CHAPTER 27

ELECTRIC POWER GENERATION AND DISTRIBUTION

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 21, Manufacturing Industry.

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 receiving an annual rainfall of 30 inches or over, 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; supply electricity to the Commonwealth Government (i) for defence purposes, (ii) for consumption in the Australian Capital Territory; and 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 61 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 62, page 976.

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 320MW), returned to the Tumut River and then by another pressure tunnel to Tumut 2 underground Power Station (capacity 280 MW), thence discharging into Talbingo Reservoir, also 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

* *See also* Chapter 23 Water Resources of this issue and special detailed article in Year Book No. 42, pp. 1103–30.

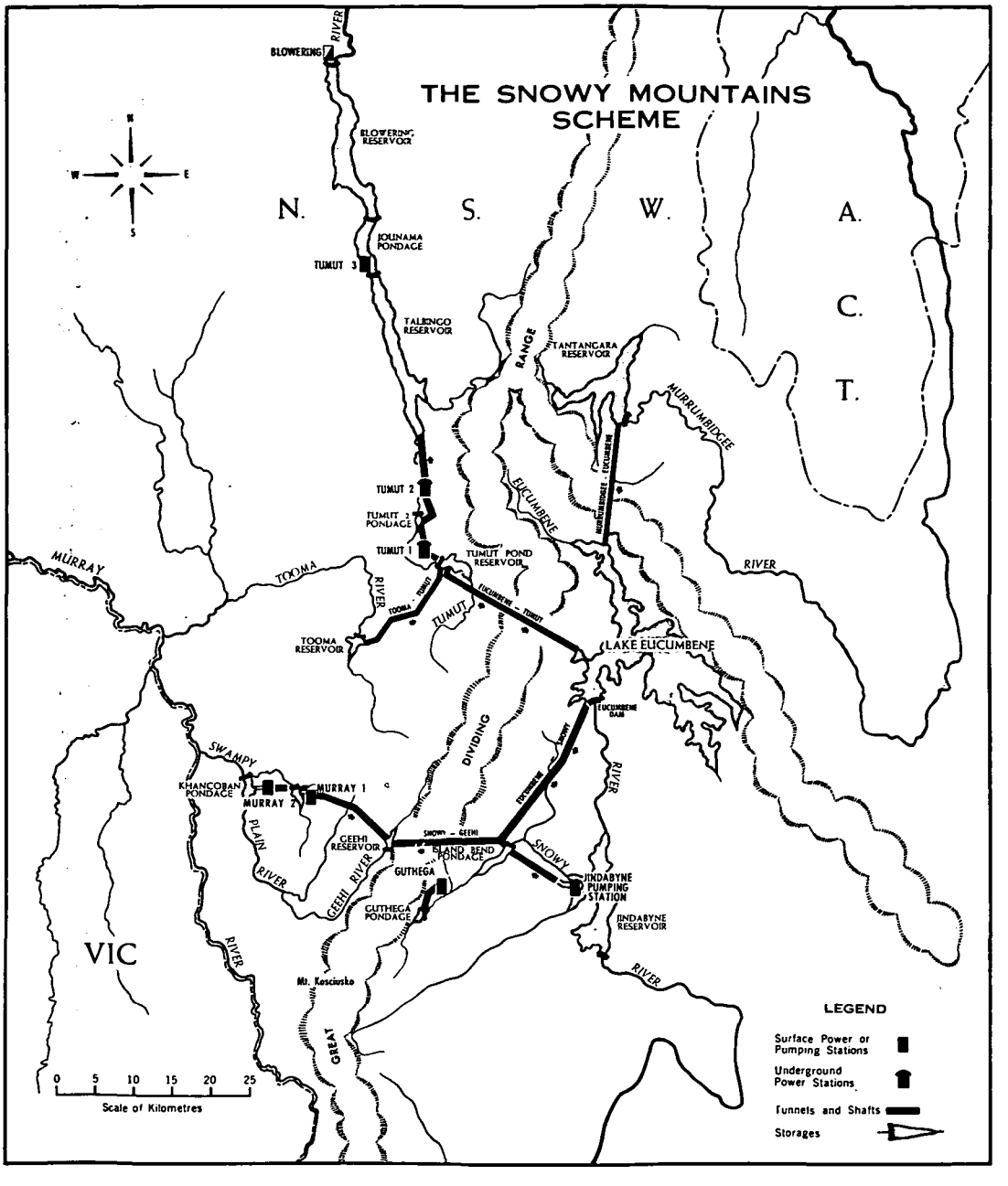
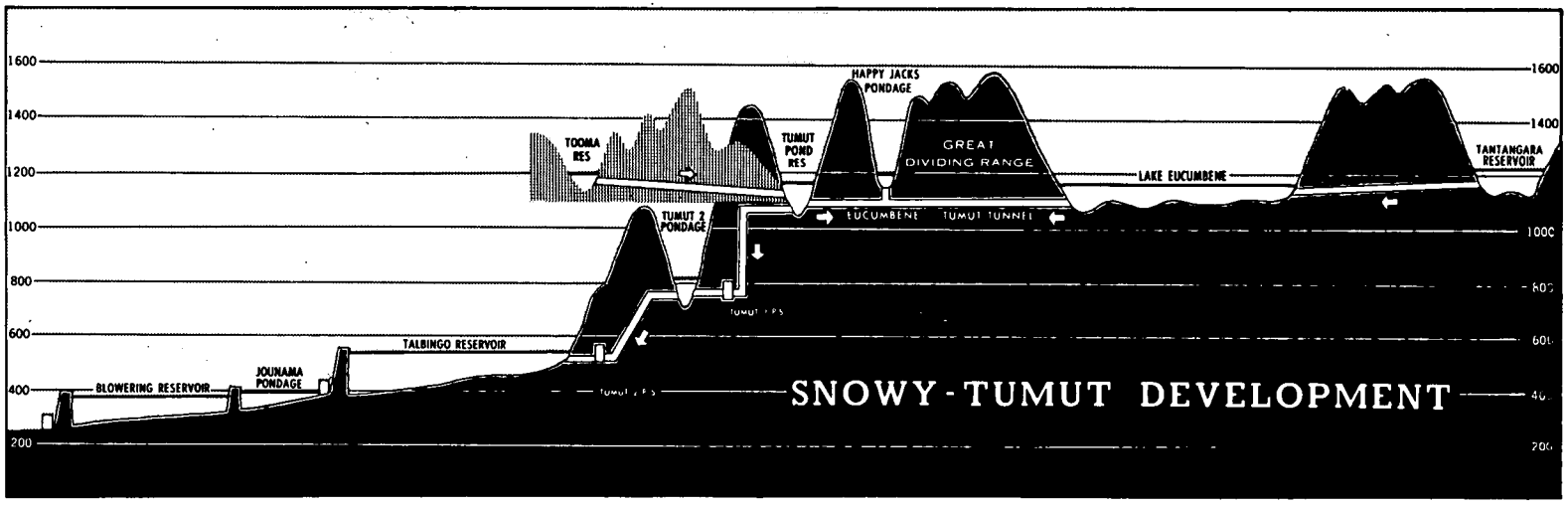

THE SNOWY MOUNTAINS SCHEME
N. S. W. A. C. T.
VIC
BLOWERING RIVER
BLOWERING RESERVOIR
JOUNAMA POND DAGE
TUMUT 3
TALBINGO RESERVOIR
TANTANGARA RESERVOIR
RANGE
MURRUMBIDGEE
EUCUMBENE
TUMUT 2
TUMUT 2 POND AGE
TUMUT 1
TUMUT POND RESERVOIR
MURRAY
TOOMA
RIVER
TOOMA RESERVOIR
TUMUT
LAKE EUCUMBENE
EUCUMBENE DAM
DIVIDING
SNOWY
SWAMPY
KHANCOBAN POND AGE
MURRAY 1
MURRAY 2
PLAIN RIVER
GEEHI RESERVOIR
GEEHI RIVER
SNOWY - GEEHI
ISLAND BEND POND AGE
GUTHEGA
GUTHEGA POND AGE
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
Funnels and Shafts
Storages

PLATE 61

PLATE 62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HAPPY JACKS PONDAGE
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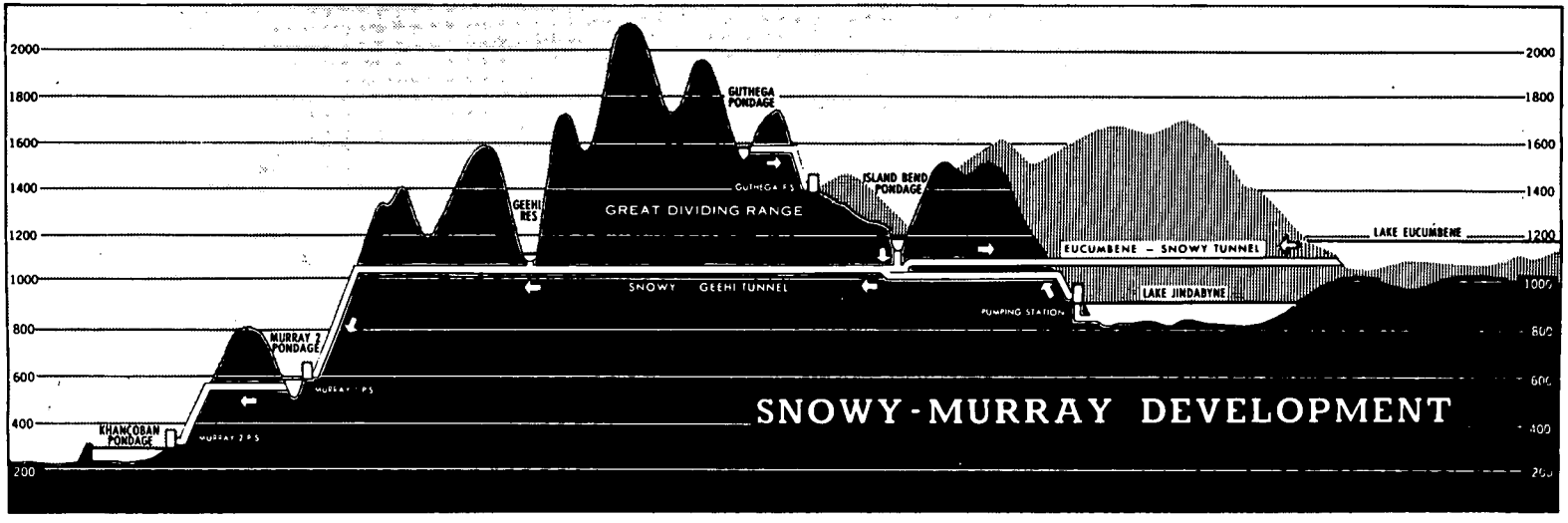
LAKE EUCUMBENE
TANTANGARA RESERVOIR
TUMUT 2 PONDAGE
EUCUMBENE - TUMUT TUNNEL
TUMUT 2 P.S.
TALBINGO RESERVOIR
JOUNAMA PONDAGE
BLOWERING RESERVOIR
TUMUT 1 P.S.
SNOWY-TUMUT DEVELOPMENT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GUTHEGA PONDAGE
GUTHEGA P.S.
GEEHI RES
GREAT DIVIDING RANGE
ISLAND BEND PONDAGE
EUCUMBENE - SNOWY TUNNEL
LAKE EUCUMBENE
SNOWY GEEHI TUNNEL
LAKE JINDABYNE
PUMPING STATION
MURRAY 2 PONDAGE
MURRAY 2 P.S.
KHANCOBAN PONDAGE
MURRAY 1 P.S.
SNOWY-MURRAY DEVELOPMENT

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.

(*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 tributories, 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 million kWh a year. The Commonwealth Government reserves 670 million kWh for supply to the A.C.T., and 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 four Acts govern electricity supply in New South Wales.

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

The Gas and Electricity Act, 1935, established the Sydney County Council which is responsible for the distribution of electricity in a large part of the Sydney metropolitan area. The Act 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.

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 had 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 and 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

standardisation 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 $38,902,028 in subsidies, of which $32,435,374 had been paid. Further details of the operation of the scheme are given on page 956, Year Book No. 56.

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 1,404 kilometres of traffic routes throughout the State.

Generation and transmission

Of the State's electrical power requirements during the year ended 30 June 1975, 97.6 per cent was generated in New South Wales (78.4 per cent by coal fired power stations, 0.3 per cent by internal combustion plants, 16.5 per cent from the Snowy Mountains Hydro-Electric Authority and 2.4 per cent by other hydro-electric stations). Net interstate imports of electricity accounted for the remaining 2.4 per cent.

Major generating stations. At 30 June 1975 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), 240 MW; Pyrmont (Sydney), 200 MW. The total nominal capacity of the Electricity Commission's system as at 30 June 1975 was 6,377 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 1975 there were in service 3,207 circuit kilometres of 330 kV and 6,282 kilometres of 132 kV transmission lines (including 206 kilometres operating for the time being at 66 kV). There were also in service 4,446 kilometres of transmission line of 66 kV and lower voltages, and 435 kilometres of underground cable. The installed transformer capacity at the Commission's 152 sub-stations was 21,423,450 kVA.

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 and 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.

Future projects include the installation of an additional 500 MW unit at Wallerawang and two 660 MW units at Vales Point to be in operation in 1976 and 1978 respectively. 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.

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 and Sydney North to Sydney East. Two new 330 kV substations, Sydney East and Beaconsfield West, are being established in the Sydney Metropolitan Area. 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 974). Apart from this area, major hydro-electric stations are in operation at the Warragamba Dam (50 MW) and Hume Dam (50 MW). There are, in addition 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. This project is now nearing completion.

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 as a semi-government authority, the Commission is administered by a full-time Chairman and three part-time Commissioners. The Minister for Fuel and Power is responsible under the *Fuel and Power Act* 1965 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 plants and develop the State's hydro-electric resources. It 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 227,600 sq km and the transmission network covers practically the entire population of the State.

Victoria's electricity system is based on the utilisation of the extensive brown coal deposits in the La Trobe Valley in Central Gippsland.

In 1974–75 the output of brown coal from the Commission's three open cuts at Yallourn, Yallourn North and Morwell totalled 25.3 megatonnes of which 23.1 mt were used in the Commission's power stations. Apart from the brown coal 172 kilotonnes of briquettes and 19.4 kt of fuel oil were used as fuel in power stations.

Electricity generation, transmission and supply

In 1974–75 the Commission generated in its thermal and hydro-electric power stations or purchased 17,033 GWh. The total installed generating plant capacity at 30 June 1975 was 4,395 MW.

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 (half of output) on the Murray River boundary with New South Wales. 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 1975 the electrical transmission and distribution system in the State supply network comprised 103,536 km of overhead lines and 2,599 km of underground lines. There are 4 auto-transformation stations, 26 terminal substations, 169 zone substations and 71,680 distribution sub-stations. 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 260,000 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.

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.

Complete electrification of the State has virtually been achieved. At 30 June 1975 the Commission had 1,159,500 retail customers excluding bulk sales. There were 982,500 domestic, 82,200 industrial and 94,500 commercial consumers. In country areas electricity was supplied to about 75,000 farms.

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 Commission plans to erect a 1,000 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 will be built at Dartmouth in north-eastern Victoria in conjunction with the dam currently under construction, to come into operation about 1979–80. A major, base load, generating complex of about 4,000 MW capacity at Loy Yang in the eastern part of the La Trobe Valley is planned to begin operating in the early 1980's.

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.

Electricity supply in Queensland is governed by the following Acts which are administered by the Commission.

'*The State Electricity Commission Acts*, 1937–1965.' These Acts constituted the Commission and define its powers and duties.

'*The Electric Light and Power Act*, 1896–1972.' This Act relates to the constitution of electric authorities, except the Southern Electric Authority and the Northern Electric Authority, and defines their powers and duties and the conditions under which electricity is to be supplied and used.

'*The Regional Electric Authorities Acts*, 1945–1964.' These Acts provide for the constitution of Regional Electricity Boards representative of the Commission and the Local Authorities within each region, and define their powers and responsibilities.

'*The Southern Electric Authority of Queensland Acts*, 1952–1964.' These Acts established the Southern Electric Authority and define the powers and responsibilities of the Authority.

'*The Northern Electric Authority of Queensland Act*, 1963–1964.' This Act established the Northern Electric Authority. It also defines its powers and responsibilities.

'*The Electrical Workers and Contractors Act*, 1962–1974.' This Act provides for the certification of electrical workers and for the licensing of electrical contractors.

State Electricity Commission of Queensland

The Commission commenced to function in January 1938. The Commission is the statutory authority concerned, *inter alia*, with the administration of electricity supply legislation, the general control, organisation and efficient development of the electricity supply industry in Queensland, the forward planning of such development, the control of electricity charges, the administration of regulations and rules relating to safety, the raising of capital, the provision of engineering and consulting services, the promotion of the use of electricity, particularly in manufacturing and rural industries, and the fixing of standards. In addition, it is an authority to which consumers may appeal on matters in dispute between them and their electric authorities. The Commission is also empowered to own and operate generating stations and transmission lines and to sell electricity in bulk.

Organisation

Regional electrification, with centralised generation and main transmission, is the predominant feature of the organisation of the electricity supply industry in Queensland. The more populous eastern part of the State is served by three major networks.

The southern network embraces the areas of supply of the Southern Electric Authority, the Brisbane City Council, the Wide Bay-Burnett Regional Electricity Board, and the Dalby Town Council. Generation and main transmission in this area are the responsibility of the Southern Electric Authority, which sells energy in bulk to the other three Authorities. The Wide Bay-Burnett Board also operates its own base load power station at Howard. The Southern Electric Authority is also responsible for the distribution of electricity to a large area of South-East Queensland outside metropolitan Brisbane.

The central network which is interconnected with the southern network by a 275 kV transmission line is within the area of supply of the Capricornia Regional Electricity Board. The Board is responsible for the generation, main transmission and distribution of electricity.

The northern network covers the areas of supply of the Cairns, Townsville, and Mackay Regional Electricity Boards. Generation and main transmission are the responsibility of the Northern Electricity Authority which sells electricity in bulk for distribution by the three Regional Electricity Boards. In addition, the Cairns Regional Electricity Board operates small internal combustion generating stations at certain isolated centres in its area, and the Townsville Regional Electricity Board supplies the western area of its region by means of a distribution system based on an internal combustion station at Hughenden.

West of the three main networks the form of organisation which has been adopted is determined by the stage of electrical development which has been reached. Immediately west of the Capricornia region the Central Western Regional Electricity Board operates an interconnected system with generation centralised at internal combustion stations at Longreach and Barcaldine. Other smaller regions of electricity supply are centred on Roma and Mount Isa. In addition, parts of southern Queensland are supplied by the Tenterfield Municipal Council and the North West County Council of New South Wales, whilst the Balonne Shire Council purchases electricity in bulk from the Electricity Commission of New South Wales. In the remaining parts of Western Queensland there are a number of isolated electricity undertakings operated by Shire Councils.

It is proposed that the industry be reorganised by making the 22 existing electricity authorities into 8 new authorities. Draft legislation to give effect to this proposal is well advanced.

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 1974–75 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 but the power station at Roma also uses locally produced natural gas. Electricity generated by public electricity undertakings in Queensland during 1974–75 totalled 8,272 million kWh. A further 104 million units were purchased in bulk from other producers of electricity for re-distribution to consumers.

At 30 June 1975 the total generating capacity of Queensland public electricity undertakings was 2,073 MW comprising 1,789 MW of steam plant, 132 MW of hydro-electric plant, 37 MW of internal combustion plant and 115 MW gas turbine plant.

The southern electricity network is served by the following steam power stations: Bulimba 'A' (65 MW), Bulimba 'B' (180 MW), Tennyson 'A' (120 MW), Tennyson 'B' (120 MW), Swanbank 'A' (396 MW), Swanbank 'B' (480 MW) and Howard (37.5 MW) together with gas turbine stations—Swanbank 'C' (30 MW) and Middle Ridge (60 MW). The central network is served by power stations at Rockhampton (52.5 MW steam and 25 MW gas turbine) and at Callide (120 MW) steam). The northern electricity network is supplied by steam power stations at Collinsville (180 MW) and Townsville (37.5 MW) and hydro-electric stations at Kareeya (72 MW) and Barron Gorge (60 MW).

The electrical transmission and distribution systems within the State comprised over 91,721 circuit kilometres of electric lines at 30 June 1975. 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 1975 the total number of electricity consumers was 670,989 of whom 246,642 were in the Brisbane metropolitan area.

Future development

Major development of the State's generating capacity is concentrated on the construction of the power station at Gladstone (1,100 MW). The Gladstone power station will comprise four 275 MW generating sets, the first of which is expected to be commissioned early in 1976.

Construction of the second 275 kV line between Southern and Central Queensland is well advanced and it is expected that this reinforcing link will be in service in 1976. The 275 kV connection between Gladstone and the northern grid is programmed for completion in 1977.

A 34 MW gas turbine plant is to be installed at Mackay and site work has commenced.

Two 660 kW sets have been installed at Barcaldine with tenders being called for two further 1,615 kW sets. The 66 kV interconnection between Barcaldine and Longreach was completed in May 1975.

Two 4 MW generating sets are on order by the Roma Town Council to cater for the continuing load growth in the area.

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, and by agreement with other organisations which generate or supply electricity, arrange 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 1975, the Electricity Trust operated plant with a capacity of 1,185 MW, and is the most important authority supplying electricity in the State. There were approximately 495,000 ultimate consumers of electricity in the State, of whom 490,000 were supplied directly and approximately 5,000 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, the Mt Gambier Station has an installed capacity of 22 MW and Pt Lincoln 9 MW—both locations are connected with the Trust's interconnected system with 132 kV lines. In addition, the Trust operates a turbo-generator station at Dry Creek (104 MW).

The two main fuels used by the Trust are sub-bituminous coal from Leigh Creek for the Port Augusta, Playford power stations 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 this 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 and gas burning station at Kwinana. A small hydro-electric station is situated at Wellington Dam near Collie and at Geraldton there is a gas turbine generating plant. A uniform tariff electricity supply is provided from these stations through an interconnected grid system to the Metropolitan Area, the South-West and Great Southern Areas, including an area extending eastward to Kollyanobbing and northwards as far as Ajana beyond Northampton. The Commission also owns and operates diesel power stations at Port Hedland, Halls Creek, Roebourne, Kununurra, Esperance and Onslow.

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 twenty-six 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, whilst simulated natural gas (SNG) is reticulated in the Bunbury area and tempered liquified petroleum gas (TLP) in Albany.

Some details of the Commission's activities for the year ending June 1975 are: Number of electricity consumer accounts 317,069 and 62,284 gas consumer accounts; electricity generated 3,564 million kWh; gas sold 776,569,000 units; fuel used for electricity generation 1,709,000 tonnes of coal, 186,000 tonnes of fuel oil, and 26,389,000 litres of diesel fuel.

Sales for the year ending 30 June 1975, compared with those for the preceding year, show an increase of 6.57 per cent for electricity and 27.0 per cent for gas.

Tasmania

A considerable part of the water catchment in Tasmania is at high level, with a substantial natural storage available, and this has made it possible 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 industry to Tasmania. However, in recent years Tasmania's advantage in selling electric power has been reduced. A cost differential favouring Tasmania still exists but it is no longer as marked. 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

In 1929 the Government passed the *Hydro-Electric Commission Act* 1929, which established the Hydro-Electric Commission and vested in the Commission, with some minor exceptions, the right to use the waters of the State of Tasmania, and authorised it to develop and reticulate electric power for all purposes. In 1930 this corporate body took over the State hydro-electric undertaking and the business of the Hydro-Electric Department.

Output and capacity of hydro-electric system

The following table outlines the development of the Tasmanian generating system.

TASMANIAN POWER GENERATING SYSTEM

Station	Year of commission	Head (metres)	Generator capacity (MW)(a)	Assessed annual capacity(b) (million kWh)
COMPLETED STATIONS				
Waddamana 'B'	1949	344	48.0	(c)
Tarraleah	1951	299	90.0	583
Butlers Gorge	1951	56	12.2	68
Trevallyn	1955	126	80.0	541
Tungatinah	1956	306	125.0	552
Lake Echo	1956	173	32.4	75
Wayatinah	1957	62	38.2	265
Liapootah	1960	110	83.7	439
Catagunya	1962	43	48.0	251
Poatina	1965	829	250.0	1,275
Tods Corner	1966	41	1.6	13
Meadowbank	1967	29	40.0	200
Cluny	1967	16	17.0	89
Repulse	1968	27	28.0	154
Rowallan	1968	49	10.4	37
Lemonthyme	1969	159	51.0	284
Devils Gate	1969	69	60.0	298
Wilmot	1971	251	30.6	127
Bell Bay (Stage 1)	1971	(d)	120.0	788
Cethana	1971	99	85.0	407
Paloona	1972	31	28.0	131
Fisher	1973	649	43.2	245
Bell Bay (Stage 2)	1974	(d)	120.0	788
Total	..	..	*1,442.4*	*7,610*
STATIONS UNDER CONSTRUCTION				
Gordon (Stage 1)	1977	186	288.0	1,466
Poatina (e)	1977	829	50.0	..
Mackintosh	1981	68	72.0	..
Rosebery	1983	63	76.5	..
Pieman	1985	93	270.0	..
Total	..	..	*756.5*	..

(a) Emergency gas turbine generating capacity of 21,000 kW at Bell Bay not included. (b) Assessed annual capacity is based on simulated operation of the whole system for hydro-electric plant. The figures for thermal plant correspond to a capacity factor of 75 per cent. (c) Reserve plant only. (d) Thermal station. (e) Additional generator to be installed in the existing station.

Although Tasmania has only three percent of Australia's population, it produces ten percent of Australia's total electricity. In 1974–75, electricity generation in Tasmania totalled 5,949 million kilowatt hours.

New capacity

The Gordon River Power Development, Stage 1, to be completed in 1977, will create the largest water storage in Australia. The Lake Pedder storage was created by a combination of two dams and a levee on the Serpentine and Huon Rivers while Lake Gordon resulted from a single dam on the Gordon River. Water will be carried from the Gordon storage by a vertical shaft and short horizontal tunnel to a power station 186 metres underground. The station is designed to be operated by remote control from Hobart, 160 kilometres away, and to have an initial capacity of 288 MW.

A hydro-electric development on the Pieman, Murchison and Mackintosh Rivers in western Tasmania was approved by Parliament in 1971. Total installed capacity of the scheme will be approximately 420 MW. Preliminary construction works are now in progress and operation of the first stage of the development is expected to commence in 1981, with the completion of the whole development scheduled for about 1985.

The Commission is conducting extensive surveys and investigation of other schemes with a view to further 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 of diesel alternators which are retained as a standby for essential supplies. The total number of ultimate consumers at 30 June 1975 was 62,632. During the year 1974–75 the bulk electricity purchased was 924,077,000 kWh and the system maximum demand was 235.3 MW.

Northern Territory

Electricity is supplied in the main population centres by the Department of the Northern Territory through the Electricity Supply Division of the Department of Construction.

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

The Stokes Hill Power Station has an installed capacity of 70.5 MW with an additional 23.5 MW set now being installed and due for commissioning in 1976. A 10 MW gas turbine was commissioned in 1974. A contract has been let for the last stage of development of the Stokes Hill Power Station, comprising two 23.5 MW sets, which, when completed in late 1978, will give the station a capacity slightly in excess of 141 MW. Preliminary planning for a second power station in Darwin is proceeding.

Cyclone Tracy devastated Darwin on Christmas Day 1974, resulting in most of the transmission and distribution systems being destroyed. Electricity supply authorities from all parts of Australia aassisted in rebuilding the electricity supply system. Connections were made to temporary dwellings but no charges were made for electricity up to May 1975.

A new diesel station was commissioned in Alice Springs in 1973 and together with the old station has an installed capacity of 26.6 MW. Tenders are expected to be called by the end of 1976 for a fourth 5.6 MW diesel alternator set.

Katherine is supplied by a 7 MW diesel station. A 2.03 MW diesel alternator set has been transferred from Alice Springs and is due for completion in 1976.

A new 4.7 MW diesel power station in Tennant Creek has been commissioned to supply the town after the agreement with Peko N.L. for the purchase of bulk electricity expires. It is planned to instal a fourth 1.56 MW diesel alternator during 1977–78.

In February 1975 a new 0.4 MW diesel power station and reticulation system was commissioned to supply a number of railway centres.

Mataranka Aboriginal communities generate their own electricity as do Nabalco which operate a 120 MW oil fired steam power station and a large diesel station at Gove.

Statistical Summary

For a summary of operations of electricity establishments in 1969–70 and 1971–72, *see* Chapter 21, Manufacturing Industry, pages 736–7.