

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 Territory.

The information contained in the chapter relates to situations existing and projects contemplated in December 1967, 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.

INTRODUCTION

Distribution of population and location of 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 1967 thermal power equipment represented 71 per cent, hydro plant 26 per cent, and internal combustion equipment 2.5 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 governmental 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 pursuits 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 (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 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, 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 67 opposite). For purposes of both power production and irrigation it is necessary to regulate run-off, and this will be achieved by the use of Lake Eucumbene (formed by the construction of Eucumbene Dam) and other smaller storages to control the waters of the Eucumbene, Murrumbidgee, Tooma, and Tumut Rivers of 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 68, page 1134.

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 usable storage of 3.5 million acre feet. The waters of the Upper Murrumbidgee River are diverted into Lake Eucumbene by a dam at Tantangara and a 10½-mile tunnel from Tantangara Reservoir. From Lake Eucumbene the water flows through a 14-mile 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 9-mile 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 (capacity 1,500,000 kW, of which 500,000 kW will be provided by pump turbines) will be constructed below Talbingo Reservoir and will discharge into Jounama Pondage on the Tumut River. This pondage will provide a downstream pumping pool and also re-regulate discharges from Tumut 3 Power Station as required. Releases from Jounama Pondage will then enter Blowering Reservoir formed by Blowering Dam. This dam is under construction by the Snowy Mountains Authority as an agent for the State of New South Wales and will provide for the regulation of power station discharges for irrigation use in the Murrumbidgee Valley. The Authority is constructing a power station at the foot of the dam to generate power from releases of water for irrigation purposes.

* See also the chapter Water Conservation and Irrigation of this issue and special detailed article in Year Book No. 42, pp. 1103-30.

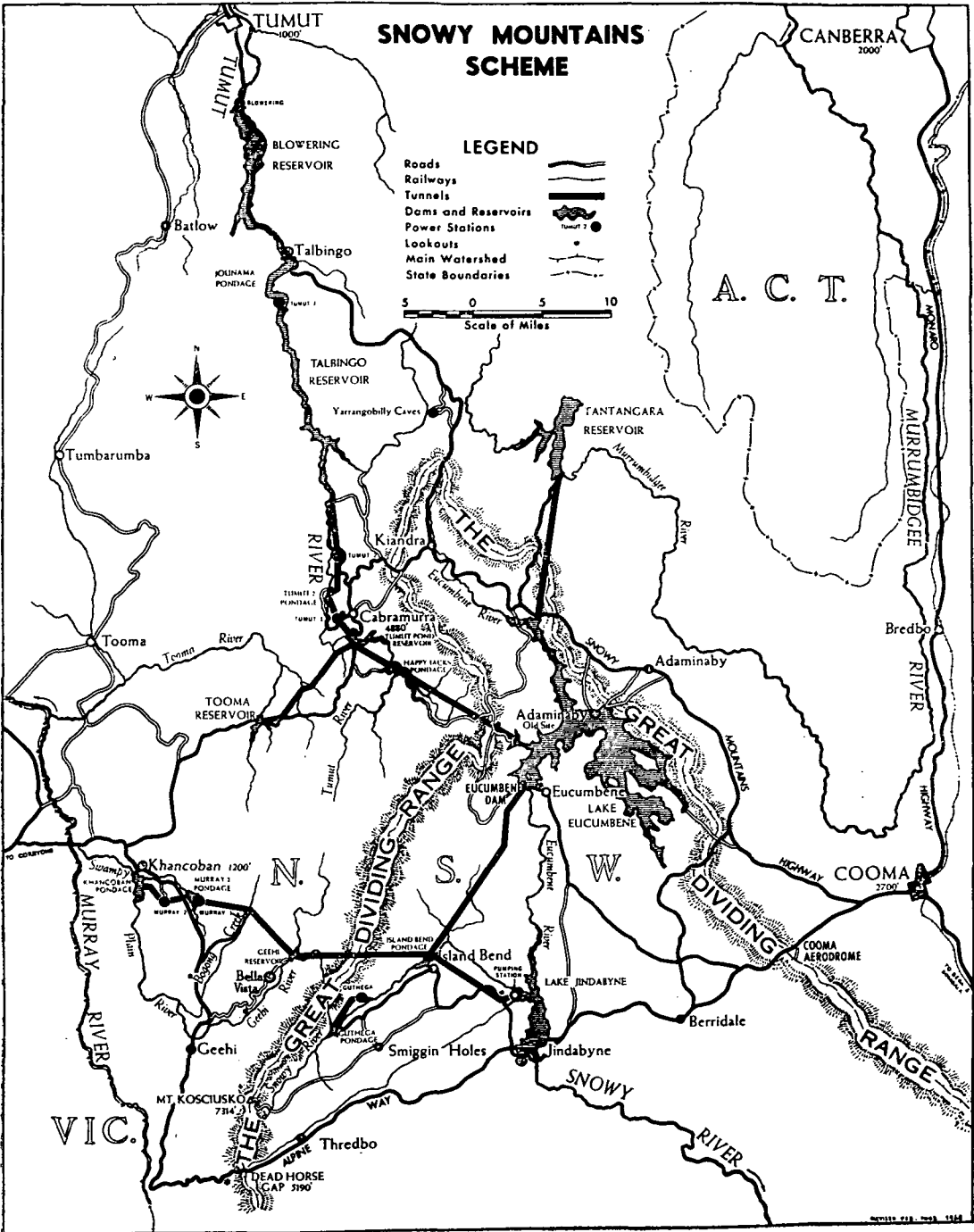


PLATE 67

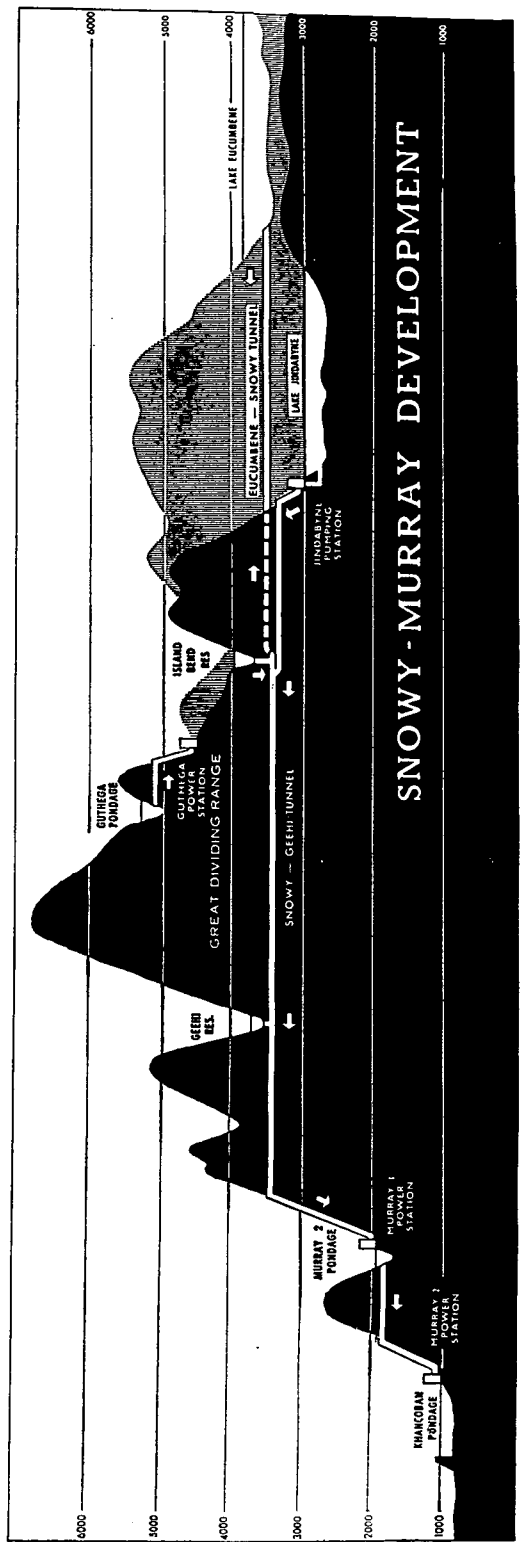
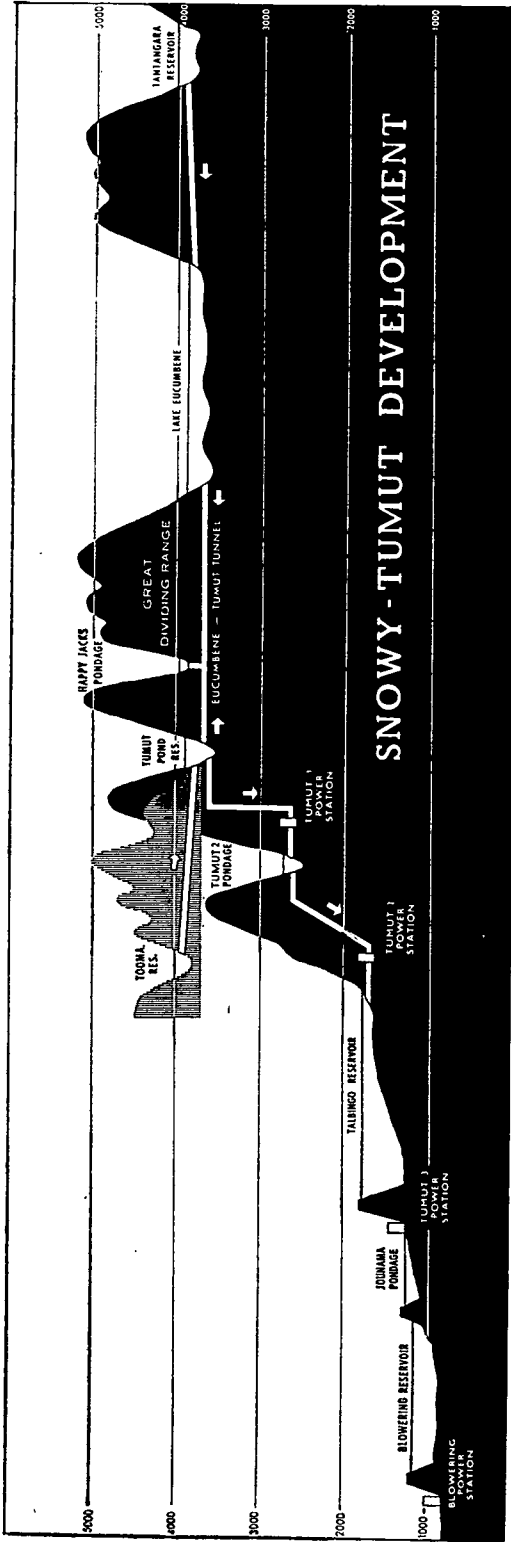


PLATE 68

Snowy-Murray Development. The principal features of the Snowy-Murray Development are the diversion of the main stream of the Snowy River by tunnels, shafts, and pipelines westwards through the Great Dividing Range into the Swampy Plain River in the catchment of the Upper Murray, and the development of power on the western slopes of the Alps. The main works of the development will be 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, will have a combined capacity of 1,500,000 kW.
- (b) A tunnel from a small 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 will be 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 the construction of a pumping plant, pipeline and tunnel to lift this water from Jindabyne Reservoir to the Snowy-Geehi Tunnel near Island Bend, where it will join 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 2 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 is being arranged so that the early stations operate, initially, somewhat below the peak of the system load, with a progressive change to predominantly peak load operation as construction proceeds and as the load increases 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 330 kV 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. Although most of the output from the scheme will go to the States of New South Wales and Victoria, the Commonwealth Government has the right to draw from the scheme its requirements of power and energy for the Australian Capital Territory and for defence purposes. For convenience, the Commonwealth's requirements are drawn from the New South Wales transmission network by an exchange arrangement between the Commonwealth 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 scheme and future programme

The scheme's first power station, Guthega, of 60,000 kW initial 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 14-mile Eucumbene-Tumut Tunnel was completed in June 1959. The 10½-mile Murrumbidgee-Eucumbene Tunnel and the 9-mile Tooma-Tumut Tunnel came into operation early in 1961. Following the completion of the Upper Tumut Works, construction activity has been concentrated on the Snowy-Murray development. The first unit of this development, the Eucumbene-Snowy project which comprises Island Bend Dam and the 15-mile Eucumbene-Snowy Tunnel, commenced diverting Snowy River water to storage in Lake Eucumbene in August 1965. Completion of a 9-mile trans-mountain Snowy-Geehi Tunnel, the 7½-mile Murray 1 Pressure Tunnel, the first of the 1-mile 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 have now been brought into commercial operation with the opening of the Murray 1 Project in July 1967. The total installed capacity of the scheme has now reached 1,610,000 kW.

Khancoban Dam, designed to regulate power station releases before their discharge into the Murray River, was completed in February 1966. Construction is proceeding on the Murray 2 Project in the base of the open cut excavated in the bank of Khancoban Reservoir downstream of Murray 1 Project. The four units of Murray 2 Power Station totalling 550,000 kW are scheduled to come into commercial operation in the first half of 1969.

Construction is also proceeding on the Jindabyne Project. The earth and rockfill dam was completed in September 1967, and the pumping station and Jindabyne-Island Bend Tunnel will come into service by the end of 1968.

Blowering Dam on the Tumut River will also be in service towards the end of 1968, and the 80,000 kW Blowering Power Station, also under construction, will be ready for commercial operation in October 1969 when the first of the stored water in the Blowering Reservoir will be released for the irrigation season downstream on the Murrumbidgee Irrigation Areas.

Work has begun on the Tumut 3 Project with the placing of earth and rockfill for Jounama Dam. This embankment will be sufficiently complete by winter of 1968 to allow the rising waters of the Blowering Reservoir to flood the Jounama Dam Site. The remaining sections of Tumut 3 Project are planned for completion by 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 three main 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 Electricity Development Act, 1945-1965, 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, 1950-1965, 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 1967 there were 41 supply authorities throughout the State, 34 electricity county councils (consisting of groups of shire and or municipal councils), four 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.

Over recent years there has been a distinct trend towards the consolidation of supply areas on a district basis for electricity distribution purposes. Generally, these consolidations have taken the form of a county district consisting of a number of neighbouring shire and municipal and city areas grouped only for electricity supply purposes, and administered by a county council of representatives elected by the constituent councils. Of the 224 cities, municipalities and shires in New South Wales, 215 are included in one or other of the thirty-four electricity county districts. The majority of these county districts have been constituted since 1945. The largest of the county councils is the Sydney County Council, which at 30 June 1967 was supplying 559,584 consumers in the Sydney metropolitan area.

Electricity Authority of New South Wales

The Electricity Authority was constituted for the purposes of promoting and regulating the co-ordination, development, expansion, extension, and improvement of electricity supply throughout the State. The following are the main functions of the Authority.

Distribution. The approval of the Authority is required for the establishment or acquisition of an electricity trading undertaking by a local government council, for the granting or renewing by such a council of electricity franchise agreements or corresponding agreements with other councils, and for the giving or taking of bulk supplies of electricity. It also has power to formulate proposals for the establishment of county councils. In exercising these powers, the Authority is concerned mainly with seeing that distributing authorities are sufficiently strong to provide an economical, efficient and satisfactory service. Its most important activities in this regard are in investigating supply areas and in making recommendations to the Minister for the consolidation of such areas into county districts.

Rural electrification. The Authority administers the rural electricity subsidy scheme under which rural electrification throughout the State has progressed very rapidly (see page 1138).

Safety. The Electricity Development Act, 1945-1965 contains provisions for the making of regulations relating to most aspects of safety, and these powers are being used more and more extensively. Safety regulations now in force cover such matters as inspection of consumers' installations, licensing of electricians and electrical contractors, approval of electrical appliances, safety of linesmen, and overhead line construction.

Generation and transmission. The approval of the Authority is required for the establishment or extension of power stations and main transmission lines (with the exception of those of the Electricity Commission).

Traffic route lighting. The authority administers a Traffic Route Subsidy Scheme under which a subsidy is paid to councils for the lighting of traffic routes to a standard approved by the Authority.

Generation and transmission

Except in the Snowy Mountains district and in one or two other areas New South Wales is lacking in major water power potential, and for the generation of electricity the State is dependent mainly on steam power stations. During the year ended 30 June 1967, coal-fired power stations generated 89.2 per cent of the State's energy requirements, hydro-electric stations 10.4 per cent and internal combustion plants 0.5 per cent. Of the 10.4 per cent generated from hydro-electric stations approximately 80 per cent was from the Snowy Mountains Scheme. This proportion will increase with the expansion of that scheme, but it is not expected that more than 15 per cent to 20 per cent of the State's power needs will be supplied from this source. The coal-fired steam power stations (and possibly atomic power stations in the future) will therefore continue to supply the greater part of requirements.

Major generating stations. At 30 June 1967 the major power stations of the State system of the Electricity Commission of New South Wales and their effective capacities were as follows: *Steam*—Vales Point (Lake Macquarie), 875,000 kW; Bunnerong (Sydney), 375,000 kW; Munmorah (Tuggerah Lakes), 350,000 kW; Wangi (Lake Macquarie), 330,000 kW; Tallawarra (Lake Illawarra), 320,000 kW; Wallerawang (near Lithgow), 240,000 kW; Pyrmont (Sydney), 200,000 kW; White Bay (Sydney), 172,000 kW; Balmain (Sydney), 107,000 kW; Port Kembla, 60,500 kW; Zarra Street (Newcastle), 42,500 kW; Muswellbrook, 30,000 kW; Lithgow, 27,000 kW; Tamworth, 27,000 kW; Maitland, 20,000 kW; Penrith, 20,000 kW; Liverpool, 20,000 kW; *Hydro*—Hume (near Albury), 50,000 kW; Warragamba (near Penrith), 50,000 kW; Burrinjuck (near Yass), 20,000 kW. There were also various other steam, hydro and internal combustion stations aggregating 40,000 kW. The total effective capacity of the Electricity Commission's system was 3,376,000 kW. The greater part of the Commission's generating plant is concentrated within a hundred mile radius of Sydney—the largest stations outside this area being located at Hume, Muswellbrook and Tamworth.

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 400 miles inland.

At 30 June 1967 there were in service 1,011 route miles of 330 kV (including 143 miles operating for the time being at 132 kV) and 2,397 miles of 132 kV transmission lines (including 55 miles operating for the time being at 66 kV or lower). There were also in service 2,532 miles of transmission line of 66 kV and lower voltages. The installed transformer capacity at the Commission's 124 sub-stations was 11,408,150 kVA.

Separate systems and total State installed capacity. A number of small plants which supply isolated towns and villages have not yet been interconnected with the main network. Some local government bodies have undertaken the development of independent power stations. Of these, the more important are: the Northern Rivers County Council, which has constructed a steam power station at Koolkhan (near Grafton) with an installed capacity of 28,750 kW, and the North-West County Council, which has established a 15,000 kW steam power station on the Ashford coalfield. The aggregate effective capacity for the whole of the New South Wales systems and isolated plants was 3,538,450 kW at 30 June 1967 and the number of ultimate consumers at this date was 1,427,654.

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. Vales Point and Wangi, on Lake Macquarie, Wallerawang, near Lithgow, and Tallawarra, on Lake Illawarra, have been completed.

Construction of the Munmorah Power Station, located between Lakes Munmorah and Budgewoi (on the central coast), is in progress. The plant at Munmorah will ultimately comprise four 350,000 kW generating units, the first of which was commissioned in 1967, the second in 1968, and the third and fourth units will follow at yearly intervals thereafter.

During the first half of 1965 work commenced on the Liddell Power Station project in the Hunter Valley, between Singleton and Muswellbrook. The designed capacity of Liddell is 2,000,000 kW, consisting of four 500,000 kW generating units, and is the biggest thermal power station yet planned in Australia. The first unit is scheduled for commissioning in 1971, and the second, third and fourth units in 1972, 1973 and 1974 respectively. The development of the 330 kV main system is continuing.

New work in hand includes the extension of 330 kV transmission to Tamworth and the construction of major 330 kV transmission centres at Tamworth and Newcastle and later at Armidale. Plans to augment the transmission system during the next five years provide for the construction of 460 route miles of 330 kV lines 1,237 miles of 132 kV overhead lines, 35 miles of cables, and 25 new sub-stations.

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 1132). Apart from this area, major hydro-electric stations are in operation at the Warragamba Dam (50,000 kW), Hume Dam (50,000 kW), Burrinjuck Dam (20,000 kW), and Keepit Dam (6,000 kW). The output of Warragamba Power Station depends upon the availability of water surplus to the requirements of the Sydney metropolitan area, and the output of the other stations on the release of water for irrigation. There are, in addition, four smaller hydro-electric installations in operation in various parts of the State.

Rural electrification

When the Electricity Authority of New South Wales was constituted in 1946 less than one-quarter of New South Wales farms within reasonable reach of public electricity supply systems were being served with electricity. Under a subsidy scheme approved in August 1946, local electricity suppliers receive subsidies from the Electricity Authority towards the cost of new rural lines. The amount of subsidy is based on the estimated cost of the proposed extension and the number of consumers able to be served by the new lines. The scheme was designed to encourage local electricity supply authorities to construct the more economic extensions first by fixing a limit to the cost for which suppliers could be subsidised. Originally this limit was \$500 per consumer when averaged over the cost of the whole extension, but the limit was raised to \$800 in December 1953. Some subsidy was paid on higher cost extensions, but the excess over an average of \$800 was not subsidised.

To assist supply authorities in extending supply to less populated, and thus high-cost, areas of the State the subsidy scheme was extended from May 1959 to provide for payment of increased subsidy in respect of extensions where the average capital cost per consumer lies within the range of \$1,200–\$1,600.

Between August 1946 and June 1967, applications for subsidy had been made by electricity suppliers to the Authority covering rural extensions costing \$80 million to give supply to some 59,475 farming properties and 35,770 other rural consumers and involving 58,216 miles of line. The greater part of this work had been completed at 30 June 1966. At this date the Authority was committed to the payment of \$33,668,048 in subsidies, of which \$19,665,374 had been paid.

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.

Constituted by the *Electricity Commissioners Act 1918*, the State Electricity Commission is a semi-governmental 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, acquire and operate electricity undertakings, develop, own and operate brown coal open cuts and briquetting works, and develop the State's hydro-electric resources. From its own revenues, which it controls, the Commission must meet all expenditure in the operation of its power, fuel and subsidiary undertakings, provide for the statutory payment of 3 per cent of its revenue to State Consolidated Revenue, and meet depreciation and all other charges on capital funds.

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. Incidental to its main operations, the Commission owns and operates the tramway systems in Ballarat and Bendigo.

State Electricity Commission of Victoria

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 and serves 98 per cent of the population. Development of Victoria's electricity system is based on the utilisation for both power and fuel of Victoria's extensive brown coal resources in the Latrobe Valley in eastern Gippsland, with supplementary development of the hydro-electric potential of north-eastern Victoria. Victoria is entitled to one-third of the electricity from the Snowy Mountains Hydro-electric Scheme, after the Commonwealth has taken the power it needs for its purposes. Victoria also shares with New South Wales in the electricity generated at Hume Hydro Station on the River Murray. More than 86 per cent of the State's electricity is generated from brown coal, either used in its raw state or manufactured into higher quality fuel in the form of brown coal briquettes. All the brown coal and briquette fuel is supplied by undertakings which the Commission itself owns and operates. Output of brown coal in 1966-67 from the three open cuts at Yallourn, Yallourn North and Morwell totalled 21,982,975 tons, of which 16,469,136 tons were used in the Commission's own power stations, and 5,082,326 tons were manufactured into 1,820,120 tons of brown coal briquettes, 30 per cent of the briquette output then being used for electricity production in metropolitan and provincial steam power stations. The two functions, generation of electricity and production of fuel, are closely integrated. Apart from the large proportion of brown coal and briquette fuel consumed in the power stations, the process of briquette manufacture results also in the generation of electricity, since the steam needed for processing the raw coal for briquetting is first used to operate turbo-generators.

Electricity supply

At 30 June 1967 the number of ultimate consumers in Victoria was 1,135,613. Of these, 1,129,704 were served by the State system and 5,909 by local country undertakings. The State system supplies all the Melbourne metropolitan area and over 2,300 other centres of population.

Complete electrification of the State is now within sight. By 30 June 1967 about 955,000 of the 967,000 homes in the State and 68,312 of Victoria's 69,700 farms were supplied with electricity. State-wide electrification is now nearing completion. It is expected that fewer than 3,000 homes and 1,250 farms in remote and isolated parts will be out of reach of public supply mains. Efforts will continue to be made to supply as many of these as possible.

The Commission sells electricity retail in all areas except part of the metropolitan area, where it sells in bulk to eleven municipal undertakings which operate as local retail supply authorities under franchises granted before the Commission was established. Bulk supply is also being provided at present to several New South Wales municipalities and irrigation settlements bordering the River

Murray. The number of consumers served by the State system outside the Melbourne metropolitan area is 531,025. Of the new consumers connected to supply each year, more than two-thirds are outside the metropolitan area. New farm connections approximate 3,600 a year.

The Commission's retail consumers numbered 911,038 at 30 June 1967. Retail supply is administered through the metropolitan branch and ten extra-metropolitan branches (Barwon, Eastern Metropolitan, Gippsland, Mallee, Midland, Mid-Western, North-Eastern, Northern, South-Western and Wimmera). At 30 June 1967 there were branch and district supply offices in Melbourne and 95 other cities and towns in Victoria.

Electricity production, transmission and distribution

Electricity generated in the State system or purchased by it totalled 11,209 million kWh in 1966-67, or more than 99 per cent of all Victoria's electricity for public supply. 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 1967 was 2,896,000 kW. Power stations are interconnected and feed electricity into a common pool for general supply. The major power station in this interconnected system is the brown coal burning power station at Yallourn, which alone generates over 38 per cent of Victoria's electricity. Other power stations in the interconnected system comprise two further base load brown coal burning power stations, Morwell and Hazelwood (which now has four of its planned eight 200,000 kW generating sets in service); steam stations in Melbourne (Newport, Richmond and Spencer Street), Geelong and Ballarat, and also at Red Cliffs, which has, in addition, some internal combustion plant; and hydro-electric stations at Kiewa, at Eildon, on the Rubicon and Royston Rivers near Eildon, and at Cairn Curran. All within Victoria are Commission-owned, except Spencer Street Power Station, which remains the property of the Melbourne City Council, although operated as a unit in the interconnected system. A 330 kV transmission line links the Victorian system with the Snowy Mountains undertaking, and also provides facilities for interconnection between the Victorian and New South Wales State generating systems. Also linked with the Victorian interconnected system is the hydro station at Hume Dam on the River Murray. This power station is operated by the Electricity Commission of New South Wales. Output and operating costs are shared by Victoria and New South Wales. In meeting the total demand on the system, which fluctuates throughout the day and from month to month, each group of stations in the interconnected system is assigned a predetermined function dependent upon the availability of power from each group and the economics of generation. The various stations are utilised in the combination that will meet the system load most economically at a given time.

The electrical transmission and distribution system in the State supply network at 30 June 1967 comprised 53,210 miles of power-lines, 24 terminal receiving stations, 91 main transmission sub-stations, and more than 51,000 distribution sub-stations. Main transmission is by 330 kV, 220 kV and 66 kV power lines which supply the principal distribution centres and also provide interconnection between the power stations. The 330 kV and 220 kV systems total 1,425 route miles.

Future development

Major new construction is concentrated on the erection, on the brown coal fields of the Latrobe Valley, of a large brown coal burning power station (Hazelwood), which is designed to operate on raw brown coal fuel supplied by belt conveyor direct from the Morwell open cut. Hazelwood Power Station is the largest project yet undertaken by the Commission and is designed to have a capacity of 1,600,000 kW in 1971. By that year the State's power resources, including Victoria's share of the output of the Snowy scheme, will have increased by 35 per cent to 3,907,000 kW. The first of Hazelwood's eight 200,000 kW turbo-generators was commissioned in October 1964, the second generating set went into service in 1965, the third generating set in 1966, and the fourth generating set in 1967. Four other 200,000 kW sets will follow at yearly intervals. Power generated at Hazelwood Power Station is transmitted at high voltage to Melbourne metropolitan terminal stations for distribution through the State supply network. To follow the Hazelwood project a new power station—to be known as Yallourn 'W'—will be built about half a mile west of the present Yallourn Power Station. It will also operate on brown coal which will be supplied by conveyors from Yallourn open cut. Yallourn 'W' will have two 350,000 kW turbo-generators, the first to be in service in 1972 and the second in 1973.

Local country electricity undertakings

At 30 June 1967 there were five independent electricity undertakings in country centres in Victoria generating and distributing their own local supply. Three of these undertakings were in the west and north-west of the State. Under the State Electricity Commission's rural electrification programme

almost all the independent local country undertakings will ultimately be acquired and absorbed into the State system. For the year 1966-67 the total production of the independent undertakings was 23 million kWh. The number of consumers at 30 June 1967 was 5,909. The operation of the independent undertakings is governed by the *Electric Light and Power Act 1958*, which is administered by the State Electricity Commission.

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 1964.*' 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 directly and operate generating stations and transmission lines and to sell electricity in bulk, but up to the present it has not been found necessary or desirable to implement this power.

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. In addition to its main interconnected system this Board operates a smaller isolated system in the western portion of its area. This small system will be integrated with the main system at an early date.

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.

At present there is no interconnection between these three main networks. 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 being progressively centralised at internal combustion stations at Longreach and Barcardine. 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. In the remaining parts of Western Queensland there are a number of isolated electricity undertakings operated by Shire Councils.

The organisation of the industry in Queensland is moving progressively towards a greater integration of generating authorities so that the production of electricity can be centred to an increasing extent on larger and more efficient power stations.

Electricity generation, transmission and distribution

Electricity generated in the State is based primarily on black coal, 87.7 per cent of the total production during 1966-67 being derived from this fuel. Hydro-electric stations, located mainly in north Queensland, provided 10.7 per cent, and the balance of the production, 1.6 per cent, was from internal combustion plants located mainly in western Queensland, utilising oil, coal, or natural gas as fuel. Natural gas is the principal fuel used at the Roma power station. Electricity generated in Queensland in power stations in 1966-67 totalled 4,379 million kWh. At 30 June 1967 the major power stations within the State were as follows: *Steam*—Bulimba A (Brisbane), 92,500 kW; Bulimba B (Brisbane), 180,000 kW; New Farm (Brisbane), 75,000 kW; Tennyson A (Brisbane), 120,000 kW; Tennyson B (Brisbane), 120,000 kW; Swanbank A (Ipswich), 198,000 kW; Howard (near Maryborough), 37,500 kW; Rockhampton, 52,500 kW; Callide, 60,000 kW; Mackay, 12,250 kW; Townsville, 37,500 kW; *Hydro*—Kareeya (Tully Falls), 72,000 kW; Barron Gorge (near Cairns), 60,000 kW. The Mackay station also contains 3,000 kW of internal combustion plant. The total installed capacity of all Queensland generating stations was 1,259,300, which comprised 1,091,750 kW of steam plant, 135,205 kW of hydro-electric plant and 32,345 kW of internal combustion plant.

The electrical transmission and distribution systems within the State comprised 39,135 circuit miles of electric lines at 30 June 1967. The main transmission voltages are 132 kV, 110 kV, 66 kV and in certain areas 33 kV. Extensive rural electrification has been undertaken by means of the single wire earth return system. At 30 June 1967 the total number of electricity consumers was 515,000, of whom 203,000 were in metropolitan Brisbane. The total number of farming properties supplied with electricity was approximately 26,500.

Future development

Major new construction is concentrated on the development of four new power stations sited on coalfields. These are at Swanbank (396,000 kW and 480,000 kW) on the West Moreton coalfield near Ipswich, Callide (120,000 kW) on the Callide open-cut coalfield near Biloela, and at Collinsville (120,000 kW) on the Collinsville coalfield. These stations will supply the southern, central and northern networks, respectively. Cooling water for the Callide station is provided from a dam on Callide Creek. A dam on the Broken River will serve the Collinsville station. The water requirements of the Swanbank power station will be supplied from the Moogerah Dam. The Swanbank A station will consist of six 66,000 kW generating sets. Three of the six sets at this station had been commissioned by 30 June 1967. The fourth and fifth sets will be commissioned in 1968, with the final set scheduled for commission early in 1969. Gas turbine plants with generating capacities of 30,000 kW and 60,000 kW will be commissioned at Swanbank and Middle Ridge in 1969 and 1970, respectively. These units will be used as peak load plant. The planned ultimate capacity of Swanbank B power station is 480,000 kW. It will comprise four 120,000 kW generating sets, one of which will be commissioned annually from 1970 to 1973.

At 30 June 1967 two 30,000 kW generating sets had been commissioned at the Callide power station. A third unit was commissioned in October 1967. The final 30,000 kW set is scheduled for commissioning early in 1969. A 25,000 kW gas turbine unit was installed at Rockhampton in December 1967. At Collinsville power station, two 30,000 kW sets are planned for commissioning in 1968, with the third and fourth sets scheduled for 1970 and 1971, respectively. Investigations

are currently proceeding into the next major power station, or stations, to supply south, central and northern Queensland after the early 1970's. The economics of interconnecting the three major grids are an essential part of these investigations.

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

Three main categories of organisations generate electric power in South Australia, namely: (a) governmental, which includes the Electricity Trust; (b) local authorities, e.g. municipal and district councils; and (c) other, including individuals and firms engaged primarily in generating power for sale, firms generating power primarily for their own use but supplying outside consumers, and firms generating power solely for their own use.

Of the total installed capacity in South Australia at 30 June 1967, the Electricity Trust operated plant with a capacity of 781,400 kW, and is the most important authority supplying electricity in the State. There were approximately 397,000 ultimate consumers of electricity in the State, of whom 381,000 were supplied directly and approximately 11,100 indirectly (i.e. through bulk supply) by the Trust. Its major steam stations are Osborne 'A' (60,000 kW), Osborne 'B' (240,000 kW), Port Augusta Playford 'A' (90,000 kW) and Playford 'B' (240,000 kW), and Torrens Island (120,000 kW).

The Trust operates two smaller power stations. The Mt Gambier station has an installed capacity of 21,800 kW and burns either wood waste or fuel oil. The other station at Port Lincoln has a 5,000 kW steam and a 4,600 kW diesel plant. Both locations are connected with the Trust's interconnected system with 132 kV lines.

No hydro-electric potential exists in South Australia. Steam generating units comprise 98 per cent of installed capacity and the balance is internal combustion equipment.

Leigh Creek and other new capacity

Fairly extensive deposits of low grade sub-bituminous coal are obtainable at Leigh Creek, about 360 miles north of Adelaide. Under the Electricity Trust of South Australia Act, 1946, the Trust was given authority to develop Leigh Creek coal for use in its own undertakings and also for sale to other consumers. Production from the Leigh Creek field commenced in 1944, and in the year ended 30 June 1967, 2,031,639 tons of coal were produced, practically all of which was used by the electricity undertaking at the Port Augusta Playford Power Stations, which use Leigh Creek coal exclusively.

A power station is to be constructed on Torrens Island near Adelaide, and four 120,000 kW turbo-alternators and associated boilers modified to use both natural gas or oil will be installed by 1971. The No. 1 unit consisting of 120,000 kW turbo alternator and associated boiler was placed on load for the first time in April 1967.

Western Australia

Since 1952 the State Electricity Commission of Western Australia has generated and distributed all electric current in the Perth metropolitan area. 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 was established by the *State Electricity Commission Act, 1945*, and, as at present constituted, consists of nine members, including the Chairman, appointed by the Governor. Four of the Commissioners are representatives of consumers, one for the metropolitan area, two for the rest of the State and one representing commercial consumers. Of the remaining five, one is the Under Treasurer of the State or his deputy, one represents employees of the Commission and three are required to be qualified engineers.

The Commission is empowered to co-ordinate all power undertakings in the State and to encourage and promote the use of electricity and other power, especially for industrial, manufacturing and rural purposes.

General pattern of electricity supply

The State Electricity Commission gives central power station supply to the metropolitan area, an area of approximately 30,000 square miles in the South-West and Great Southern Areas, and an area extending eastward from Perth to Koolyanobbing. The policy of extending power supplies to rural holdings is continuing, and at 30 September 1967 some 8,300 such consumers were connected. A scheme known as the Northern Areas State Power Scheme is also being developed, and a depot has been established in the Geraldton area where the Commission purchases power in bulk to supply districts as far north as Northampton. It also supplies Port Headland with power which is generated by a diesel station situated in the town.

In the other areas of the State, towns are supplied by the local authority or by a concessionaire operating under an agreement with the local authority and the Commission. Power stations operated under these conditions are exclusively diesel of varying sizes.

In Kalgoorlie the large goldmines generate their own power requirements. The Kalgoorlie Town Council operates a 50-cycle diesel station to supply A.C. consumers in Kalgoorlie and Boulder. The D.C. stations of the Kalgoorlie and Boulder Town Councils will continue to operate for some time at least.

The total number of consumers at 30 June 1967 was 226,360, of whom 206,722 were supplied by the Commission.

The Commission has developed its system to provide for the rapid expansion of industry and housing, and generating plant has increased almost eight-fold in the past twenty-one years. The four major power stations in the system are interconnected with the South-West Power Station at Collie, enabling the most economical units to be used as a base load station. Continuous development of the transmission and distribution system is also being undertaken to keep pace with the growth in consumer demand, which is being maintained at a high level. The activities of the interconnected system for the year 1966-67 were as follows: plant capacity, 409,500 kW; maximum load, 401,000 kW; units generated, 1,544,000 kW; fuel used per unit (kWh) generated, 1.39 lb; coal used, 836,058 tons.

New projects

Three of the four turbo-alternators installed at the Muja Power Station (near Collie) have been commissioned, and work on the other unit is proceeding to schedule. Contracts have been let for four 120,000 kW oil-fired units for a new station being built at Kwinana. It is expected that these units will be commissioned in 1969, 1970, 1971 and 1972.

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 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. The abundant and comparatively cheap supplies of electricity and other natural resources have attracted to Tasmania a number of important secondary industries, including large electro-chemical and metallurgical works with high load factor (in consequence of which the system load factor is also very high—70 per cent), for which energy costs constitute a large proportion of the total cost of production. The continuous power demand of these organisations when plant is in full operation aggregates 350,000 kW. 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.

The total installed capacity of alternators in the various power stations operating now, under construction, or projected is as follows.

<i>Power stations</i>	<i>Water system</i>	<i>Date of entry into system (a)</i>	<i>kW</i>
Waddanana 'B'	Great Lake	1944	48,000
Tarraleah	Derwent	1938	90,000
Bolters Gorge	Derwent	1951	12,200
Tongatinah	Nive/Ouse/Little Pine	1953	125,000
Trevallyn	South Esk(b)	1955	80,000
Lake Echo	Little Pine/Ouse	1956	32,400
Wayatinah	Derwent	1957	38,250
Liapootah	Derwent	1960	83,700
Catagunya	Derwent	1962	48,000
Poatina	Great Lake	1964	250,000
Tods Corner	Arthurs Lake	1966	1,600
Meadow Bank	Derwent	1967	40,000
Cluny	Derwent	1968	21,250
Repulse	Derwent	1968	28,000
Rowallan	Mersey-Forth	1968	10,450
Lemonthyme	Mersey-Forth	1969	51,000
Devils Gate	Mersey-Forth	1969	60,000
Wilmot	Mersey-Forth	1970	30,600
Cethana	Mersey-Forth	1970	85,000
Paloona	Mersey-Forth	1971	28,000
Fisher	Mersey-Forth	1971	44,650
Bell Bay Thermal		1971	120,000
Gordon River, Stage 1	Gordon/Serpentine/Huon	1975	240,000

(a) Actual till 1968; planned dates for subsequent years. (b) Discharge from Poatina enters South Esk via tributaries.

The number of ultimate consumers at 30 June 1967 was 135,941.

New capacity

The Hydro-Electric Commission is engaged on a construction programme comprising the Lower Derwent Power Development, the Mersey-Forth Power Development, Gordon River Power Development, Stage 1, and Bell Bay Thermal Power Station. Completion of the first-named, with dams and associated power stations Repulse, Cluny and Meadowbank, adds a further 85,000 kW to the system, and also brings to an end the exploitation of the power potential of the River Derwent and its tributaries.

The Mersey-Forth Power Development is scheduled to be completed progressively between 1968 and 1971. The essence of this development is the diversion of the flows of the Mersey and Wilmot Rivers and tributaries into the Forth River and the construction of Forth River dams. These diverted flows will be used for power generation at seven distinct power stations. The Mersey-Forth Project will add a total of 309,700 kW to the system. The first stage of the Gordon River Power Development involves the construction of a dam and a power station with a proposed instalment of 240,000 kilowatt capacity with provision for an increase to 320,000 kilowatts. An oil-fired thermal station with a single 120,000 kilowatt generator, to be built at Bell Bay on the River Tamar, is scheduled for completion by January 1971.

The Commission is conducting extensive surveys and investigation of other schemes with a view to further construction after the completion of the present programme. Investigations are continuing into the very considerable resources as yet untouched, principally in the west and south-west of the State, and it is estimated that the potential which can be developed economically should ultimately harness 2,400,000 kW to the system.

Statistical summary

The following table shows statistics for each State and Territory separately and for Australia for the year 1966-67. Statistics of the electricity supply industry for the years 1962-63 to 1966-67 are given in the chapter Manufacturing Industry. Particulars of the Snowy Mountains scheme are included under New South Wales in the following table.

CENTRAL ELECTRIC STATIONS: STATES AND TERRITORIES, 1966-67

	N.S.W.	Vic.	Qld	S.A.	W.A.	Tas.	N.T.	A.C.T.	Aust.
Generating stations—									
Government . . . No.	28	13	..	13	12	13	5	..	84.
Local authority . . . „	8	4	42	7	30	..	..	..	91
Companies . . . „	14	1	1	10	41	2	..	..	69
<i>Total stations</i> . . . „	50	18	43	30	83	15	5	..	244.
Installed capacity of generators—									
Steam . . . '000 kW	3,416	2,098	1,092	(a)	454	..	(a)	..	7,884.
Hydro . . . „	1,561	335	135	..	2	860	..	..	2,893
Internal combustion . . . „	79	22	32	(a)	109	1	(a)	..	273.
<i>Total capacity</i> . . .	5,056	2,454	1,259	809	565	861	47	..	11,051
Persons employed(b) . . . No.	4,103	3,965	1,918	(a)	1,120	(a)	91	..	13,085.
Value of output(c) . . \$'000	142,213	94,089	49,623	(a)	27,106	(a)	2,419	..	355,731
Value of production(d) . . „	104,343	63,978	23,641	(a)	15,434	(a)	1,263	..	237,385.
Electricity generated(e) . . million kWh	16,722	10,712	4,625	3,402	1,903	4,119	103	(g)	41,587
Ultimate consumers(f) No.	1,427,654	1,135,613	515,000	397,000	226,360	135,941	7,736	30,615	3,875,919.

(a) Not available for publication; included in the total for Australia. (b) Average employment in generating stations over whole year, including working proprietors. (c) Value, at generating station, of electricity produced plus certain earnings. (d) Value added in the process of generation. (e) Total generated including that generated by factories for their own use. The generation of electricity within each State takes no account of interchange of electricity between States. Furthermore, Victorian details exclude entitlements to generation from Hume Power Station and the Snowy Mountains Hydro-electric Scheme. (f) Approximate figures supplied by the electricity authority in each State. An 'ultimate consumer' is a person, business, undertaking, etc. that has contracted to receive electric power from a public or private organisation supplying this service. The number of ultimate consumers is not identical with the number of persons served with electricity because one ultimate consumer may represent three or four persons, e.g. in a household. (g) Not available. Excluded from Australian total.

Commonwealth Territories

The electricity supply undertakings at Canberra in the Australian Capital Territory and at Darwin, Katherine, Tennant Creek, and Alice Springs in the Northern Territory are operated by the Commonwealth Government.

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 1967 was 30,615. During the year 1966-67 the bulk electricity purchased was 377,280,000 kWh and the system maximum demand was 92,450 kW.

Northern Territory

At Darwin, supply was established by the Town Council in October 1934, but during April 1937 responsibility for generation and supply was transferred to the Northern Territory Administration. The Stokes Hill Power Station is now equipped with four turbo alternators with a total

capacity of 47,000 kW. Old Diesel Power Station with a capacity of approximately 5,000 kW is available as a stand-by. A 66kV transmission system is used in Darwin area. At Alice Springs the power station is equipped with a diesel generating plant of 8,000 kW total capacity. At Katherine the power station is equipped with a diesel generating plant of 1,900 kW total capacity while at Pine Creek and Elliot power is supplied by a small automatic diesel alternator of 90 kW capacity. The total number of ultimate consumers served in the Territory at 30 June 1967 was 7,736.

Papua and New Guinea

Papua and New Guinea Electricity Commission. Responsibility for the operation and establishment of the electrical undertakings in Papua and New Guinea is vested in the Papua and New Guinea Electricity Commission, whose headquarters are located at Port Moresby. The Commission came into operation on 1 July 1963, and assumed the functions and responsibilities previously vested in the Electrical Undertakings Branch of the Department of Public Works. The Commission, on its own behalf, operates the public supplies in the main centres of population and, on behalf of the Administration, operates the supply in the minor centres and patrol posts, hospitals, agricultural establishments, etc., where the supply cannot be considered to be a fully commercial supply. It has also regulatory functions associated with the licensing of electricians and contractors, the control of franchise holders and the approval of appliances and electrical materials for use in the Territory.

Generating facilities. The Electricity Commission owns and operates thermal and hydro-electric facilities at Port Moresby and Goroka and thermal facilities at Lae, Madang, Samarai, Wewak, Rabaul, Kavieng and Kokopo, with a total installed capacity of 21.8 MW at 30 June 1967.

	<i>Hydro</i> kW	<i>Thermal</i> kW	<i>Total</i> kW
Port Moresby	5,500	5,370	10,870
Lae	(a)	3,300	3,300
Madang . . . . .	..	1,620	1,620
Goroka	400	500	900
Wewak . . . . .	..	1,360	1,360
Rabaul . . . . .	..	3,000	3,000
Kavieng, Kokopo, Samarai . . . . .	..	730	730
Total	5,900	15,880	21,780

(a) For the growing demand of Lae, a 66 kV transmission line has been constructed to enable the import of 2,000 kW of power from the hydro-electric plant of Placer Development Ltd., at Bulolo.

In addition, the Commission owns and operates the distributing systems in these centres. The total substation capacity of all the systems amounts to approximately 45,585 kVa divided up in 349 stations. The Commission maintains the generating plant and distribution systems in all minor centres, acting as an agent of, and from funds provided by, the Administration. In the financial year 1966-67, 138 centres with a total installed capacity of approximately 6.0 MW were supplied with power. The townships of Wau and Bulolo are supplied exclusively with power generated by Placer Development Ltd. The number of consumers served by the Commission at 30 June 1967 was 11,417.

Future development. Considerable progress has been made at the Rouna No. 2 Power Station, although delays in the civil works resulted in commissioning the first set later than originally planned. The second and third sets are to follow in March 1968. The order for the manufacture and installation of Nos 4 and 5 generators at Rouna No. 2 has been placed, and these two sets are expected to be operating in 1969. Design work has commenced regarding the raising of the Sirinumu Dam to provide water storage for the enlarged Rouna No. 2 Power Station. Construction is to be completed by early 1971.

Investigations have been completed on the proposed hydro-electric development of the Upper Ramu River, and recommendations have been submitted by the Administration to the Commonwealth Government. The recommendations include proposals for a station designed for an ultimate installed capacity of 72,000 kW for a regional supply to Lae, Madang, Kainantu, Goroka, and Mount Hagen. Some 400 miles of 66 kV and 132 kV transmission line will be required to bring power to the centres of consumption.

Pending construction of the Upper Ramu hydro-electric scheme the diesel power stations at Lae, Madang, Goroka, and Mt Hagen are being extended as necessary to meet the growing loads in these areas.

Investigations are still continuing to locate suitable sources of hydro-electric power to supply the developing area on the Gazelle Peninsula of New Britain. However, the Warangoi Scheme, which looked promising initially, now appears uneconomical because of porous bedrock. Investigations have commenced in determining the next stage in developing supply to Port Moresby. Besides further development of the Laloki River, the potential of the Musa, Angabunga, and Vanapa Rivers are being examined. The feasibility of connecting Port Moresby with the future Upper Ramu Scheme is also being considered. Several small hydro-electric schemes for remote centres are being investigated. These include a 160 kW scheme for Finschhafen and a 200 kW scheme for Wabag. At Rabaul work has commenced on the installation of a 1,200 kW diesel generating set to be commissioned late 1968. A second unit is planned for 1969. Work has also commenced on a 22,000 V line to connect Kokopo to Rabaul.