAPTER 18

ELECTRIC POWER

This chapter is divided into three major parts: the Introduction, which deals briefly with the resources, generation and distribution, and future development of electric power in Australia; the Snowy Mountains Hydro-electric Scheme; and the origins, development, present situation and new projects of electrical systems in each Australian State and internal Territory.

The information contained in the chapter relates to situations existing and projects contemplated, and may be considerably affected by changes in policy or plans, or by developments in the projects themselves. Greater descriptive and historical detail about the various systems is contained in earlier issues of the Year Book. For further details *see also* the annual reports of the respective authorities. Statistics on the electricity industry are included in tables in Chapter 17, Manufacturing and Internal Trade.

INTRODUCTION

Distribution of population and location of electric power resources in Australia

The two principal centres of population and industry in Australia, the metropolitan areas of Sydney and Melbourne, make the greatest demands for electric power, and their growth has been associated with the development of large deposits of coal located relatively close to the source of demand. This, together with the fact that the major water resources are also located in the south-eastern portion of Australia, materially influences the distribution of industrial population and the location of major electric power stations. By far the most important source of energy used in the production of electric power in Australia is coal.

Most of Australia is poorly supplied with water; only about 13 per cent receives an annual rainfall of 750 mm or more, and these areas are confined largely to Tasmania and to the narrow coastal strip along the east coast of the mainland. The only region on the mainland of Australia high enough to receive reliable winter snowfall, and from which, therefore, reasonably constant water supplies throughout the year can be expected, is the mountain chain which stretches from the high plateaux of south-eastern New South Wales to the north-eastern highlands of Victoria. The hydro-electric potential of this area is considerable; the two major projects in the area are the Snowy Mountains and Kiewa Schemes. Other hydro-electric potential does exist on the mainland on the rivers of the coastal areas of New South Wales and Queensland, but the amount available is smaller than the potential of the Alpine region. In Tasmania, hydro-electric resources have been estimated at about 50 per cent of the total Australian hydro-electric potential. On the mainland the chief source of energy is coal; in Tasmania it is water.

Electric power generation and distribution

At the beginning of this century Australia's electrical undertakings were carried on mainly by private enterprise, but with some measure of government control designed to provide standards of safety and to define the scope and obligations of the private organisations. A trend towards public ownership commenced during the 1914–18 War and became more pronounced after the 1939–45 War. By 1961 all major generating stations supplying the public were, in varying degrees, under the control of statutory organisations constituted with the object of unifying and co-ordinating the generation and distribution of electricity supplies. There are still a large number of small private and municipal enterprises generating power for supply to country towns, although central authorities are extending supply to these places wherever practicable. In many areas it has been, and remains, the practice for central authorities to sell power in bulk to local distributing organisations which undertake reticulation.

In addition to the private, local government and statutory organisations which generate and/or distribute electricity for sale, numerous firms generate power for use in their own establishments, particularly those engaged in mining remote from the main centres of population. This chapter, however, is concerned mainly with the activities of central electric stations, as the power regularly produced for such internal consumption is, in any case, a relatively small proportion of the total power produced. The measures taken by authorities to satisfy the demand created by the post-war growth in population and building and by developments in industry and commerce are described in the following pages.

SNOWY MOUNTAINS HYDRO-ELECTRIC SCHEME*

Snowy Mountains Hydro-electric Power Act 1949

In July 1949 the Commonwealth Government established the Snowy Mountains Hydro-electric Authority, and empowered it: to generate electricity by means of hydro-electric works in the Snowy Mountains Area; to supply electricity to the Commonwealth Government (i) for defence purposes, (ii) for consumption in the Australian Capital Territory; and to supply to a State, or to a State Authority, electricity not required for defence purposes or for consumption in the Australian Capital Territory.

The Snowy Mountains Act is supported by a detailed agreement between the States of New South Wales and Victoria and the Commonwealth Government with regard to the construction and operation of the Scheme, the distribution of power and water, charges to be made for electricity, and other such matters. The Snowy Mountains Council, established under the terms of the Agreement and consisting of representatives of the Commonwealth Government, the Authority and the two States, directs and controls the operation and maintenance of the permanent works of the Authority and the allocation of loads to generating stations.

Snowy Mountains Hydro-electric Scheme

The broad basis of the Snowy scheme is to transfer waters, which would otherwise flow to the sea unharnessed, from the Snowy River and its tributaries to the inland system so that the water may be used for irrigation and to provide power. It involves two main diversions: the diversion of the Eucumbene, a tributary of the Snowy, to the Upper Tumut River; and the diversion of the main stream of the Snowy River at Island Bend and Jindabyne to the Swampy Plain River. These two diversions divide the scheme geographically into two sections: the Snowy–Tumut Development and the Snowy–Murray Development (*see* plate 38 opposite). For purposes of both power production and irrigation it is necessary to regulate run-off, and this is achieved by the use of Lake Eucumbene (formed by the construction of Eucumbene Dam) and other storages to control the waters of the Eucumbene, Murrumbidgee, Tooma, and Tumut Rivers for the Snowy–Tumut Development and of the Snowy and Geehi Rivers for the Snowy–Murray Development. A sectional diagram of the scheme appears on plate 39, page 446.

Snowy–Tumut Development. This development comprises works for the diversion and regulation of the waters of the Eucumbene, Upper Tooma, Upper Murrumbidgee, and Upper Tumut Rivers and their combined development through a series of power stations down the Tumut River. A major dam has been constructed on the Eucumbene River to create Lake Eucumbene, which has an ultimate useable storage of 4,300 million cubic metres. The waters of the Upper Murrumbidgee River are diverted into Lake Eucumbene by a dam at Tantangara and a 17-kilometre tunnel from Tantangara Reservoir. From Lake Eucumbene the water flows through a 23-kilometre tunnel to Tumut Pond Reservoir on the upper reaches of the Tumut River, where it joins the waters of the Tumut River itself and the waters of the Tooma River diverted to Tumut Pond Reservoir by a diversion dam and a 14-kilometre tunnel.

From Tumut Pond Reservoir water is conveyed by pressure tunnel to Tumut 1 underground Power Station (capacity 320 MW), returned to the Tumut River, and then conveyed by another pressure tunnel to Tumut 2 underground Power Station (capacity 280 MW), thence discharging into Talbingo Reservoir, again on the Tumut River.

Tumut 3 Power Station, the largest station of the scheme (generating capacity 1,500 MW and pumping capacity 300 cubic metres per second), has been constructed below Talbingo Reservoir and discharges into Jounama Pondage on the Tumut River. This pondage provides a downstream pumping pool and also regulates discharges from Tumut 3 Power Station as required. Releases from Jounama Pondage then enter Blowering Reservoir formed by Blowering Dam. This dam, constructed by the Snowy Mountains Authority as an agent for the State of New South Wales, provides for the regulation of power station discharges for irrigation use in the Murrumbidgee Valley. The Authority has constructed a power station at the foot of the dam to generate power from releases of water for irrigation purposes.

Snowy–Murray Development. The principal features of the Snowy–Murray Development are the diversion of the main stream of the Snowy River by tunnels, shafts, and pipelines westwards through the Great Dividing Range into the Swampy Plain River in the catchment of the Upper Murray, and the development of power on the western slopes of the Alps. The main works of the development are as follows:

(*a*) A tunnel from the Snowy River near Island Bend through the Great Dividing Range to Geehi Reservoir on the Geehi River, and two power projects between Geehi Reservoir and the Swampy Plain River near Khancoban. The power stations associated with these two power projects, Murray 1 and Murray 2, have a combined capacity of 1,500 MW.

* *See also* Chapter 15 Water Resources, Sewerage and Drainage of this issue and the special detailed article in Year Book No. 42, pp. 1103–30.

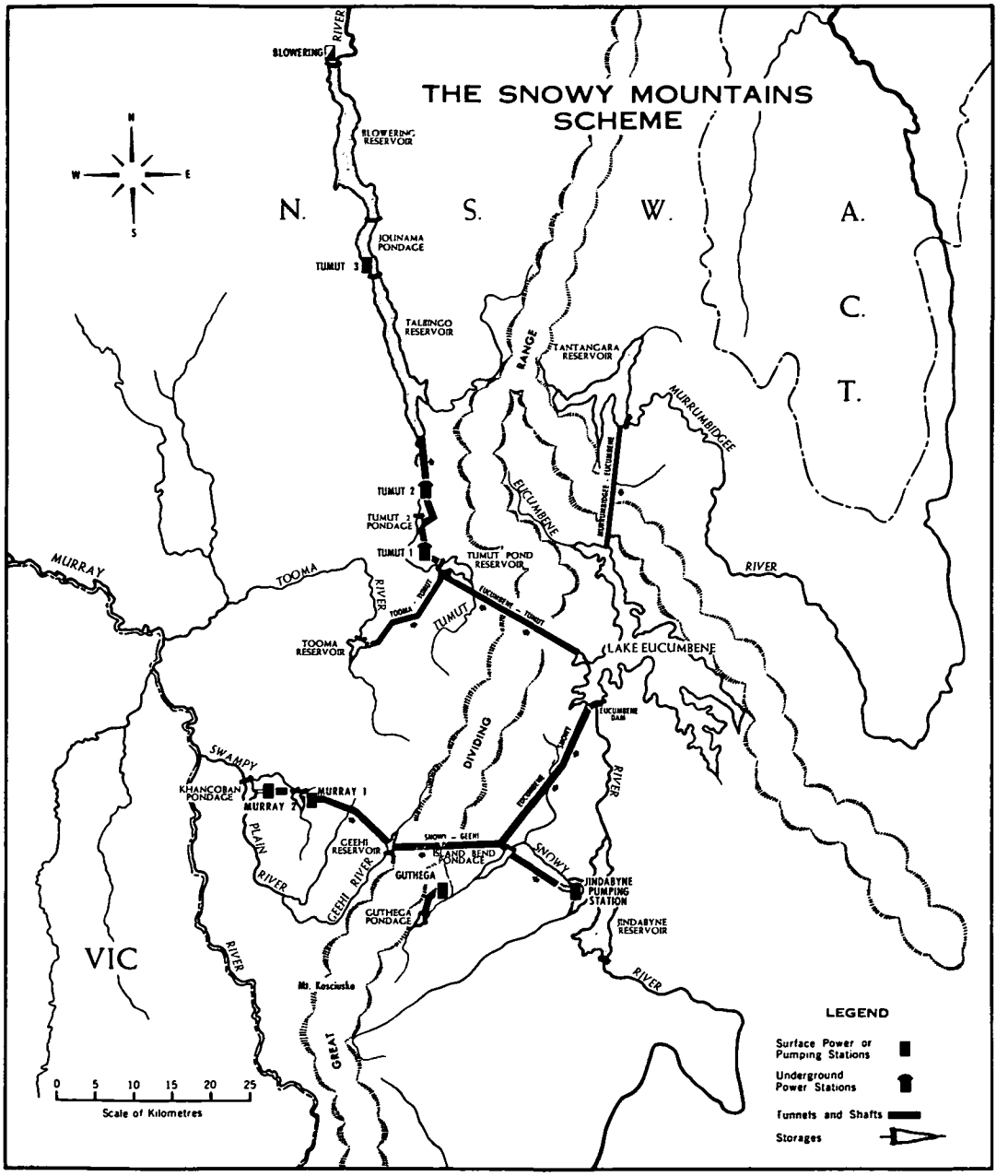
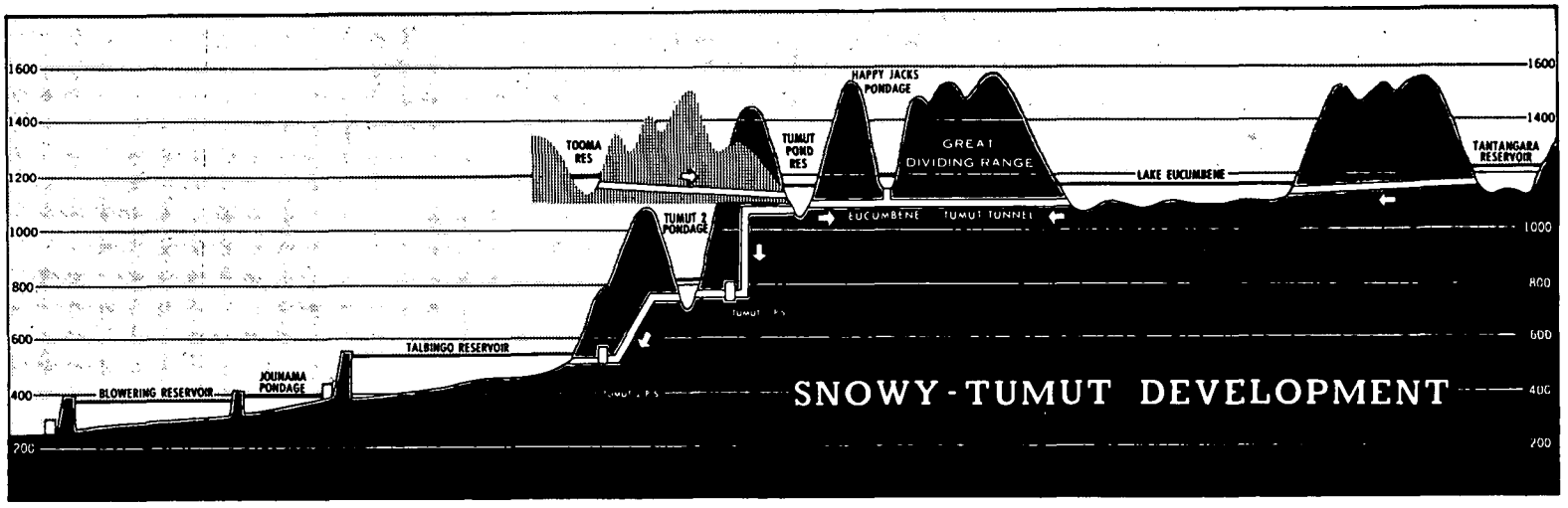

THE SNOWY MOUNTAINS SCHEME
N. S. W. A.
C. T.
VIC
BLOWERING RIVER
BLOWERING RESERVOIR
JOUNAMA PONDAGE
TUMUT 3
TALBINGO RESERVOIR
TANTANGARA RESERVOIR
RANGE
MURRUMBIDGEE
EUCUMBENE
TUMUT 2
TUMUT 3 PONDAGE
TUMUT 1
TUMUT POND RESERVOIR
MURRAY
TOOMA RIVER
TOOMA RESERVOIR
TUMUT
LAKE EUCUMBENE
EUCUMBENE DAM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

PLATE 38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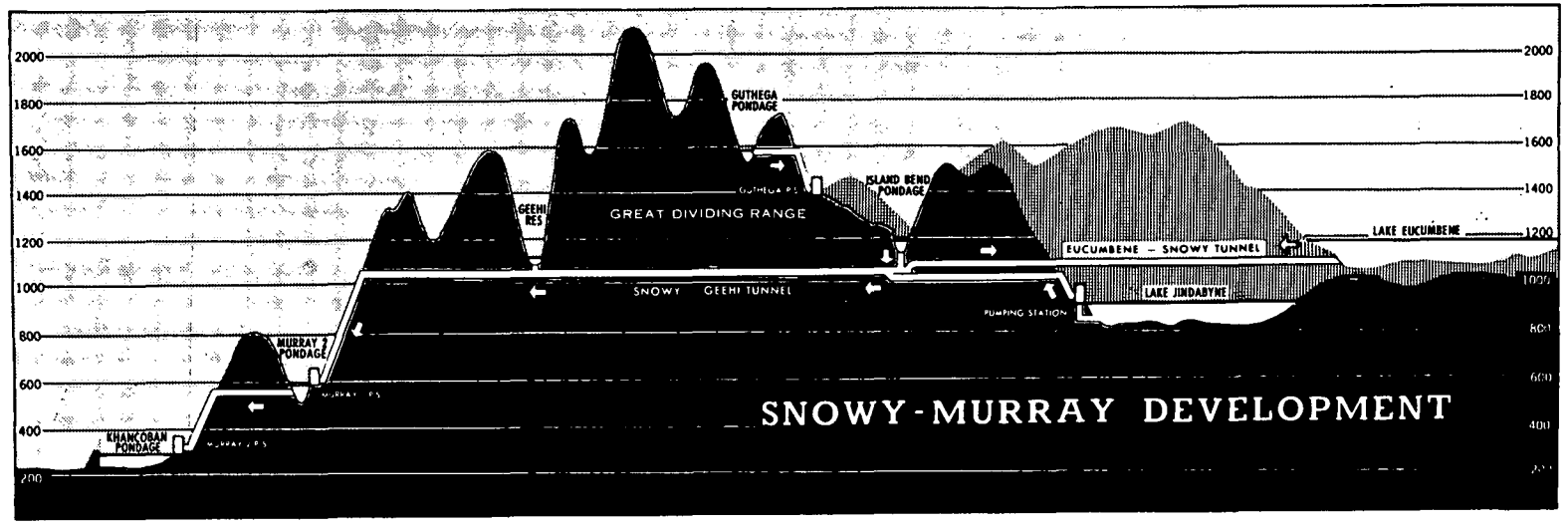
LAKE EUCUMBENE
TANTANGARA
RESERVOIR
TUMUT 2
PONDAGE
EUCUMBENE TUMUT TUNNEL
TUMUT P/S
TALBINGO RESERVOIR
JOUNAMA
PONDAGE
BLOWERING RESERVOIR
TUMUT P/S
SNOWY-TUMUT DEVELOPMENT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GUTHEGA
PONDAGE
GUTHEGA P/S
ISLAND BEND
PONDAGE
GEEHI
RES
GREAT DIVIDING RANGE
LAKE EUCUMBENE
EUCUMBENE - SNOWY TUNNEL
SNOWY GEEHI TUNNEL
LAKE JINDABYNE
PUMPING STATION
MURRAY 2
PONDAGE
MURRAY P/S
KHANCOBAN
PONDAGE
MURRAY P/S
SNOWY-MURRAY DEVELOPMENT

(*b*) A tunnel from a dam on the Snowy River near Island Bend to Eucumbene Dam to carry Snowy water to Lake Eucumbene for storage at times of high river flows. When river flows are lower than average, this stored water is returned towards Island Bend and thence through the Snowy–Geehi Tunnel to Geehi Reservoir and Murray 1 and Murray 2 Power Stations.

(*c*) A dam on the Snowy River near Jindabyne to store the residual flow of the Snowy and Eucumbene Rivers downstream from Island Bend and Eucumbene Dams, including the flows of major tributaries, the Crackenback and Mowamba Rivers; and a pumping plant, pipeline and tunnel to lift this water from Jindabyne Reservoir to the Snowy–Geehi Tunnel near Island Bend, where it joins the flow to the Geehi Reservoir for use through Murray 1 and Murray 2 Power Stations.

The power output of this section of the Scheme is increased by the Guthega Project, a subsidiary hydro-electric project on the Upper Snowy River above Island Bend with a generating capacity of 60 MW.

Utilisation of power from scheme

The future electric power plants on the mainland of Australia will be predominantly thermal or thermo-nuclear installations, and in an electrical system in which the greater part of the energy is generated in thermal plants it is usually found that the hydro installations operate to the best advantage on peak load. However, the existing New South Wales and Victorian systems include a proportion of relatively old and less efficient installations which, for reasons of fuel economy, are also best used for the production of peak load power. Therefore, in order to utilise the potential of the Snowy Mountains Scheme most effectively, the order of development was arranged so that the early stations operated, initially, somewhat below the peak of the system load, with a progressive change to predominantly peak load operation as construction proceeded and as the load increased in magnitude.

The Snowy Mountains Scheme is situated about midway between the principal load centres of Sydney and Melbourne and is connected to those cities by 330kV transmission lines. It is, consequently, in a position to take advantage of the diversity in the power requirements of these two load systems, a most important factor in so far as it affects the economy of operation of the supply systems of the two States. The average energy generated by the Snowy Mountains Hydro-electric Scheme is 5,070 GWh a year. The Commonwealth Government reserves 670 GWh for supply to the A.C.T.; Victoria receives one-third of the surplus and N.S.W. is entitled to the other two-thirds. For convenience, the Commonwealth Government's requirements are drawn from the New South Wales transmission network by an exchange arrangement between the Commonwealth Government and the Electricity Commission of New South Wales. Electricity over and above that required by the Commonwealth Government is divided between the States of New South Wales and Victoria in the ratio 2:1.

Progress of the scheme

The Scheme's first power station, Guthega, of 60 MW capacity came into operation in February 1955. It was followed by Tumut 1, an underground power station with a capacity of 320 MW, in 1959, and by the 280 MW Tumut 2 underground Power Station in 1962. Eucumbene Dam, which provides the major regulating storage for the Scheme, was completed in May 1958. Tumut Pond Dam, completed in September 1958, provides the balancing storage for the power stations of the Upper Tumut Works. The first trans-mountain diversion of water from Lake Eucumbene to the Tumut River at Tumut Pond was made possible when the 23 kilometre Eucumbene–Tumut Tunnel was completed in June 1959. The 17 kilometre Murrumbidgee–Eucumbene Tunnel and the 14 kilometre Tooma–Tumut Tunnel came into operation early in 1961. Following the completion of the Upper Tumut Works, construction activity was concentrated on the Snowy–Murray Development. The first unit of this development, the Eucumbene–Snowy project which comprises Island Bend Dam and the 24 kilometre Eucumbene–Snowy Tunnel, commenced diverting Snowy River water to storage in Lake Eucumbene in August 1965. Completion of a 14 kilometre trans-mountain Snowy–Geehi Tunnel, the 12 kilometre Murray 1 Pressure Tunnel, the first of the 1.6 kilometre long Pressure Pipelines, and the first two units of the 950 MW Murray 1 Power Station in April 1966 allowed the first diversion of the water from the Snowy River to the Murray River in the west. All of the ten turbo-generators were brought into commercial operation with the opening of the Murray 1 Project in July 1967.

Khancoban Dam, designed to regulate power station releases before their discharge into the Murray River, was completed in February 1966. The Murray 2 Project, in the base of the open cut excavated in the bank of Khancoban Reservoir downstream of Murray 1 Project, was completed in 1969. The four units of Murray 2 Power Station totalling 550 MW came into commercial operation in October 1969. Construction is also complete on the Jindabyne Project. The earth and rockfill dam was completed in September 1967, and the pumping station and Jindabyne-Island Bend Tunnel came into service in February 1969.

Blowering Dam on the Tumut River came into service in May 1968, and the 80 MW Blowering Power Station began commercial operation in August 1971.

The total installed capacity of the Scheme has now reached 3,740 MW.

For the Tumut 3 Project the construction of Jounama Dam was completed in 1968 so that the storage of water in Blowering Dam could commence. Talbingo Dam was completed in October 1970 and Tumut 3 Power Station was officially opened in October 1972 with two generators in operation. The succeeding four generators were brought into service to achieve full operation in 1974.

STATES AND TERRITORIES

New South Wales

In Year Book No. 39 an account was given in some detail of the origin and development of electricity generation and distribution in New South Wales. At present the following five Acts govern electricity supply in New South Wales:

The *Local Government Act, 1919*, which lays down the various rights and reponsibilities of local government bodies in the establishment and operation of electricity trading undertakings;

The *Gas and Electricity Act, 1935*, which established the Sydney County Council and which is responsible for the distribution of electricity in a large part of the Sydney metropolitan area, and which also amended the Local Government Act in certain respects;

The *Electricity Development Act, 1945*, which established the Electricity Authority of New South Wales as the body responsible for the promotion, regulation and co-ordination of electricity supply throughout the State including matters relating to electrical safety;

The *Electricity Commission Act, 1950*, which constituted the Electricity Commission of New South Wales as the major generating and bulk transmission authority; and

The *Energy Authority Act, 1976*, which constituted the Energy Authority of New South Wales which took over certain emergency powers previously exercisable by the Electricity Commission.

Electricity Commission of New South Wales and electricity supply authorities

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

The retail sale of electricity to the public is, in general, carried out by separate electricity supply authorities. At 30 June 1975 there were 41 retail supply authorities throughout the State, comprising 34 electricity county councils (consisting of groups of shire and/or municipal councils), 2 city councils, 1 municipal council, 2 shire councils, and 2 private franchise holders. In addition to the Electricity Commission, 2 coal companies supply electricity in bulk to retail supplying authorities. Most of the small power stations which operated in many country centres have closed down as the main transmission network has been extended.

Most electricity distribution areas have been consolidated into county districts consisting of a number of neighbouring local government areas grouped for electricity supply purposes and administered by a county council comprising representatives elected by the constituent councils. Of the 222 cities, municipalities and shires in New South Wales, 215 are included in one or other of the 34 electricity county districts.

The Electricity Authority of New South Wales

The *Electricity Development Act, 1945*, confers broad powers on the Electricity Authority to co-ordinate and develop the public electricity supply industry. The functions of the Authority include the promotion of the use of electricity, especially its use for industrial and manufacturing purposes and for primary production. Technical advice is given to retail electricity supply authorities on various aspects of their activities such as the framing of retail electricity tariffs, public lighting and the standardising of materials and equipment. The Authority acts in an advisory capacity to the Minister for Mines and Energy on electricity distribution matters generally, and may make recommendations concerning the organisation of distribution, the amendment of the law relating to the generation, transmission, distribution and supply of electricity, or on any other matters affecting the electricity distribution industry.

The Authority administers the Rural Electricity Subsidy Scheme under which the rural electrical development of the State has now been virtually completed where the extension of supply is economically feasible. Under the subsidy scheme, local electricity suppliers receive subsidies from

the Authority towards the cost of new rural lines. At 30 June 1975 the Authority was committed to the payment of $40,494,143 in subsidies, of which $34,567,374 had been paid. Further details of the operation of the scheme are given in Year Book No. 56, page 956.

The *Electricity Development Act* contains provisions for the making of regulations relating to most aspects of electrical safety. Regulations now in force cover such matters as consumers' installations, licensing of electricians and electrical contractors, approval of electrical articles, safety of linesmen, and overhead line construction and maintenance. In addition, a number of aspects not governed by legislation are covered by codes of practice or recommended procedures.

The Authority also administers the Traffic Route Lighting Subsidy Scheme, which provides for financial assistance to councils towards the cost of installation of improved lighting on traffic routes traversing built-up areas with the objective of reducing the incidence of night road accidents. Since the introduction of the scheme in 1964, subsidy has been approved in respect of some 1,601 kilometres of traffic routes throughout the State.

Generation and transmission

Of the State's electrical power requirements during the year ended 30 June 1977, almost all was generated in New South Wales (86.6 per cent by coal fired power stations, 0.3 per cent by internal combustion plants, 12.1 per cent from the Snowy Mountains Hydro-Electric Authority and 1.2 per cent by other hydro-electric stations). Net interstate exports of electricity accounted for the remaining 0.2 per cent.

Major generating stations. At 30 June 1977 the major power stations of the State system of the Electricity Commission of New South Wales and their nominal capacities were as follows: Liddell (Hunter Valley), 2,000 MW; Munmorah (Tuggerah Lakes), 1,400 MW; Vales Point (Lake Macquarie), 875 MW; Wangi (Lake Macquarie), 330 MW; Tallawarra (Lake Illawarra), 320 MW; Wallerawang (near Lithgow), 740 MW; Pyrmont (Sydney), 200 MW. The total nominal capacity of the Electricity Commission's system as at 30 June 1977 was 6,389 MW. The greater part of the Commission's generating plant is concentrated within a one hundred and eighty-five kilometre radius of Sydney.

Major transmission network. The retailing of electricity to 97 per cent of the population of New South Wales is in the hands of local distributing authorities, which obtain electricity in bulk from the Commission's major State network. This network of 330 kV, 132 kV, 66 kV and some 33 kV and 22 kV transmission lines links the Commission's power stations with the load centres throughout the eastern portions of the State, extending geographically up to 650 kilometres inland.

At 30 June 1977 there were in service 3,437 circuit kilometres of 330 kV and 6,599 kilometres of 132 kV transmission lines (including 206 kilometres operating for the time being at 66 kV). There were also in service 4,543 kilometres of transmission line of 66 kV and lower voltages, and 449 kilometres of underground cable. The installed transformer capacity at the Commission's 162 sub-stations was 23,546 MVA.

Separate systems and total State installed capacity. Several local government bodies operate their own power stations and generate portion of their requirements which is supplemented by interconnection with the system of the Electricity Commission. Of these, the more important are the Northern Rivers County Council (installed capacity 28.75 MW) and the North-West County Council (15 MW). In addition, a private company operates small stations supplying the towns of Ivanhoe and Wilcannia. The aggregate effective capacity for the whole of New South Wales systems and isolated plants was approximately 6,493 MW at 30 June 1975, while the number of ultimate consumers at this date was 1,789,337.

Future development

The major thermal stations at Liddell, Munmorah and Vales Point and those at Wangi, Tallawarra and Wallerawang are the main base load supply sources for the State.

The first 500 MW generating unit of the Liddell Power Station in the Hunter Valley was commissioned in 1971, followed by the second in 1972 and the third and fourth in 1973, making a total capacity of 2,000 MW. A 500 MW unit was brought into service at Wallerawang in 1976.

Future projects include the installation of two 660 MW units at Vales Point to be in operation in 1978. A further 500 MW unit is to be installed at Wallerawang in 1981. Two 660 MW units are scheduled to be installed at a new power site at Eraring in the early 1980's, to be followed by a further two units at the same site.

The development of the 330 kV main system is continuing. Work in progress includes the construction of major 330 kV transmission lines from Wallerawang to Sydney South. A new 330 kV substation has been commissioned at Sydney East and a new 330 kV substation at Beaconsfield West is being established. Other work is in progress and being planned throughout the State to augment the transmission system.

Hydro-electricity

The greater part of the hydro-electric potential of New South Wales is concentrated in the Snowy Mountains area (*see* Snowy Mountains Hydro-electric Scheme, page 444). Apart from this area, major hydro-electric stations are in operation at the Warragamba Dam (50 MW) and Hume Dam (50 MW). In addition, there are six smaller hydro-electric installations in operation in various parts of the State. A pumped-storage hydro-electric system to produce 240 MW is being installed as part of the Shoalhaven Scheme in conjunction with the Metropolitan Water Sewerage and Drainage Board.

Victoria

A detailed description is given in Year Book No. 39 of the development of the generation and supply of electricity in the cities of Melbourne, Geelong, Ballarat and Bendigo to the time of the creation of the State Electricity Commission in 1921 and the early development of the Commission's undertakings.

State Electricity Commission of Victoria

Established under earlier legislation and currently operating under the provisions of the *State Electricity Commission Act* 1958, No. 6377 as a semi-government authority, the Commission is administered by a full-time Chairman and three part-time Commissioners. The Minister for Minerals and Energy is responsible under the *Minerals and Energy Act* 1976 for the operations of the Commission.

The principal function of the Commission is to generate or purchase electricity for supply throughout Victoria. For this purpose it is vested with the authority to own, erect and operate power stations and other electrical plant and installations; and to supply electricity to individual consumers or in bulk to any public institution or corporations and municipalities which have a franchise to sell direct to customers. The Commission may own, develop and operate brown coal open cuts, and briquetting plant and develop the State's hydro-electric resources. The Commission is required to meet from its own revenue, which it controls, all expenditure involved in operating its power and fuel undertakings and to provide for statutory transfers to the Consolidated Revenue fund of the State.

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

Since it began operating in 1921 the Commission has expanded and co-ordinated the generation, purchase and supply of electricity on a State-wide basis to the stage where its system generates almost all the electricity produced in Victoria (which has an area of 228,000 sq km) and the transmission network covers practically the entire population of the State. As at 30 June 1976, the Commission had total assets of $1,436 million, employed 18,572 persons, had a total income of $398.2 million and, during the preceding twelve months, had increased sales of electricity by 4.8 per cent.

Victoria's electricity system is based on the utilisation of the extensive brown coal deposits in the La Trobe Valley in Central Gippsland, about 140 to 180 km east of Melbourne. These deposits total about 108,000 megatonnes, of which about 12,000 megatonnes are commercially recoverable at present day costs.

In 1975–76 the output of brown coal from the Commission's three open cuts at Yallourn, Yallourn North and Morwell totalled 28.1 megatonnes of which 25.3 megatonnes were used in the Commission's power stations. A further 2.5 megatonnes were used to produce 1.0 megatonne of briquettes and .24 megatonne was sold to the public. Sales of briquettes to the public totalled 782,000 tonnes, producing an income of $11.1 million. Apart from the brown coal, 164 kilotonnes of briquettes and 25.0 kilotonnes of fuel oil were used as fuel in power stations.

Electricity generation, transmission and supply

In 1975–76 the Commission generated in its thermal and hydro-electric power stations, or purchased, 18,900 GWh. The total installed generating plant capacity at 30 June 1976 was 4,745 MW, inclusive of the capacity both within the State and available to Victoria from New South Wales.

The power stations are interconnected and feed electricity into a common pool for general supply. The major generating plant in the interconnected system is the 1,600 MW Hazelwood base load, brown-coal-fuelled power station near Morwell in the La Trobe Valley, which alone generates over 50 per cent of Victoria's electricity. Other brown coal power stations in the interconnected system comprise the established base load stations at Morwell and Yallourn and the partially completed Yallourn 'W' station. Peak load steam stations are located in Melbourne (Newport, Richmond and

Spencer Street). Hydro-electric stations are located at Kiewa, at Eildon, on the Rubicon and Royston Rivers near Eildon and at Cairn Curran. All generators for public supply within Victoria are owned by the Commission except Spencer Street Power Station, which remains the property of the Melbourne City Council although operated as a unit of the interconnected system.

Generation in thermal stations is supplemented by supply from the Commission's hydro stations in the mountains in the north east of the State and by entitlements from the Snowy Mountains Hydro-electric Scheme in south-eastern New South Wales (one third of output after provision for the Commonwealth Government's needs) and the Hume Power Station on the Murray River boundary with New South Wales (half of output). The Snowy Mountains Scheme is linked to the Victorian system by a 330 kV transmission line which allows for a two-way interchange with New South Wales.

At 30 June 1976 the electrical transmission and distribution system in the State supply network comprised 105,027 km of overhead lines and 2,928 km of underground lines. There are 4 auto-transformation stations, 26 terminal substations, 173 zone substations and 74,340 distribution substations. Transmission is mainly by 500, 330, 220 and 66 kV lines which supply the principal distribution centres and provide interconnection between the power stations. The total length of the 500, 330 and 220 kV lines is 3,691 km.

The Commission sells electricity retail in all Victorian supply areas except for eleven Melbourne metropolitan municipalities. These municipalities purchase electricity in bulk from the Commission and retail it to approximately 270,000 customers within the municipalities concerned under franchises granted by the Victorian Government before the Commission was established in 1921. Bulk supply is also provided to several municipalities in New South Wales and to a number of towns and areas bordering the Murray River.

Complete electrification of the State has virtually been achieved and only a few remote areas do not receive supply. At 30 June 1976 the Commission had 1,187,200 retail customers excluding bulk sales, and the income derived was $309.3 million. There were 1,007,600 domestic, 83,300 industrial and 96,000 commercial consumers. In country areas electricity was supplied to about 75,000 farms. Sales of electricity during the period, including bulk supplies, totalled 14,907 kWh and produced total income of $382 million.

Retail supply is administered through the Melbourne metropolitan branch and nine extra-metropolitan branches at Geelong, Ballarat, Bendigo, Dandenong, Traralgon, Mildura, Colac and Horsham. District supply offices are located in Melbourne and all other major cities and towns in the State.

Current and future development

The only power station currently under construction is Yallourn W in the La Trobe Valley. It is designed as a 4 unit, base load station of 1,450 MW capacity fuelled by brown coal. The first two 350 MW units are now in commission. The second two units, each of 375 MW capacity, are scheduled to begin operating in 1980 and 1981. The total cost of the station is estimated to exceed $400 million. The Commission is erecting a 500 MW natural gas fired power station at Newport to come into operation at the end of the decade. A hydro-electric station with one 150 MW unit capacity is being built at Dartmouth in north-eastern Victoria, in conjunction with the dam currently under construction, to come into operation about 1979–80. The largest future program is the proposal approved by the Government to develop a major base load generating complex of about 4,000 MW capacity at Loy Yang in the eastern part of the La Trobe Valley, planned to begin operating in the early 1980's. A new coal field will be opened for the project, which is expected to cost more than $120 million at present day valuation.

Queensland

In Year Book No. 39 an account is given of the growth of electricity generation in Queensland, with particular reference to south-eastern Queensland, and of the events leading up to the establishment in 1937 of the State Electricity Commission of Queensland. In Year Book No. 53 an account is given of the post-war development and organisation of the electricity supply in Queensland.

Legislation

Prior to the reorganisation of the electricity supply industry in Queensland on 1 July 1977, there were six regulatory Acts (*See* Year Book No. 61, p. 98). These Acts were repealed by the *Electricity Act* 1976 which consolidated and amended the law relating to the organisation and regulation of the generation, transmission, distribution, supply and use of electricity in Queensland and to matters of safety associated with these functions.

State Electricity Commission of Queensland

Its main functions are to plan and ensure the proper development and coordination of the electricity supply industry throughout the State, to enforce safety regulations, to control electricity charges, to raise capital for development, and to administer all electricity supply legislation.

Organisation

The function of main generation in the reorganised industry is carried out by the Queensland Electricity Generating Board which controls the coastal power stations. These were previously operated by the Southern Electric Authority, the Wide Bay–Burnett Regional Electricity Board, the Capricornia Regional Electricity Board and the Northern Electric Authority.

The Queensland Electricity Generating Board supplies energy in bulk to seven distributing boards whose responsibility is the distribution of electricity to retail consumers in their respective areas. These boards are the South East Queensland Electricity Board, the South West Queensland Electricity Board, the Wide Bay–Burnett Electricity Board, the Capricornia Electricity Board, the Mackay Electricity Board, the North Queensland Electricity Board and the Far North Queensland Electricity Board.

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

Electricity generation, transmission and distribution

Electricity generated in the State is based primarily on steam power stations using black coal, 90 per cent of the total production during 1976–77 being derived from this fuel. Hydro-electric stations located mainly in North Queensland provided 9 per cent, and the balance of the production was provided from internal combustion and gas turbine stations. These gas turbine stations use oil as their energy source. All of the internal combustion diesel stations use oil as fuel. The power station at Roma also uses locally-produced natural gas. Electricity generated in Queensland in power stations during 1976–77 totalled 9,269.5 GWh. A further 99.5 GWh were purchased in bulk from other producers of electricity for re-distribution to consumers.

At 30 June 1977 the total generating capacity of all Queensland power stations was 2,345 MW, comprising 1,998 MW of steam plant, 132 MW of hydro-electric plant, 52 MW of internal combustion plant and 163 MW gas turbine plant.

The southern-central electricity network is served by the following steam power stations: Tennyson 'A' (120 MW), Tennyson 'B' (120 MW), Bulimba (180 MW), Howard (37.5 MW) and Callide (120 MW). Gas turbine stations at Middle Ridge (60 MW), Swanbank 'C' (30 MW) and Rockhampton (25 MW) also serve the southern-central network. Power supply to this network has been augmented by the commissioning of two 275 MW steam sets together with a 14 MW gas turbine set at the thermal power station at Gladstone. The northern electric network is supplied by steam power stations at Collingsville (180 MW) and Townsville (37.5 MW), hydro-electric stations at Kareeya (72 MW) and Barron Gorge (60 MW) and a gas turbine station at Mackay (34 MW).

The electrical transmission and distribution systems within the State comprised approximately 100,800 circuit kilometres of electric lines at 30 June 1977. The main transmission voltages are 275 kV, 132 kV, 110 kV, 66 kV and, in certain areas, 33 kV and 22 kV. The electricity supply industry's extensive rural electrification program continued using the single wire earth return system.

At 30 June 1977 the total number of electricity consumers was 715,080, of whom 250,170 were in the Brisbane municipal area.

Future development

Construction of the power station at Gladstone in Central Queensland is well advanced. When complete, this station will consist of six 275 MW steam sets and one 14 MW gas turbine set. By August 1977 the first two steam sets and the gas turbine set were fully operational. The third and fourth 275 MW sets will be operational by the end of 1978, with the fifth and sixth sets due for completion in 1981 and 1982 respectively.

Approval has been given by the Government to proceed with the Wivenhoe Pumped Storage Hydro-Electric Project in conjunction with the construction of the Wivenhoe Dam on the Brisbane River. The power station will consist of two 250 MW pump turbine units, to be commissioned in 1983, at an estimated cost of $160 million based on mid-1977 price levels. Tenders have been called for the major plant items comprising turbines, pumps and generators, and orders should be placed by early 1978.

The construction of the 275 kV transmission link between the central and northern networks should be completed and operational by late 1977.

South Australia

A general historical survey concerning the electricity supply industry in South Australia is given in Year Book No. 39, page 1186. The survey traces the development of the industry from its formation in South Australia in 1895 until the establishment of the South Australian Electricity Commission in 1943.

Electricity Trust of South Australia

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

Capacity and production

Of the total installed capacity in South Australia at 30 June 1976, the Electricity Trust operated plant with a capacity of 1,237 MW, making it the most important authority supplying electricity in the State. There were approximately 511,500 ultimate consumers of electricity in the State, of whom 506,000 were supplied directly and approximately 5,500 indirectly (i.e. through bulk supply) by the Trust. Its major steam stations are Osborne (240 MW), Port Augusta Playford 'A' (90 MW) and Playford 'B' (240 MW), and Torrens Island (480 MW).

The Trust operates two smaller stations: at Mount Gambier (installed capacity of 22 MW) and Port Lincoln (9 MW). Both locations are connected to the Trust's interconnected system with 132 kV lines. In addition, the Trust operates a turbo-generator station at Dry Creek (156 MW).

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

Western Australia

For information on the early history of electricity supply in the metropolitan area, *see* Year Book No. 39, page 1189.

State Energy Commission of Western Australia

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

The Commission operates coal-burning power stations at East Perth, South Fremantle, Bunbury and Muja and an oil-burning station at Kwinana. A small hydro-electric station is situated at Wellington Dam near Collie and there is a gas turbine generating plant at Geraldton. A uniform tariff electricity supply is provided from these stations through an interconnected grid system to the Metropolitan Area and the South-West and Great Southern Areas, including an area extending eastward to Koollyanobbing and northwards as far as Binnu beyond Northampton. The Commission also owns and operates diesel power stations at Esperance, Fitzroy Crossing, Halls Creek, Kununurra, Onslow, Port Hedland and Roebourne.

Small electricity supply systems too remote to be connected to the grid system or supplied from the Commission-owned diesel stations are still controlled by local government authorities and are being absorbed in a leasing arrangement whereby the local generating plant and distribution system is operated by the Commission under an arrangement known as the Country Town's Assistance Scheme. Under the scheme, the Commission undertakes to operate, maintain, replace or upgrade plant and supply equipment as necessary. At the present time there are 31 country towns supplied under the provisions of the Country Towns' Assistance Scheme.

Natural gas is reticulated in most areas of the Perth metropolitan region and in Pinjarra, simulated natural gas (SNG) is reticulated in the Bunbury area, and tempered liquified petroleum gas (TLP) is reticulated in Albany.

Some details of the Commission's activities for the year ending June 1976 (1977)* are: Number of electricity consumer accounts, 335,000 (395,000) and gas consumer accounts, 68,000 (76,000); electricity generated 3,906 (4,244) GWh; gas sold 833,389,000 (854,100,000) units; fuel used for electricity generation 1,971,000 (2,088,000) tonnes of coal, 163,400 (196,000) tonnes of fuel oil, and 39,729,000 (52,670,000) litres of diesel fuel.

Sales for the year ending 30 June 1976 (1977)*, compared with those for the preceding year, show an increase of 9.2 (7.6) per cent for electricity and 7.3 (2.4) per cent for gas.

Tasmania

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

Hydro-Electric Commission

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

Output and capacity of hydro-electric system

For information on the development of the Tasmanian generating system *see* Year Book No. 61, pages 984–985.

At the end of December 1977 generator capacity stood at: hydro generation, 1,396 MW; oil-fired thermal, 240 MW; and diesel, 1.7 MW. It is expected that the installation of the second generator in the Gordon River Hydro-Electric Scheme, Stage I, will be carried out during 1978, increasing generating capacity by 144 MW.

The future development program provides for the completion of Stage I of the Gordon River Scheme and construction of a system based on the Pieman, Murchinson and Mackintosh Rivers in Western Tasmania; these works, which have already been approved, will add 851 MW to the State's power grid.

The Commission is conducting extensive surveys and investigation of other possible schemes with a view to construction after the completion of the present program. It is estimated that the potential which can be developed economically should ultimately harness 3,000 MW to the system.

Australian Territories

Australian Capital Territory

The supply authority is the A.C.T. Electricity Authority which took over the functions of the Canberra Electric Supply Branch, Department of the Interior, on 1 July 1963. Supply was first made available in Canberra during 1915 and was met from local steam plant. Connection to the New South Wales interconnected system was effected in 1929, and all requirements are now taken from this system. Locally-owned plant consists of 4 MW diesel alternators which are retained as a standby for essential supplies. The total number of ultimate consumers at 30 June 1977 was 71,737. During the year 1976–77 the bulk electricity purchased was 1,143 GWh and the system maximum demand was 316 MW.

* Bracketed figures refer to year ended 30 June 1977.

Northern Territory

Electricity is supplied in the main population centres by the Department of the Northern Territory. The Electricity Supply Division of the Department of Construction designs, constructs, operates and maintains electricity supply facilities on the Department of the Northern Territory's behalf.

An oil-fired steam power station is operated at Darwin with 66 kV transmission. Alice Springs, Pine Creek, Katherine, Tennant Creek, Elliott, Mataranka and Tea Tree are supplied by diesel power stations.

The Stokes Hill Power Station in Darwin has an installed capacity of 94 MW with two additional 23.5 MW sets now being installed. These are due for commissioning in 1978, and will give the station an installed capacity of 141 MW. Preliminary planning for a second power station in Darwin is proceeding. A 10 MW gas turbine was commissioned in 1974 for emergency standby purposes.

A new diesel station was commissioned in Alice Springs in 1973 and, together with the old station, has an installed capacity of 24.8 MW. An order has been placed for a fourth 5.6 MW diesel alternator set. Planning for further extension is proceeding.

Katherine is supplied by an 8.5 MW diesel station. A new 4.7 MW diesel power station in Tennant Creek operates automatically with a minimum of staff. A fourth 1.56 MW diesel alternator is on order. Small diesel stations are operated at Elliott (340 kW), Pine Creek (900 kW), Mataranka (480 kW) and Tea Tree (120 kW).

There are 33 Aboriginal communities which generate their own electricity. A total of 85 generators are in operation in these communities with an installed capacity of 14.5 MW. Nabalco operates a 120 MW oil-fired steam power station and a large diesel power station at Gove.

Statistical Summary

For a summary of operations of electricity establishments in 1971–72 and 1974–75, *see* Chapter 17, Manufacturing and Internal Trade, pages 433–435.