

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. At 30 June 1972 thermal power equipment represented 71.6 per cent, hydro plant 26.0 per cent, and internal combustion and gas turbine equipment 2.4 per cent of the total installed generating capacity.

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, and plans have been formulated to develop more than 4,000,000 kW by 1975. The two major construction projects in this 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 1949-1958

In July 1949 the Australian 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 Australian 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 Australian 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 Australian 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 59 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 60, page 984.

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 320,000 kW), returned to the Tumut River and then by another pressure tunnel to Tumut 2 underground Power Station (capacity 280,000 kW), thence discharging into Talbingo Reservoir, also on the Tumut River.

Tumut 3 Power Station, the largest station of the scheme (generating capacity 1,500,000 kW and pumping capacity 3,000 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.*

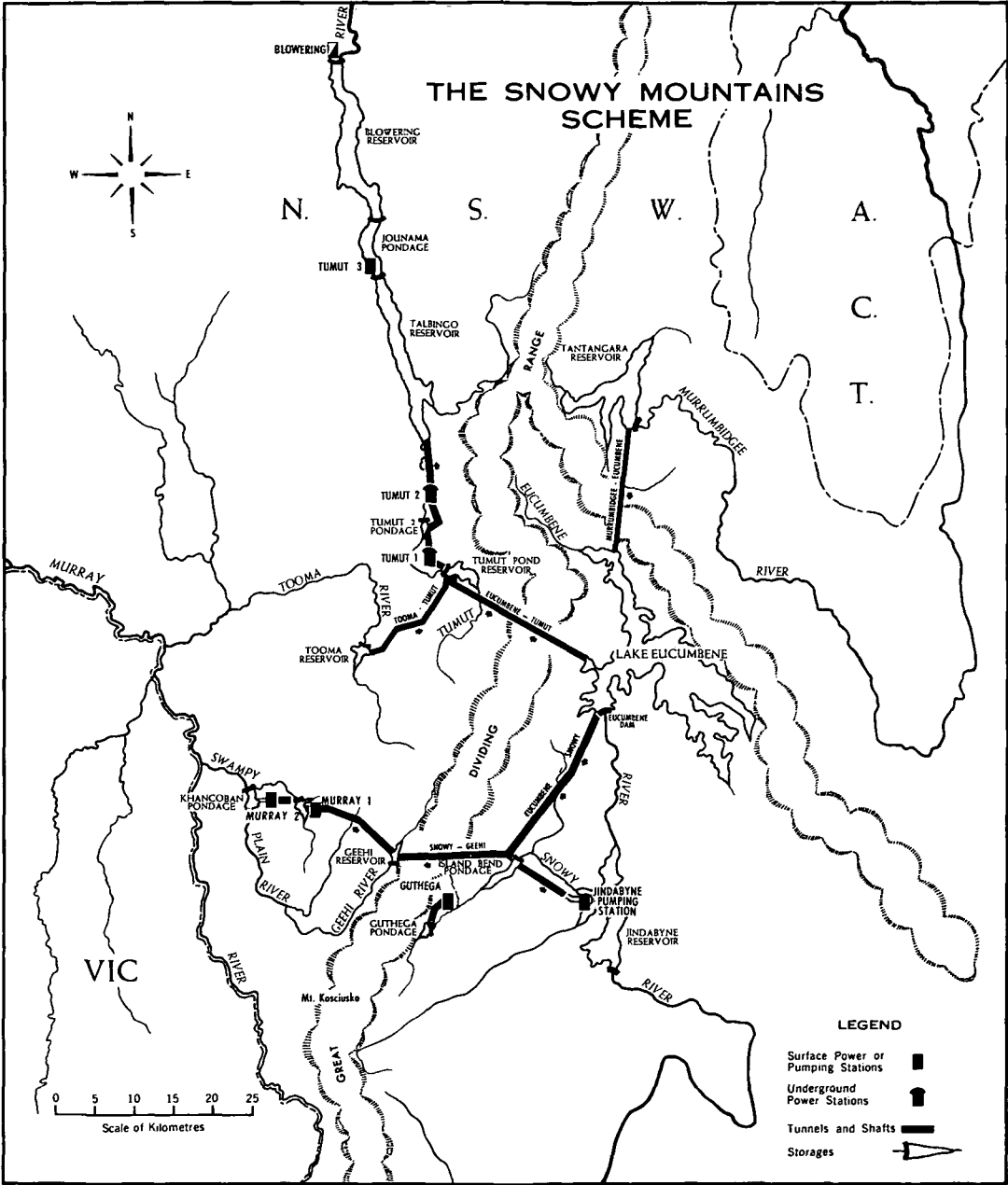


PLATE 59

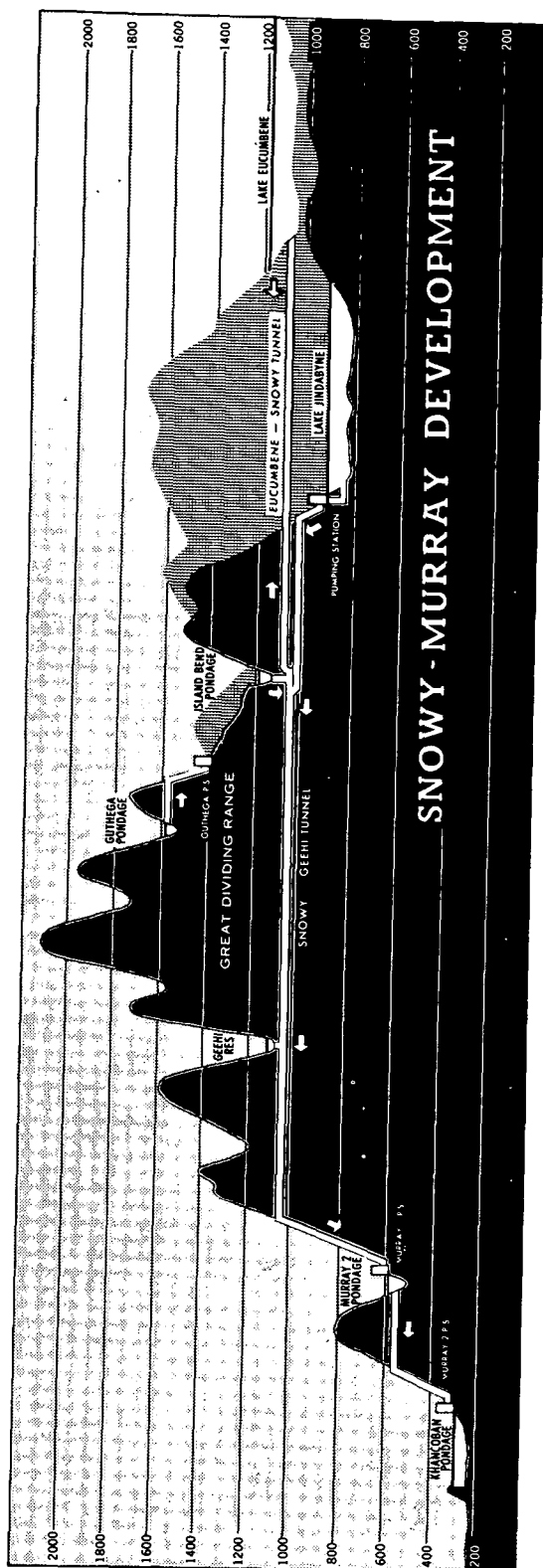
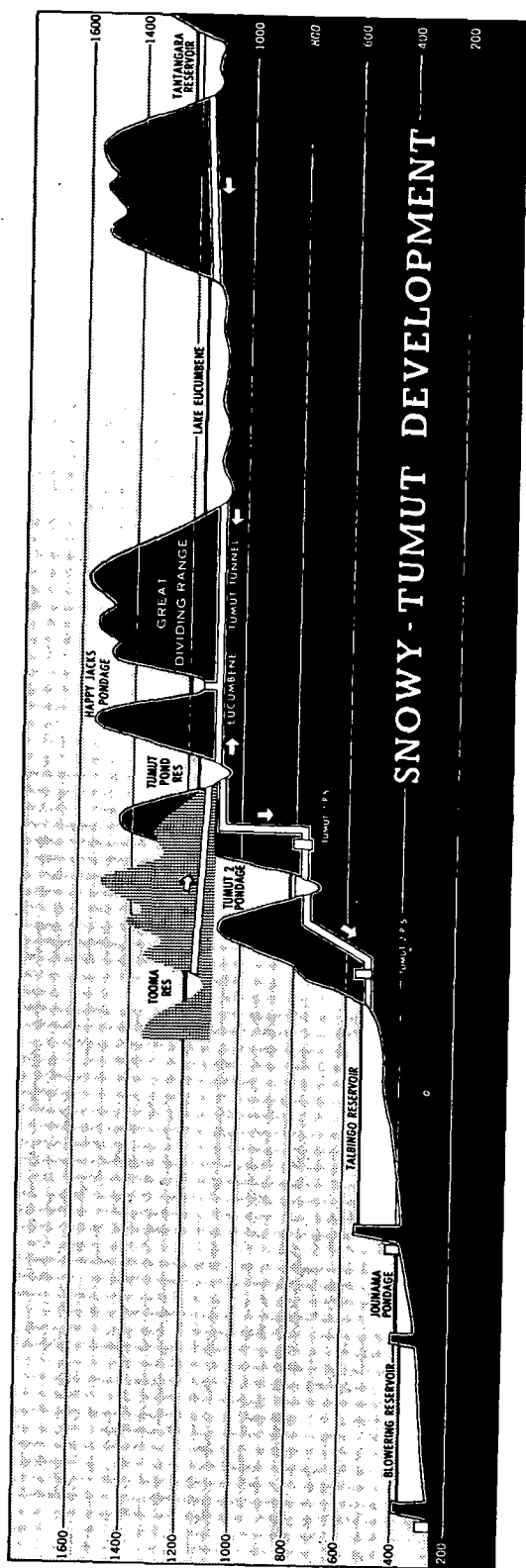


PLATE 60

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 1,500,000 kW.
- (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 60,000 kW.

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 Australian 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 Australian Government's requirements are drawn from the New South Wales transmission network by an exchange arrangement between the Australian Government and the Electricity Commission of New South Wales. Electricity over and above that required by the Australian Government is divided between the States of New South Wales and Victoria in the ratio 2:1.

Progress of scheme and future program

The scheme's first power station, Guthega, of 60,000 kW capacity, came into operation in February 1955. It was followed by Tumut 1, an underground power station with a capacity of 320,000 kW, in 1959, and by the 280,000 kW 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 950,000 kW 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 550,000 kW 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 80,000 kW Blowering Power Station began commercial operation in August 1971.

The total installed capacity of the scheme has now reached 3,740,000 kW.

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 co-ordination of electricity supply throughout the State.

The Electricity Commission Act, 1950, which constituted the Electricity Commission of New South Wales as the major generating authority and not subject to the provisions of the Electricity Development Act.

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 1973 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 and 2 municipal councils, 1 shire council, 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 223 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 Power 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 1973 the Authority was committed to the payment of \$37,423,178 in subsidies, of which \$29,873,374 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 1,196 kilometres of traffic routes throughout the State.

Generation and transmission

Of the State's electrical power requirements during the year ended 30 June 1973, 88.9 per cent was generated by coal fired power stations in New South Wales, 0.3 per cent by internal combustion plants, 10.8 per cent by hydro-electric stations (including 7.7 per cent obtained direct from the Snowy Mountains Scheme). Interstate imports accounted for 1.4 per cent of the State's electricity requirements.

Major generating stations. At 30 June 1973 the major power stations of the State system of the Electricity Commission of New South Wales and their effective capacities were as follows: Liddell (Hunter Valley), 1,500,000 kW; Munmorah (Tuggerah Lakes), 1,400,000 kW; Vales Point (Lake Macquarie), 875,000 kW; Bunnerong (Sydney), 375,000 kW; Wangi (Lake Macquarie), 330,000 kW; Tallawarra (Lake Illawarra), 320,000 kW; Wallerawang (near Lithgow), 240,000 kW; Pyrmont (Sydney), 200,000 kW. The total effective capacity of the Electricity Commission's system as at 30 June 1973 was 5,892,000 kW. 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 33kV and 22kV 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 1973 there were in service 2,438 route kilometres of 330 kV and 5,522 kilometres of 132 kV transmission lines (including 206 kilometres operating for the time being at 66 kV). There were also in service 4,373 kilometres of transmission line of 66 kV and lower voltages, and 196 kilometres of underground cable. The installed transformer capacity at the Commission's 152 sub-stations was 20,419,450 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 inter-connection with the system of the Electricity Commission. Of these the more important are the Northern Rivers County Council (installed capacity 28,750 kW) and the North-West County Council (15,000 kW). 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 5,989,325 kW at 30 June 1973 and the number of ultimate consumers at this date was 1,703,467

Future development

The major new thermal stations already built and those now being developed on the coalfields will become the main base load supply sources for the State. Munmorah, located between Lakes Munmorah and Budgewoi, Wangi, on Lake Macquarie, Wallerawang, near Lithgow, and Tallawarra, on Lake Illawarra, have been completed.

The first 500,000 kW generating unit of the Liddell Power Station in the Hunter Valley was commissioned in 1971, followed by the second in 1972 and the third in 1973. The fourth followed early in 1974, making a total capacity of 2,000,000 kW.

Future projects include the installation of an additional 500,000 kW unit at Wallerawang, scheduled for commissioning in 1975-76 and two 660,000 kW units at Vales Point required for operation in the late 1970s.

The development of the 330 kV main system is continuing. New work recently completed includes the construction of major 330 kV transmission lines from Lower Tumut to Canberra, Canberra to Dapto, and Liddell to Newcastle. A new 330 kV substation, Sydney East, is 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 982). Apart from this area, major hydro-electric stations are in operation at the Warragamba Dam (50,000 kW), Hume Dam (50,000 kW) and Burrinjuck Dam (20,000 kW). There are, in addition, five smaller hydro-electric installations in operation in various parts of the State. A pumped-storage hydro-electric system to produce 240,000 kW by 1976, is being installed as part of the Shoalhaven Scheme in conjunction with the Metropolitan Water Sewerage and Drainage Board.

Victoria

In Year Book No. 39 a detailed description is given of the development of electricity generation in the cities of Melbourne, Geelong, Bendigo and Ballarat up to the time of transfer of control of electricity undertakings in those cities to the State Electricity Commission of Victoria. An account is also given of the events culminating in the establishment of the Commission in 1919, and of the early developments in the Commission's undertakings.

State Electricity Commission of Victoria

Constituted by the *Electricity Commissioners Act* 1918, the State Electricity Commission is a semi-government authority administered since 1921 by a full-time Chairman and three part-time Commissioners. The principal duty of the Commission is to co-ordinate and extend on an economic basis the supply of electricity throughout Victoria. For this purpose it is vested with power to erect, own and operate power stations and other electrical plant and installations, supply electricity retail to individual consumers or in bulk to any corporation or public institution, develop, own and operate brown coal open cuts and briquetting works, and develop the State's hydro-electric resources. From its own revenues, which it controls, the Commission must meet all expenditure in the operation of its power and fuel undertakings and provide for statutory transfers to the Consolidated Fund of Victoria.

The Commission is the controlling authority for all electrical undertakings in Victoria. It is responsible for the registration of electrical contractors, the licensing of electrical mechanics, the control of installation methods and material, and the testing and approval of electrical equipment and appliances.

Since it began operating in 1919 the State Electricity Commission has expanded and co-ordinated the production and supply of electricity on a State-wide basis to the point where its system now generates almost all the electricity produced in Victoria. Victoria's electricity system is based on the utilisation of the extensive brown coal resources of the Latrobe Valley in Gippsland.

Output of brown coal in 1973-74 from the Commission's three open cuts at Yallourn, Morwell and Yallourn North totalled 25,148,000 tonnes, of which 21,743,000 tonnes were used in the Commission's power stations. A further 3,097,000 tonnes of brown coal were used to manufacture 1,164,000 tonnes of briquettes, of which 194,000 tonnes were burnt in power stations. The only other fuel used in power generation was 35,000 tonnes of oil.

Generation in thermal stations is supplemented by energy from the Commission's hydro stations in the mountains north-east of the State, and by hydro entitlements from the Snowy Mountains Scheme (one-third of the output after provision of the Australian Government's needs) and Hume Power Station (half of the output).

Electricity Supply

At 30 June 1974 the number of ultimate consumers in Victoria was 1,400,000 all served by the Commission except the extreme eastern settlements of Bendoc and Bonang (supplied from an adjoining area of New South Wales).

The Commission sells electricity retail in all Victorian supply areas except for eleven metropolitan municipalities. These municipalities, retailing electricity under franchises granted before the Commission was established, take bulk supply from the Commission. Bulk supply is also provided to several New South Wales municipalities and irrigation settlements bordering the River Murray.

The Commission's retail consumers numbered over 1,146,000 at 30 June 1974. Of these some 964,000 were domestic, 87,000 industrial and 95,000 commercial. Retail supply is administered through the metropolitan branch and nine extra-metropolitan branches with headquarters at Geelong, Dandenong, Traralgon, Mildura, Ballarat, Benalla, Bendigo, Colac and Horsham. Branch and district supply offices are located in Melbourne and all other major cities and towns in Victoria.

Complete electrification of the State has virtually been achieved. By 30 June 1974 over 1,100,000 homes and 75,000 farms were supplied with electricity. Only a few remote areas remain out of reach of public supply mains.

Electricity production, transmission and distribution

Electricity generated in the State system or purchased by it totalled 16,147,000 MWh in 1973-74. The system comprises a series of thermal and hydro-electric power stations. Inclusive of generator capacity both within the State and available to the Victorian system from outside the State, the total installed generator capacity at 30 June 1974 was 4,330 MW. Power stations are interconnected and feed electricity into a common pool for general supply. The major power station in the interconnected system is the 1,600 MW Hazelwood brown coal burning power station near Morwell, 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 partly completed Yallourn 'W' station. Peak load steam stations are located in Melbourne (Newport, Richmond and Spencer Street), and Red Cliffs, which has, in addition, some internal combustion plant. Hydro-electric stations are at Kiewa, at Eildon, on the Rubicon and Royston Rivers near Eildon, and at Cairn Curran. All generators for public supply within Victoria are Commission-owned, except Spencer Street Power Station, which remains the property of the Melbourne City Council, although operated as a unit of the interconnected system. The Victorian system is linked with the Snowy Mountains Scheme by a 330 kV transmission line, which also allows the interchange of energy between New South Wales and Victoria. The hydro station at Hume Dam on the River Murray is also linked with the Victorian interconnected system. Output and operating costs of this power station, owned by the Electricity Commission of New South Wales, are shared equally by the Electricity Commissions of Victoria and New South Wales.

The electrical transmission and distribution system in the State supply network at 30 June 1974 comprised over 100,000 kilometres of power-lines, 30 terminal receiving stations, and 70,000 sub-stations. Main transmission is by 500 kV, 330 kV, 220 kV, and 66 kV power lines which supply the principal distribution centres and also provide interconnection between the power stations. The 500 kV, 330 kV and 220 kV systems total 3,700 route kilometres.

Future development

Yallourn 'W' Power Station, now under construction, is located about one kilometre west of the present Yallourn Power Station. The first of two 350 MW turbo-generators is in service and the second unit is scheduled for early 1975. The third and fourth units, each 375 MW, are planned for service in 1979 and 1980. A natural gas-fired power station of 1,000 MW capacity is under construction adjacent to the existing Newport Power Station. It will have two 500 MW generating units, the first to be in service in 1977, the other in 1979. A 150 MW hydro station associated with an irrigation dam at Dartmouth is planned to be in operation during 1979.

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 to 1965.*' These Acts constituted the Commission and define its powers and duties.
- '*The Electric Light and Power Acts, 1896 to 1967.*' These Acts relate to the constitution of electric authorities, except the Southern Electric Authority and the Northern Electric Authority, and define their powers and duties and the conditions under which electricity is to be supplied and used.
- '*The Regional Electric Authorities Acts, 1945 to 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 to 1964.*' These Acts established the Southern Electric Authority and define the powers and responsibilities of the Authority.
- '*The Northern Electric Authority of Queensland Acts, 1963 to 1964.*' These Acts established the Northern Electric Authority. They also define its powers and responsibilities.
- '*The Electrical Workers and Contractors Acts, 1962 to 1971.*' These Acts provide 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 rural area outside metropolitan Brisbane.

The central network is within the area of supply of the Capricornia Regional Electricity Board, which is responsible for the generation, main transmission and distribution of electricity.

The central and southern networks were interconnected by a 275 kV transmission line in early 1973.

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, and electricity is purchased 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 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.

An inquiry is being made into all aspects of the future organisation of the industry in Queensland. It is planned that a single generating authority will become operative in 1975 and will be responsible for generation and main transmission throughout the State. Improvements in the organisation of the distribution function will be complementary to this development.

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 1972-73 being derived from this fuel. Hydro-electric stations, located mainly in North Queensland provided 8 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 in Queensland in power stations during 1972-73 totalled 7,612 million kWh. A further 22 million units were purchased in bulk from other producers of electricity for re-distribution to consumers.

At 30 June 1973 the total generating capacity of all Queensland power stations was 2,019,258 kW comprising 1,728,500 kW of steam plant, 135,200 kW of hydro-electric plant, 40,558 kW of internal combustion plant and 115,000 kW gas turbine plant.

The Southern electricity network is served by the following steam power stations: Bulimba 'A' (65,000 kW), Bulimba 'B' (180,000 kW), Tennyson 'A' (120,000 kW), Tennyson 'B' (120,000 kW), Swanbank 'A' (396,000 kW), Swanbank 'B' (480,000 kW) and Howard (37,500 kW) together with gas turbine stations—Swanbank 'C' (30,000 kW) and Middle Ridge (60,000 kW). The central network is served by power stations at Rockhampton (52,500 kW steam and 25,000 kW gas turbine) and at Callide (120,000 kW steam). The northern electricity network is supplied by steam power stations at Collinsville (120,000 kW) and Townsville (37,500 kW) and hydro-electric stations at Kareeya (72,000 kW) and Barron Gorge (60,000 kW).

The electrical transmission and distribution systems within the State comprised over 86,000 circuit kilometres of electric lines at 30 June 1973. The main transmission voltages are 275 kV, 132 kV, 110 kV, 66 kV and in certain areas 33 kV. The electricity supply industry's extensive rural electrification program continued using the single wire earth return system.

At 30 June 1973 the total number of electricity consumers was 626,888 of whom 233,596 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 (1,100,000 kW) and the construction of extensions to Collinsville (60,000 kW). The Gladstone power station will comprise four 275,000 kW generating sets, the first two of which are expected to be commissioned in 1975.

In North Queensland, the commissioning of a 60,000 kW set in 1974 will give the Collinsville station a total generating capacity of 180,000 kW.

The recommendation of the State Electricity Commission for the siting of the major power stations to follow the one being constructed at Gladstone, is now being considered by the Government.

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 1973, the Electricity Trust operated plant with a capacity of 1,081,000 kW, and is the most important authority supplying electricity in the State. There were approximately 469,000 ultimate consumers of electricity in the State, of whom

462,000 were supplied directly and approximately 7,000 indirectly (i.e. through bulk supply) by the Trust. Its major steam stations are Osborne 'B' (240,000 kW), Port Augusta Playford 'A' (90,000 kW) and Playford 'B' (240,000 kW), and Torrens Island (480,000 kW).

The Trust operates two smaller power stations, the Mt Gambier Station has an installed capacity of 22,000 kW and Pt Lincoln 9,000 kW—both locations are connected with the Trust's interconnected system with 132 kV lines.

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 station.

Western Australia

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

State Electricity Commission of Western Australia

The State Electricity Commission of Western Australia is empowered to co-ordinate all electricity and reticulated gas undertakings in the State. It is also required to encourage and promote the use of electricity and other power. The Commission provides a uniform tariff electricity supply through an interconnected grid system to the Metropolitan Area, the South-West and Great Southern areas, including an area extending eastward to Koolyanobbing and northwards as far as Ajana beyond Northampton in the Upper Midlands. Areas not connected to the grid system are supplied by independent power stations over which the Commission has varying degrees of control. Eight diesel power stations at Port Hedland (2), Karratha, Roebourne, Kununmarra, Halls Creek, Esperance and Onslow, are operated by the Commission and under the Country Towns' Assistant Scheme 21 diesel power stations and associated supply areas are operated by the Commission on behalf of the Local Authorities.

Since June 1972 the Commission has taken over the electricity supply in another five country towns, adding Kondinin, Dalwallinu, Pithara, Ongerup and Eneabba to towns now supplied from the grid system.

Under the Country Towns' Assistance Scheme the following town undertakings are now operated and maintained by S.E.C.: Yalgoo, Cue, Meekatharra, Wiluna, Gascoyne Junction, Salmon Gums, Nyabing, Pingrup, Denham, Nullagine, Marble Bar, Hyden, Kargarin, Lake Grace, Newdegate, Ravensthorpe, Derby, Leonora, Kulin and Jerramungup.

Natural gas is now reticulated in most areas of Perth metropolitan region and in Pinjarra and Carcoola, whilst simulated natural gas (SNG) is reticulated in the Bunbury area and tempered liquid petroleum (TLP) in Albany. The town of Geraldton was connected by a 132 kV transmission line to Perth's Northern Terminal and a 20 MW gas turbine generator was installed at nearby Utaarra for security and peaking purposes.

Some details of the Commission's activities for the year ending June 1973 are: Number of electricity consumer accounts 284,703 and 54,000 gas consumer accounts; electricity generated 2,985 million kWh; fuel used for electricity generation 1,150,000 tonnes of coal, 163,000 tonnes of fuel oil, 930 million cubic metres of natural gas, and 29,000,000 litres of diesel fuel.

For the same period an increase of 11.96 per cent of electricity sold was recorded whilst an increase of 56.8 per cent was also recorded in gas sold.

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, or 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 so 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 (kW)(a)	Assessed annual capacity(b) (million kWh)
COMPLETED STATIONS				
Waddamana 'B'	1949	344	48,000	(c)
Tarraleah	1951	299	90,000	606
Butlers Gorge	1951	56	12,200	71
Trevallyn	1955	126	80,000	542
Tungatinah	1956	306	125,000	557
Lake Echo	1956	173	32,400	76
Wayatinah	1957	62	38,250	278
Liapootah	1960	110	83,700	459
Catagunya	1962	43	48,000	263
Poatina	1965	829	250,000	1,329
Tods Corner	1966	41	1,600	13
Meadowbank	1967	29	40,000	210
Cluny	1967	16	17,000	93
Repulse	1968	27	28,000	161
Rowallan	1968	49	10,450	37
Lemonthyme	1969	159	51,000	284
Devils Gate	1969	69	60,000	298
Wilmot	1971	251	30,600	127
Bell Bay	1971	(d)	120,000	788
Cethana	1971	99	85,000	407
Paloona	1972	31	28,000	131
Fisher	1973	649	43,200	247
Total	..	..	1,322,400	6,977
STATIONS UNDER CONSTRUCTION				
Bell Bay, Stage 2	1974	(d)	120,000	788
Gordon, Stage 1	1976	186	288,000	1,466
Total	..	..	408,000	2,254
ALL STATIONS				
Grand Total	..	..	1,730,400	9,231

(a) Emergency gas turbine generating capacity of 21,000 kW at Bell Bay and 10,000 kW at Macquarie Point (Hobart) not included. (b) Assessed annual capacity is based on simulated operation of the whole system for hydro-electric plant. The figure for thermal plant corresponds to a capacity factor of 75 per cent. (c) Reserve plant only. (d) Thermal station.

The number of ultimate consumers at 30 June 1974 was 160,302.

New capacity

The Hydro-Electric Commission's current construction program is the Gordon River Power Development, Stage 1.

The first stage of the Gordon River Power Development involves the construction of a dam and a power station with a proposed instalment of 288,000 kW capacity with provision for an increase to 320,000 kW. An oil fired thermal station with a single 120,000 kW generator was completed at Bell Bay on the River Tamar in 1970. The second stage of the station which will double the capacity will be completed late in 1974. A further planned development is the Pieman River Scheme on the west coast of the State. It is expected that the first station in the scheme will be commissioned in 1980. The planned capacity of the Pieman River Scheme is 420,000 kW.

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 3,000,000 kW 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 4,000 kW of diesel alternators which are retained as a standby for essential supplies. The total number of ultimate consumers at 30 June 1973 was 54,053. During the year 1972-73 the bulk electricity purchased was 707,913,000 kWh and the system maximum demand was 184,400 kW.

Northern Territory

Electricity is supplied in the main population centres of the Northern Territory by the Electricity Supply Undertaking. The Department of the Northern Territory is responsible for policy, finance and business management of the Undertaking and the Department of Housing and Construction is responsible for operations and technical aspects.

A steam turbo-generating station is operated at Darwin. Alice Springs, Katherine, Pine Creek, Elliot and Daly Waters are supplied from diesel-generating power stations. Electricity for the township of Tennant Creek is at present purchased in bulk from Peko Mines N.L.

The Darwin Power Station has a generating capacity of 80,300 kW and a firm capacity of 56,800 kW. An additional generating unit with a capacity of 23,500 kW is now being installed and is due to be commissioned in 1975.

A new power station was commissioned recently in Alice Springs, and is presently running in parallel with the old station. Together they provide an installed capacity of 19,000 kW and a firm capacity of 13,800 kW. A further set of 5,600 kW capacity is due for commission in April 1975.

In Tennant Creek a new power station is under construction. This has been necessary due to the increased electrical requirement of Peko Mines N.L. and their subsequent ability to continue supplying the town. The Station is expected to be commissioned in early 1975. Initially it will have an installed capacity of 4,680 kW and a firm capacity of 3,120 kW.

The capacities of the other generating stations as at 30 June 1974 were Katherine, installed 6,900 kW, firm 5,200 kW; Pine Creek, installed 900 kW, firm 500 kW; Elliott, installed 140 kW, firm 70 kW; Daly Waters, installed 90 kW, firm 45 kW.

The total number of consumers served in the Territory as at 30 June 1974 was 16,449, an increase of 7.59 per cent over that of the previous year.

Statistical Summary

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