CHAPTER VII.

ELECTRIC POWER GENERATION AND DISTRIBUTION.

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

It should be noted that the information contained in the chapter relates to situations existing and projects contemplated in 1960 and that it may be considerably affected by changes in policy or plans, or by developments in the projects themselves.

A. INTRODUCTION.

1. **Distribution of Population and Location of Power Resources.**—The geographical pattern of electric power generation and distribution in Australia has been affected by two main influences—the distribution of population, with a resulting distribution of industry, and the location of fuel and water resources.

The Australian population increased between 1939 and 1960 from approximately 6,968,000 to 10,281,000. The two principal centres of population and industry, 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 the Commonwealth, 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 30th June, 1959, thermal power equipment represented 76 per cent., hydro plant 20 per cent. and internal combustion equipment 4 per cent. of the total installed generating capacity.

Most of Australia is poorly supplied with water, only about 15 per cent. receiving an annual rainfall of 30 inches or over. This is confined largely to Tasmania and to the narrow coastal strip along the east coast of the mainland. The possibility of establishing large hydro stations in inland areas is, therefore, strictly limited by the lack of sufficient water.

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 through 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 3,000,000 kW within the next 25 years. 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 there available is only small compared with 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. Whereas on the mainland the chief source of energy is coal, water occupies this position in Tasmania.

2. **Electric Power Generation and Distribution.**—(i) *Ownership of Undertakings.* At the beginning of this century, Australia's electrical undertakings were carried on mainly by private enterprise, but some measure of governmental control was exercised through various electric light and power Acts. This legislation was designed to provide standards of safety, and to define the scope and obligations of the private organizations engaged in producing electric power for sale. A trend towards public ownership commenced during the 1914–18 War and became more pronounced after the 1939–45 War. By 1960, all major

generating stations supplying the public were, in varying degrees, under the control of State statutory organizations constituted with the object of unifying and co-ordinating the generation and distribution of electricity supplies within the various States. There are, however, 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, however, it has been and remains the practice for central authorities to sell power in bulk to local distributing organizations which undertake reticulation.

In addition to the private, local government and statutory organizations which generate and/or distribute electricity for sale, there are numerous firms generating 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, and the power regularly produced for such internal consumption is, in any case, a relatively small proportion of the total power produced.

(ii) *Power Production and Generating Capacity.* In the period between 1938–39 and 1959–60, production of electric power in Australia increased by nearly 400 per cent. from 4,688 to 23,344 million kilowatt hours.

Since the 1939–45 War, industry and commerce have expanded rapidly, many new houses have been built and the population has increased by approximately 39 per cent. These factors, together with the extension of electricity supplies to rural areas and the increased use of domestic electric appliances, have all helped to bring about a position where the greatly increased demand for power cannot be satisfied by the existing installed capacity of central generating stations.

At 30th June, 1959, installed generating capacity in Australia totalled approximately 5.53 million kW compared with 4.88 million kW in 1958, an increase of over 13 per cent. In 1958–59, each kW of installed capacity produced an average of nearly 4,000 kWh. These figures are based on Commonwealth totals; figures for the States vary, depending on such factors as the distribution of demand, number of consumers, and type of equipment employed.

B. SNOWY MOUNTAINS HYDRO-ELECTRIC SCHEME.*

1. **Snowy Mountains Hydro-electric Power Act, 1949.**—In July, 1949, the Commonwealth Government passed the Snowy Mountains Hydro-electric Power Act establishing the Snowy Mountains Authority.

The functions and powers of the Authority as defined in the Act are:—

(*a*) to generate electricity by means of hydro-electric works in the Snowy Mountains Area;
(*b*) to supply electricity generated to the Commonwealth:—
  (i) for defence purposes;
  (ii) for consumption in the Australian Capital Territory.

The Authority is empowered also to supply to a State, or to a State Authority, electricity not immediately required for defence purposes or for consumption in the Australian Capital Territory.

To enable it to perform its functions, the Authority is given power to construct, maintain, operate, protect, manage and control works:—

(*a*) for the collection, diversion and storage of water in the Snowy Mountains Area;
(*b*) for the generation of electricity in that area;
(*c*) for the transmission of electricity generated by the Authority;
(*d*) incidental or related to the construction, maintenance, operation, protection, management or control of any works otherwise specified in the Act.

The Authority is constituted by a Commissioner appointed by the Governor-General. He is assisted by two Associate Commissioners also appointed by the Governor-General.

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

* *See also* Chapter VIII.—Water Conservation and Irrigation, page 259 of this issue and special detailed article in Official Year Book No. 42, pp. 1103–1130.

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.

2. **Geography of the Area.**—The Snowy Mountains Area in south-eastern New South Wales is the only part of the continent in which altitudes exceed 7,000 feet and in which there is a substantial area over the altitude of 6,000 feet. The precipitation which results from the presence of this barrier on the line of the prevailing winter depressions of Antarctic origin amounts to as much as 120 inches a year in the vicinity of Mt. Kosciusko, the highest point in Australia. The drainage from the snowfields is practically all to three systems—those of the Murray and Murrumbidgee Rivers, which flow inland, and that of the Snowy River, which flows southward to Bass Strait.

3. **Description of the Scheme.**—(i) *General.* The Scheme 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. The features referred to may be identified by reference to the map on page 239. For purposes of both power production and irrigation, it is necessary to provide a considerable degree of regulation of run-off and this will be achieved by the use of Lake Eucumbene formed by the construction of Eucumbene Dam to control the waters of the Eucumbene, Murrumbidgee and Tumut Rivers for the Snowy-Tumut Development and of the Snowy River for the Snowy-Murray Development.

(ii) *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 length of the Tumut River. A major dam has been constructed on the Eucumbene River to create Lake Eucumbene with an ultimate usable storage of 3.5 million acre feet. The waters of the Upper Murrumbidgee River will be diverted into Lake Eucumbene by construction of a dam at Tantangara and a 10½ mile tunnel from Tantangara Reservoir. From Lake Eucumbene, the water will flow through a 14 mile tunnel to Tumut Pond Reservoir on the upper reaches of the Tumut River where it will join 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. A feature of this 14 mile Eucumbene-Tumut Tunnel will be its use during periods of high flow to divert waters of the Tumut River from Happy Jacks Shaft or from Tumut Pond back to Lake Eucumbene for storage.

From Tumut Pond, water will be conveyed by pressure tunnel to Tumut 1 underground Power Station (capacity 320,000 kW), returned to the Tumut River and then conveyed by another pressure tunnel to Tumut 2 underground Power Station (capacity 280,000 kW), thence discharging into Tumut 3 Reservoir at Lobs Hole also on the Tumut River.

Tumut 3 and Tumut 4 Power Stations will be constructed between Tumut 3 and Blowering Reservoirs. Blowering Dam is to be constructed by the State of New South Wales and will provide for the regulation of power station discharges for use for irrigation in the Murrumbidgee valley. The Authority will, however, construct another power station at the foot of this dam to make use of irrigation releases for power purposes.

(iii) *Snowy-Murray Development.* The principal features of the Snowy-Murray Development are the diversion of the main stream of the Snowy River by tunnel 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:—

(*a*) The construction of 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 be the Scheme's largest stations and will have a combined capacity of 1,200,000 kW.

(*b*) Construction of 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) The construction of 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.

Associated with the main Snowy-Murray diversion are power developments of the Upper Snowy and Upper Geehi Rivers. The Upper Snowy proposals provide for a series of three power projects utilizing the fall in the waters of the Snowy River from Kosciusko Reservoir at elevation 5,800 feet to Island Bend at elevation 3,900 feet. One of these, the Guthega Project, came into operation in February, 1955.

On the western side of the Divide, the waters of the Upper Geehi River and its tributary, Windy Creek, falling from an altitude of 5,200 feet to Geehi Reservoir at elevation 3,600 feet, will provide power in Windy Creek Power Station.

4. **Utilization of Power.**—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 utilize the potential of the Snowy Mountains Scheme most effectively, it is proposed to arrange the order of development so that the early stations will 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 geographically about midway between the principal load centres of Sydney and Melbourne and will be connected to these centres by 330,000 volt transmission lines. It will, consequently, be in a strategic 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 share of power and energy will be drawn from the New South Wales transmission network by an exchange arrangement between the Commonwealth and the Electricity Commission of New South Wales. After fulfilling the Commonwealth's requirements, the remaining power and energy from the Scheme will be divided between the States of New South Wales and Victoria in the ratio of 2 : 1.

5. **Progress and Future Programme.**—The first power station in the Scheme, Guthega, of 60,000 kW initial capacity, came into operation in February, 1955. This was followed by Tumut 1 Power Station, total capacity 320,000 kW, which came into operation progressively during 1959. Eucumbene Dam, which provides the major regulating storage for the Scheme, was completed in May, 1958, and water now being stored in Lake Eucumbene will be used later for power generation through the Tumut Power Stations. Completion of the Eucumbene-Tumut Tunnel in June, 1959, made possible the first major trans-mountain diversion of water. Construction is at present in progress on the second of the Tumut River Power Stations, Tumut 2, which, with a capacity of 280,000 kW, is planned to come into operation in 1962. Tantangara Dam on the Murrumbidgee River was completed in February, 1960, and water is now being stored in the reservoir for diversion to Lake Eucumbene through the Murrumbidgee-Eucumbene Tunnel which was completed early in 1961. The Tooma-Tumut Pond Tunnel was also completed early in 1961.

The next works to be constructed will be parts of the main Snowy-Murray Development and it is anticipated that the first production of power from the Murray 1 Power Station and the first trans-mountain diversion of the water from the Snowy River to the Murray will occur during 1966.

C. STATES AND TERRITORIES.

§ 1. New South Wales.

1. **General.**—In Official 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, describing in particular the growth of the systems of the Sydney County Council, the Department of Railways, the Electric Light and Power Supply Corporation Ltd., the Southern Electricity Supply and the Clarence River County Council (now the Northern Rivers County Council). A description was also given of the legislation which constituted The Electricity Authority of New South Wales and the Electricity Commission of New South Wales as well as legislation existing prior to their constitution. At present, the three main Acts governing electricity supply in New South Wales are:—

(i) 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.

(ii) The Electricity Development Act, 1945–1957, which established The Electricity Authority of New South Wales as the body responsible for the co-ordination of electricity supply throughout the State.

(iii) The Electricity Commission Act, 1950–1957, 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.

2. **Organization.**—(i) *The Electricity Commission of New South Wales.*—The Commission, which was constituted under the Electricity Commission Act, 1950–1957, consists of five members of whom one is full-time Chairman and one is full-time Vice-Chairman. In its administration, the Commission is directly responsible to the Minister for Local Government.

When the Commission was established, 93 per cent. of the State's power requirements were generated by four bodies—the Sydney County Council, the Department of Railways, the Southern Electricity Supply (a division of the Department of Public Works) and the privately-owned Electric Light and Power Supply Corporation Ltd. The Electricity Commission Act, 1950–1957, and the Electricity Commission (Balmain Electric Light Company Purchase) Act, 1950, provided for the acquisition of the power stations and main transmission lines of those bodies. The transfer of the power stations and transmission lines of all these undertakings has now been effected. On 1st July, 1956, the Commission acquired the power station and bulk supply system of the Tamworth City Council, which supplied in bulk to a number of distributing bodies in the north of the State.

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 tramways, and to certain large industrial consumers. As the major generating authority, it is also responsible for the development of new power sources. An important exception is the hydro-electric potential of the Snowy Mountains region which is being developed by the Snowy Mountains Hydro-electric Authority, a Commonwealth Government body.

(ii) *Other Electricity Supply Authorities.* The retail sale of electricity to the public is, in general, carried out by separate electricity supply authorities—municipal and shire councils, electricity county councils (consisting of groups of shire and/or municipal councils) or private franchise holders. At 1st August, 1960, there were 63 of these supply authorities throughout the State of which 20 also generated part or all of their power requirements. The majority of country power stations are small oil engine plants which are becoming increasingly costly to operate. Consequently, they are gradually being closed down as the main transmission network is extended further afield.

Over the past few years, there has been a distinct trend towards the consolidation of supply areas, many of which have been regarded as being too weak individually to form satisfactory areas for distribution. Generally these consolidations have taken the form of a county district consisting of a number of neighbouring shire and municipal areas grouped for electricity supply purposes only and administered by a county council of representatives elected by the constituent shire and municipal councils.

It is interesting to note that, of the 225 shires and municipalities in New South Wales, 207 are included in one or other of the 36 electricity county districts. Thirty-three of these county districts have been constituted since 1945. The largest of the county councils is the Sydney County Council which at 30th June, 1960, was supplying 470,322 consumers in the Sydney Metropolitan Area. Unlike the other county councils, which are constituted under the provisions of the Local Government Act, 1919, the Sydney County Council was specially constituted under the Gas and Electricity Act, 1935.

(iii) *The Electricity Authority of New South Wales.*—The Electricity Authority was constituted under the Electricity Development Act, 1945–1957, for the stated purpose of promoting and regulating the co-ordination, development, expansion, extension and improvement of electricity supply throughout the State. The Authority, which is a regulatory body only, consists of seven members of whom one is a full time Chairman. Like the Commission, it is responsible to the Minister for Local Government.

The main functions of the Authority are as follows:—

(*a*) *Distribution.* Under the Act, the approval of the Authority is required, *inter alia*, 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 mainly concerned 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. Many of the new county districts referred to earlier have been formed largely as a result of the Authority's advice.

(*b*) *Rural Electrification.* The Authority administers the rural electricity subsidy scheme under which rural electrification throughout the State is progressing very rapidly (*see* para. 4, p. 232).

(*c*) *Safety.* The Electricity Development Act, 1945–1957, 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 consumer's installations, licensing of electricians and electrical contractors, approval of electrical appliances, safety of linesmen and overhead line construction.

(*d*) *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).

3. **Generation and Transmission.**—(i) *General.* 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, therefore, dependent mainly on steam power stations. During the year ended 30th June, 1960, coal-fired stations generated 93.0 per cent. of the State's energy requirements, hydro-electric stations 6.4 per cent. and internal combustion plants 0.6 per cent.

The proportion of power generated in the hydro-electric stations will increase considerably with the future plant development of the Snowy Mountains Scheme by the Commonwealth Government, but at no stage of its development will the Scheme supply more than 15 per cent of the State's energy requirements. Coal-fired steam power stations, therefore, will continue to supply the greater part of requirements for the foreseeable future.

(ii) *Major Generating Stations.* In New South Wales, the generation of electricity has followed the general world trend towards large centralized power stations supplying large areas through inter-connected transmission networks. The greater part of the coal-fired generating plant is now concentrated within the bounds of the industrial centres of Sydney, Newcastle and Wollongong, where most of the population is also located.

As at 30th June, 1959, the major power stations of the State system of the Electricity Commission of New South Wales and their installed capacities were as follows:—*Steam*—Bunnerong "A" and "B" (Sydney), 375,000 kW; Pyrmont "B" (Sydney), 200,000 kW; White Bay (Sydney), 172,000 kW; Ultimo (Sydney), 80,000 kW; Balmain (Sydney), 107,000 kW; Port Kembla, 60,500 kW; Zarra Street (Newcastle), 50,000 kW; Tallawarra (Lake Illawarra), 120,000 kW; Wangi (Lake Macquarie), 270,000 kW; Wallerawang (near Lithgow), 120,000 kW; Muswellbrook, 30,000 kW; Lithgow, 27,000 kW; Maitland,

20,000 kW; Penrith, 20,000 kW; Liverpool, 20,000 kW; Tamworth, 27,000 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 67,270 kW. The total installed capacity of the Electricity Commission's system was 1,885,770 kW.

It will be seen, therefore, that 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, capacity 50,000 kW, at Muswellbrook, capacity 30,000 kW and at Tamworth, capacity 27,000 kW.

(iii) *Inter-connected Network.* The retailing of electricity to 97 per cent. of the population of New South Wales is in the hands of local distributing authorities who obtain electricity in bulk from the inter-connected supply system of the Electricity Commission of New South Wales. This inter-connected system of 330 kV, 132 kV and 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 30th June, 1960, there were in service 1,200 miles of 132 kV transmission line (including 167 miles built for eventual operation at 330 kV) and over 3,000 miles of 66 kV and lower voltage lines (including 314 miles built for eventual operation at 132 kV and 85 miles built for eventual operation at 330 kV).

Superimposed upon the 132 and 66 kV network will be a powerful 330 kV trunk system extending from the Snowy Mountains Hydro-electric Scheme in the South through Wollongong, Sydney and Newcastle to Armidale in the North. At 30th June, 1960, the section, 85 miles long, between the Snowy Mountains Upper Tumut Switching Station and the Commission's Yass 330/132 kV Sub-station had completed its first year of operation, conveying power from the Snowy Mountains Scheme to the Commission's inter-connected system and linking the inter-connected systems of the Electricity Commission of New South Wales and the State Electricity Commission of Victoria at the Upper Tumut Switching Station. A further 252 miles of this 330 kV transmission network has been built, but these sections are operating at lower voltages for the time being.

The installed transformer capacity at the Commission's 108 bulk supply sub-stations is 3,697,500 kVA.

(iv) *Separate Systems and Total State Installed Capacity.* There are a number of small isolated plants which have not yet been interconnected with the main network and which supply isolated towns and villages. Some councils along the Victorian border receive bulk supplies from Victorian authorities.

A number of 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 25,750 kW, and the North-West County Council, which has established a 12,500 kW steam power station on the Ashford coalfield.

The aggregate installed capacity for the whole of the New South Wales systems and isolated plants was 1,953,293 kW as at 30th June, 1960.

(v) *Future Development.* The major new thermal stations now being developed on the coalfields will become the main base load centres for the northern, southern and western regions respectively. At Vales Point on Lake Macquarie, near Newcastle, work has commenced on a large thermal station with a planned capacity of about 1,000,000 kW. The initial installation will comprise two 200,000 kW generating units. Tenders have been invited for plant for the second stage of the station which will comprise one 275,000 kW generating unit. At Wangi, also on Lake Macquarie, five units with a combined capacity of 270,000 kW are operating and work is proceeding to install a further unit which will bring the capacity of this station to 330,000 kW.

At Tallawarra on Lake Illawarra, near Wollongong, work on extensions involving the installation of two 100,000 kW generating units is progressing. When completed, the capacity of this station will be 320,000 kW. At Wallerawang, four 30,000 kW units are operating and work is proceeding on the installation of a further two 60,000 kW units which will increase the capacity of the station to 240,000 kW.

A small hydro-electric generating unit (6,000 kW) is being installed at the Keepit Dam near Gunnedah.

The development of the 330 kV main system is expected to be rapid in the next few years. In addition to the eighty-five miles of 330 kV line between the Snowy Mountains and Yass now operating at 330 kV and the other elements totalling 252 miles which have

already been built and are operating at lower voltages for the present, a section 42 miles long is being built between a new 330 kV substation just south of Sydney and a new 330 kV switching station at Dapto for the connexion of the Tallawarra Power Station extensions. Contracts have been let for the construction of a further section, 110 miles long, which will duplicate the existing line between the Snowy Mountains, Yass and Dapto. This work will permit full 330 kV operation of the whole of the link between the Upper Tumut Switching Station and Sydney South when the next large hydro-electric power station at T2 is completed in 1961. Other extensions of the 330 kV system about to commence include two lines (84 miles) from the Sydney South 330 kV substation to a new substation just north of Sydney and from there to the Commission's new Power Station at Vales Point. This work is expected to be completed in 1963.

New construction of 132 kV and 66 kV transmission lines will extend the system geographically within the next two or three years to South Grafton in the north, Burren Junction in the north-west and Hay in the west. The mileage of these and other lines of such voltages to be built within this period exceeds 400 miles. In the same period the Commission will build three new 330 kV substations, eleven new 132 kV substations and a number of substations of lower voltages. The additional transformer capacity resulting from this work and the augmentation of existing substations will be of the order of 3,000,000 kVA.

(vi) *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, p. 226). Apart from this area, there are in operation the new hydro-electric stations at the Warragamba Dam (50,000 kW) and Hume Dam (50,000 kW), the 20,000 kW station at the Burrinjuck Dam, and the 7,500 kW station at the Wyangala Dam. The output of Warragamba Power Station is dependent 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.

Of the remaining hydro installations, the largest is that of the New England County Council on the Oakey River, a tributary of the Macleay River, which has a capacity of 5,250 kW.

The Northern Rivers County Council operates a hydro-electric power station on the Nymboida River, a tributary of the Clarence River. This station has a capacity of 4,650 kW.

The Bega Valley County Council has constructed a hydro-electric scheme at Brown Mountain utilizing the headwaters of the Bemboka River. This installation has a capacity of 3,950 kW.

The Mullumbimby Municipal Council has in operation two 150 kW hydro units on Wilson's Creek, a tributary of the Richmond River.

4. Rural Electrification.—When The Electricity Authority of New South Wales was constituted in 1946, one of its first tasks was to devise a scheme for subsidizing the cost of rural electrification. At that time, only 16,000 New South Wales farms were being served with electricity—less than one-quarter of those within reasonable reach of public electricity supply systems. In August, 1946, a subsidy scheme was approved by the Government and put into immediate operation. Under this scheme, 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. In order that the funds available for subsidy purposes might be used to the best possible advantage, the scheme was designed to encourage local electricity supply authorities to construct the more economic extensions first. This was achieved by fixing a limit to the cost eligible for subsidy. Originally this limit was £250 per consumer when averaged over the cost of the whole extension but the limit was raised to £400 in December, 1953. Some subsidy was paid on higher cost extensions but the excess over an average of £400 was not subsidized.

To assist supply authorities in extending supply to less populated, and thus high-cost, areas of the State, the subsidy scheme has been 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 £600–£800.

Between August, 1946, and October, 1960, about 37,100 miles of new distribution lines in rural areas were erected at a cost of over £25,000,000. These lines served 46,300 farms and 28,700 other rural consumers. During the same period, the percentage of farms connected rose from 22 per cent. to 86 per cent. At 31st October, 1960, The Electricity Authority was committed to the payment of £11,079,154 in subsidies, of which £4,924,189 had been paid.

§ 2. Victoria.

1. **General.**—In Official 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.

2. **State Electricity Commission of Victoria.**—(i) *Power and Fuel Authority.* 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 about 97 per cent. of the population through a supply net-work covering more than three-quarters of the populated area of the State.

Development of Victoria's electricity system is based on the utilization 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 the Australian Capital Territory and within the Snowy Mountains area. Output from the Snowy scheme was made available to Victoria in the latter half of 1959. Victoria also shares with New South Wales in the electricity generated at Hume Hydro Station on the River Murray. Two-thirds 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. Nearly ninety-nine per cent. of the brown coal and all the briquette fuel are supplied by undertakings which the Commission itself owns and operates. Output of brown coal in 1959–60 from the three open cuts at Yallourn, Yallourn North and Morwell totalled 13,249,496 tons, of which 8,899,324 tons were used in the Commission's own power stations, and 3,594,636 tons were manufactured into 974,670 tons of brown coal briquettes, 33 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 directly consumed in the power stations, the actual process of briquette manufacture results also in large-scale generation of electricity, since the steam needed for processing the raw coal in the briquette factory is first used to operate turbo-generators in the power plant which functions in association with the briquette works.

(ii) *Status and Powers.* Constituted by Act of the Victorian Parliament, 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, and all interest and other charges incurred in the service of its loans and other capital commitments.

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. For the accommodation of its employees at Yallourn, the Commission owns and administers the town of Yallourn and owns large housing estates in the surrounding area. In the Kiewa hydro-electric works area, it has built the two townships of Mount Beauty and Bogong, municipal administration of the former now being vested in the Shire of Bright.

(iii) *Electricity Supply.* At 30th June, 1960, consumers in Victoria served by the State system totalled 869,331. Outside the State system, there were 20,156 other consumers served by local country undertakings. The system supplies all the Melbourne metropolitan area and nearly 1,600 other centres of population.

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. Rural electrification is now about 87 per cent. completed, the over-all plan to extend the State system to all populated regions of Victoria having made rapid progress during recent years. Consumers served by the State system outside Melbourne metropolitan area (368,421) have more than doubled, and the number of farms connected to supply (44,079) has almost trebled in the past 10 years. Of the new consumers connected to supply each year, more than two-thirds are outside the metropolitan area. New farm connexions average nearly 3,000 a year.

The Commission's retail consumers totalled 679,973 at 30th June, 1960. Retail supply is administered through the metropolitan branch, seven extra-metropolitan branches (namely Ballarat, Eastern Metropolitan, Geelong, Gippsland, Midland, North Eastern and South Western) and the North Western Region, which comprises Bendigo branch and the two sub-branches based on Mildura and Horsham (Wimmera). At 30th June, 1960, there were branch and district supply offices in 81 towns in Victoria.

(iv) *Electricity Production.* Electricity generated in the State system or purchased by it totalled 6,112 million kWh in 1959–60 or 99 per cent. of all Victoria's electricity. 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 30th June, 1960, was 1,484,000 kW. All but two small regional 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 nearly half of Victoria's electricity. Other power stations in the interconnected system comprise the important brown coal burning power station at Morwell, steam stations in Melbourne (Newport, Richmond and Spencer Street), Geelong and Ballarat; hydro-electric stations at Kiewa and Eildon, and on the Rubicon and Royston Rivers, near Eildon; and internal combustion stations at Shepparton and Warrnambool. 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 new 330,000 volt transmission line links the Victorian system with the Snowy Mountains undertaking, and also provides facilities for interconnexion 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, whether steam, hydro or internal combustion, is assigned a predetermined function dependent upon the availability of power from each group and the over-all economics of generation. The various stations are utilized in the combination that will meet the system load most economically at a given time. This procedure results in an arrangement of the system on the following general lines:—

(*a*) Yallourn Power Station, owing to the low cost of extraction and ample supply of raw brown coal, is a base-load station, and is operated continuously at its maximum economic capacity. The new Morwell Power Station which like Yallourn, burns raw brown coal, is also a base-load power station.

(*b*) Metropolitan and provincial steam stations and provincial internal combustion stations situated close to load centres are designed to operate as peak load stations to assist in meeting the heavy, short period load.

(*c*) Hydro stations are operated in accordance with the availability of water. Their primary function is to provide peak load power. As the basic purpose of Eildon reservoir is to provide water for irrigation, generation of electricity is mainly governed by irrigation requirements, but provision has been made for limited operation of the power station in winter when electricity requirements are at their heaviest and there is no irrigation demand for water. Hume Hydro Station also operates on water released for irrigation and no regular output of electricity can be expected during the non-irrigation months in the winter.

Commission power stations not yet connected with the rest of the State system comprise the two steam stations (Redcliffs and Mildura) serving the Mildura region.

(v) *Transmission and Distribution.* The electrical transmission and distribution system in the State supply network at 30th June, 1960, comprised 32,331 miles of power-lines, 14 terminal receiving stations and nearly 24,000 distribution sub-stations. Main transmission is by 220 kV, 132 kV and 66 kV power lines which supply the principal distribution centres and also provide interconnexion between the power stations. The 330 kV line connecting the Victorian system with the Snowy Mountains Scheme via Dederang, near Kiewa, came into service in November, 1959. The 220 kV system now extends from Yallourn to Melbourne, Melbourne to Kiewa and Kiewa to Shepparton. Two further sections of the 220 kV system—Melbourne to Colac and Shepparton to Bendigo—are operating temporarily at 66 kV. From Yallourn there is also a 132 kV transmission line to Melbourne. The 66 kV lines radiate from Melbourne to Geelong and main centres in the South West, Ballarat and Horsham, and Bendigo and Charlton, and also to Benalla and other main centres in the North East. Further 66 kV lines radiate from Yallourn to main centres in Gippsland.

(vi) *Future Development.* With the virtual completion in the 1960–61 financial year of works in hand at the Kiewa hydro-electric undertaking, major new construction will be concentrated on the development of the Commission's brown coal undertakings at Yallourn and Morwell in the Latrobe Valley and the erection of a large new brown coal burning power station (Hazelwood) near Morwell. At the same time, the Commission will continue its programme of rural electrification, extension of the State system (particularly in western and north western Victoria) and reinforcement of supply by extending the 220 kV system from Bendigo north-westward to Kerang and subsequently to Redcliffs, near Mildura, and also to Ballarat and Geelong where connexion will be made with the existing Melbourne-Colac line, thus completing a 220 kV circle around Central Victoria.

Yallourn Power Station is being greatly enlarged. An extension of 240,000 kW capacity is due for completion in 1962, which will complete the Yallourn power generation development, except for the eventual replacement of 175,000 kW of old plant probably with one generating unit of about 200,000 kW capacity. Enlargement of the power station will require a corresponding expansion in production of brown coal at Yallourn. New dredger plant will increase annual output at the Yallourn open cut to over 12 million tons in the 1960–61 financial year.

At Morwell, six miles from Yallourn, the Commission is developing a second brown coal power and fuel project. The new project comprises a large brown coal open cut and a major power station operating in association with a large briquetting plant. Some of the electricity generated at Morwell is needed to operate the briquette works, but most of the output of the power station is transmitted through Yallourn to metropolitan terminal stations for general supply through the State network. The power station began operation at the end of 1958. Installed generator capacity, now 110,000 kW, will be increased to 170,000 kW in the 1962–63 financial year. Commercial production of briquettes (using brown coal delivered by the Commission's own interconnecting railway from the Yallourn open cut) began in December, 1959. The briquette works (completed in September, 1960) have a production capacity of approximately 1,500,000 tons of briquettes a year. The Commission's new Hazelwood Power Station will be located a short distance south of Morwell. It will operate on raw brown coal fuel supplied by belt conveyor direct from the Morwell open cut. The power station will have a capacity of 1,200,000 kW and will comprise six turbo-generators each of 200,000 kW capacity. Hazelwood will be built in stages. Contracts have been placed and site work begun for the first two generating units (400,000 kW) and the related boiler plant. The first turbo-generator is due to be in service in 1964 and the second in 1965. Succeeding units are scheduled to be in service in 1967, 1968, 1970 and 1971. Power generated at Hazelwood Power Station will be transmitted at high voltage to Melbourne metropolitan terminal stations for distribution through the State supply network.

(vii) *Hydro Electricity.* At the Kiewa hydro-electric undertaking, in addition to the two completed stations, totalling 87,600 kW capacity, a third power station of 96,000 kW capacity, already in partial operation at 30th June, 1960, was due for completion in the summer of 1960–61.

3. **Local Country Electricity Undertakings.**—At 30th June, 1960, there were 33 independent electricity undertakings in country centres in Victoria generating and distributing their own local supply. Most of these undertakings were in the far south-west, 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 1959–60, the total production of the independent undertakings was 45 million kWh. The number of consumers at 30th June, 1960, was 20,156. The operation of the independent undertakings is governed by the Electric Light and Power Act, 1958, which the State Electricity Commission administers.

§ 3. Queensland.

1. **General.** In Official Year Book No. 39, an account is given of the growth of electricity generation in Queensland, with particular reference to the City Electric Light Co. Ltd. of Brisbane (now the Southern Electric Authority of Queensland), the Brisbane City Council and the Toowoomba Electric Light and Power Co. Ltd.

The first of these organizations supplies a large part of Brisbane's electric power requirements, and those of a considerable rural area in the south-eastern corner of the State, from modern power stations at Bulimba, a suburb of Brisbane. Capacity is 95,000 kW at Bulimba " A ", 120,000 kW at Bulimba " B ", and 10,000 kW, " packaged plant " at Abermain (near Ipswich). The output from a 3,200 kW hydro-electric unit installed at Somerset Dam near Brisbane is also fed into the Southern Electric Authority system. With these plants, 763 million kWh were generated in 1958–59 while the total number of the Authority's consumers at 30th June, 1959, was 118,793.

The Brisbane City Council's electrical undertaking and power production in 1958–59 had an installed capacity of 205,000 kW comprising 75,000 kW at New Farm and 120,000 kW at the new Tennyson Station, plus a 10,000 kW " packaged plant " also erected at Tennyson. Units purchased and generated amounted to 656 million kWh, and there were 133,278 consumers connected.

The Toowoomba Electric Light and Power Co. Ltd., which commenced operations in 1905, has now been absorbed by the Southern Electric Authority of Queensland.

The generation and distribution of electric power in Queensland had, until the last 20 years, tended to lag behind developments in this field in other States of Australia. The comparatively slow growth in the production and consumption of electricity can be attributed to some extent to the absence, prior to 1938, of a central statutory authority constituted to undertake the functions of co-ordinating, unifying and controlling the production and transmission of electric power. In addition, Queensland's vast area, coupled with a low population density, made large-scale rural electrification an uneconomic proposition, except in the south-eastern portion of the State, which surrounds the major centres of industry and population.

Before establishment of the Regional Electricity Boards in 1945, no attempts had been made to unify or co-ordinate electricity supplies outside of south-eastern Queensland, and rural electrification, apart from reticulation within certain townships, was practically unknown.

2. **Royal Commission on Generation and Distribution of Electric Power in Queensland, 1936.**—On 5th December, 1935, the Queensland Government appointed a Royal Commission to inquire into and make recommendations on matters relating to the generation and distribution of electric power in Queensland. An account of the results of its investigations and of the alternative proposals put before it will be found on page 1182 of Official Year Book No. 39.

3. **The State Electricity Commission of Queensland.**—The State Electricity Commission of Queensland commenced to function during January, 1938. Its main powers were to secure a proper and efficient supply of electric power, review tariffs, grant licences to supply

electricity, secure the safety of the public, and control and advise electrical undertakings generally. It was thus a controlling authority as distinct from an operating authority. Details of its growth and development may be found in earlier issues of the Official Year Book (*see* No. 44, p. 284). Since its inception, the Commission has made considerable progress in its task of developing the State's power resources and promoting a more widespread use of electric power. The degree of utilization of electrical energy in Queensland now compares favourably with other States in the Commonwealth.

4. **Regional Electricity Boards.**—With a view to facilitating the control and development of electricity supply in areas of low population density and those having a predominantly primary producing economy, the Government, in 1945, passed the Regional Electric Authorities Act providing for the creation of regions of electricity supply and the constitution of Regional Electricity Boards.

Soon after passage of the Act, four Regional Boards were constituted, namely, Wide Bay, Capricornia, Townsville and Cairns. A fifth Board, entitled South Burnett, became an operating authority in October, 1947, but on 1st July, 1951, was absorbed in the Wide Bay Regional Board and this organization is now known as the Wide Bay-Burnett Regional Electricity Board.

As from 1st March, 1957, a further Regional Board became operative, covering the areas of Mackay, Sarina, Proserpine and adjacent rural areas under the name of Mackay Regional Electricity Board. Supply throughout this Region is provided from the central generating station at Mackay and accelerated electrical development of this area is being undertaken.

The Townsville Regional Electricity Board's area was extended in July, 1957, to include that of the Bowen Electricity Undertaking and in September, 1960, to include the Collinsville Electricity Undertaking. The local authority areas of Thursday Island and Cook were included in the Cairns Regional Electricity Board's area from 1st July, 1956, and 1st July, 1957, respectively. As from 1st January, 1958, the Capricornia Region was extended to include the Shires of Bauhinia, Belyando, Emerald and Peak Downs in Central-West Queensland.

Activities of the five Regional Boards in 1958–59 and 1959–60 compared with operations of the stations located in regions in 1945–46, are shown in the following table:—

QUEENSLAND: REGIONAL OPERATIONS.

Region.	1945–46.		1958–59.		1959–60.	
	Units Generated.	No. of Consumers.	Units Generated.	No. of Consumers.	Units Generated.	No. of Consumers.
	Million kWh		Million kWh		Million kWh	
Wide Bay-Burnett ..	13.7	11,467	81.2	29,513	90.3	31,298
Capricornia	19.5	11,196	146.9	22,417	151.3	23,210
Townsville	25.8	11,612	(*a*) 99.7	26,929	(*a*) 70.4	28,555
Cairns	22.7	9,722	174.8	21,088	230.8	22,425
Mackay	6.5	4,283	32.7	9,877	37.3	11,157
Total	*88.2*	*48,280*	*535.3*	*109,824*	*580.1*	*116,645*

(*a*) Excludes 49 m.kWh purchased from Tully Falls Power Station in 1958–59 and 94 m.kWh in 1959–60.

Installed generator capacity of the five Regional Boards at 30th June, 1960, was:—Wide Bay-Burnett, 37,500 kW; Capricornia, 54,753 kW; Townsville, 41,546 kW: Mackay, 13,000 kW; Cairns, 86,372 kW; total 233,171 kW.

5. **Creation of the Southern Electric Authority of Queensland.**—A major step in electrical progress was taken by the passing of the Southern Electric Authority of Queensland Act of 1952. This Act constituted the City Electric Light Co. Ltd. as a public authority to be known as the Southern Electric Authority of Queensland.

Two Government representatives are included on the Board of the Authority, whose establishment prepares the way for the complete amalgamation, in due course, of the electrical undertakings serving the south-eastern Queensland area of supply.

As from 1st July, 1954, the Southern Electric Authority acquired the Toowoomba Electric Light and Power Co. Ltd., thus bringing that company's area of supply under its control. The Southern Electric Authority is now responsible for the electrical supply and development of a consolidated area of 19,386 square miles.

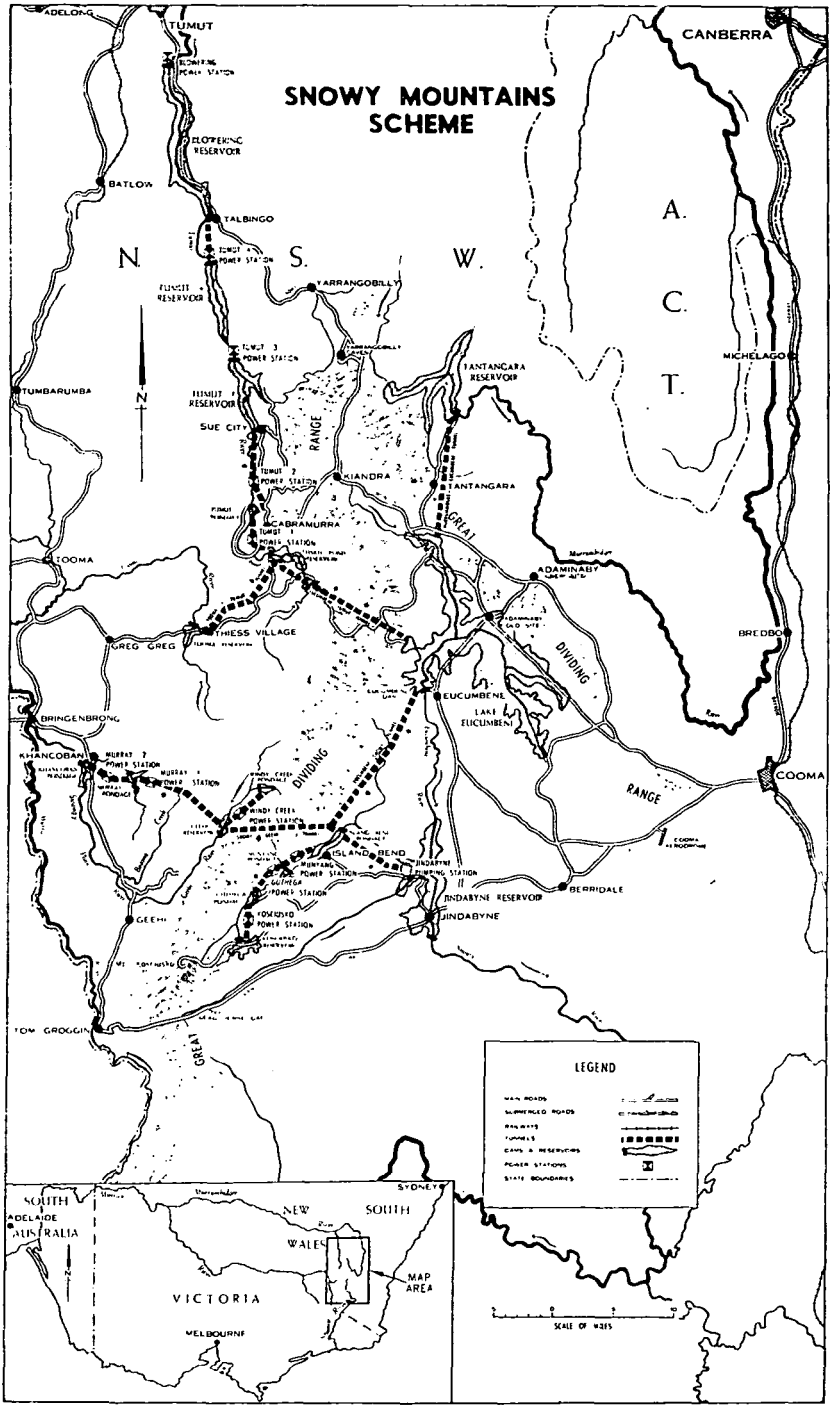
6. **Hydro-electricity.**—Behind the coastal plain of the Cairns-Ingham area is an extensive plateau with elevation ranging from 2,000 to 3,000 feet, although isolated peaks exceed 4,000 feet. The short coastal streams which rise on the plateau descend rapidly into deep gorges, which they have cut through the divide. With heavy monsoonal rainfall on their catchments and concentrated fall, these streams represent a considerable potential source of power, but storage, which can be provided in most cases, is essential to control the very variable flow.

There is a pronounced wet season from December to March, with a dry season from July to November. Average annual rainfall varies greatly with geographic location, being 178 inches at Deeral (midway between Cairns and Innisfail) but only 34 inches at Cashmere (120 miles south-west of Innisfail).

In 1935, a small hydro-electric power station was placed in service at Barron Falls, ten miles north-west of Cairns. The station comprises three 2,000 h.p. turbines, each driving a 1,320 kW generator, and with a hydraulic head of 410 feet. An output of 33 million kWh was attained during 1959–60, the station operating essentially as a run-of-river station without any significant water storage capacity being available. Power is fed at 22 kV into the main network at Mareeba and Cairns.

The hydro-electric power scheme at Tully Falls was commissioned in September, 1957, with an initial plant installation of 36,000 kW. Work has now been completed on the installation of a further two 18,000 kW sets, making a total installation of 72,000 kW. An output of 196 million kWh was obtained from this station during 1959–60. Water controlled by Koombooloomba Dam on the upper Tully River is diverted, a short distance above Tully Falls, through a tunnel and steel penstocks to an underground power station in the gorge at the foot of the Falls operating with Pelton driven generators under a head of 1,485 feet. Power is transmitted to the load centres at Cairns and Innisfail by means of 132 kV transmission lines. Future automatic power plants upstream and downstream from Tully Falls consisting of two 7,500 kW sets under 405 feet head and one 5,400 kW set under 230 feet head are under consideration. The combined peak load for the three plants would then be 69,000 kW. Interconnexion of the Tully Scheme with the Townsville area, which is also being served by a thermal station, was completed in February, 1958, by the provision of a 160 miles double circuit 132 kV transmission line. On present estimates, power from the completed Tully Scheme will be sufficient to supply the interconnected area until 1963 when additional power will be required.

The construction of a new peak load power station at Barron Falls to provide a firm (dry year) output of 60,000 kW at 25 per cent. load factor (i.e. firm output of 131 million kWh per annum) has been authorized by the Queensland Government. Orders have been placed for the major items of plant and construction of the scheme has commenced. This scheme will ensure an adequate supply of power to the Cairns and Townsville areas until 1967. The completed scheme will provide for an underground power station below the Barron Falls containing two 30,000 kW Francis turbines, operating under a head of 920 feet. Water will be carried from a pond above the Falls by horizontal tunnel and pressure tunnel to the power house. The existing weir will be raised by 8 to 16 feet for this purpose. An earth and rock fill dam will be built on Flaggy Creek, a tributary of the Barron, to provide storage capacity for the scheme, although initially spare storage capacity at the Tinaroo Falls Dam will be used.


SNOWY MOUNTAINS SCHEME
CANBERRA
A. C. T.
N. S. W.
ADELONG
TUMUT
BLOWERING POWER STATION
BLOWERING RESERVOIR
BATLOW
TALBINGO
TUMUT 3 POWER STATION
YARRANGOBILLY
TUMUT POND DAM
TUMUT 1 POWER STATION
TUMUT 2 POWER STATION
TUMUT 3 POWER STATION
TUMBARUMBA
TUMUT POND RESERVOIR
SUE CITY
KIANDRA
TANTANGARA RESERVOIR
TANTANGARA
GUTHEGA POWER STATION
GUTHEGA RESERVOIR
COOMA
ADAMINABY
BREDBO
THREDBO VILLAGE
JINDABYNE
EUCUMBENE
LAKE EUCUMBENE
BRINGENBRONG
KHANCOBAN
MURRAY 2 POWER STATION
MURRAY 1 POWER STATION
WINDY CREEK POWER STATION
ISLAND BEND
MINTARO POWER STATION
JINDABYNE PUMPING STATION
BERRIDALE
JINDABYNE RESERVOIR
GEEHI
GEEHI RESERVOIR
TOM GROGGIN
GREAT DIVIDING RANGE
LEGEND
MAIN ROADS
SURFACED ROADS
RAILWAYS
TUNNELS
CANAL & RESERVOIRS
POWER STATIONS
STATE BOUNDARIES
SCALE OF MILES
SOUTH AUSTRALIA
ADELAIDE
NEW SOUTH WALES
SYDNEY
VICTORIA
MELBOURNE
MAP AREA

Other major schemes which are currently being investigated include North Johnstone-Russell Rivers (32,000 kW); Beatrice-North Johnstone Rivers (9,000 kW); South Johnstone River (25,000 kW); Herbert River (90,000 kW).

In the Townsville Region, the Commission, acting on behalf of the Burdekin River Authority, investigated the proposed hydro-electric development of the Burdekin. The Scheme envisaged a power plant immediately below the Burdekin Falls Dam to operate under an average head of 225 feet.

In relation to other projects, the Scheme is not as favourable economically as a power production project alone, but as a joint power production, irrigation, and flood mitigation scheme, it has considerable potentialities. An estimated output of 80,000 kW at 50 per cent. load factor would be available.

The State Electricity Commission, in conjunction with other Government Departments, is carrying out an extensive investigation into the development of hydro-electric resources. It is estimated that full development of the hydro-electric potential of North Queensland would provide the equivalent of over 300,000 kW of power at 50 per cent. load factor or approximately 1,300 million kWh a year.

A number of small hydro-electric projects are being investigated in other parts of the State. On the Broken River near Eungella (50 miles west of Mackay), a site exists for the establishment of a peak load hydro-electric power station, and this is being examined. The construction, in the future, of a major dam on the Dawson River at Nathan Gorge (near Cracow) in the Capricornia Region for irrigation purposes, would permit the installation of a small hydro-electric power station at this site if the power produced could be economically absorbed. A plant of 3,200 kW capacity has been installed to utilize the outflow from Somerset Dam on the Stanley River a few miles above its confluence with the Brisbane River.

7. New Capacity.—(i) *Regions.* To provide for development of the electric power resources in the regions, the State Electricity Commission formulated a ten-year programme divided into two five-year periods. In the first, it was planned to erect main transmission systems to connect existing power stations located within the regions and supplement generating capacity by the construction of new stations. Work on this section of the plan in the original Regional Board areas is now complete. In the second, the transmission system will be extended to more sparsely settled areas, the ultimate purpose being the provision of " ring " transmission lines throughout each region and interconnexion between the regions.

A number of new generating stations have been commissioned as follows:—Wide Bay (Burnett Region), of which 15,000 kW was placed in service during September, 1951, and 7,500 kW in 1954, while a further set of 15,000 kW was installed in 1957. Rockhampton (Capricornia Region) of which 22,500 kW was placed in service during September, 1952, a further 15,000 kW in May, 1956, and a further 15,000 kW in December, 1958; and Townsville (Townsville Region) of which 22,500 kW was commissioned in July, 1953, and a further 15,000 kW in January, 1956. Each of these stations will have an ultimate installed capacity of 52,500 kW and be steam-operated. In the Cairns Region, the Tully Falls Hydro-electric Power Station has been completed with 72,000 kW installed capacity.

The Tully Falls Scheme (*see* para. 6, p. 238) was planned to link with the Townsville Regional Electricity Board's system for the purpose of marginal supply, and this interconnexion was completed by the close of 1957. Preliminary work has commenced on the construction of a further hydro-electric scheme on the Barron River which should be completed by June, 1963, and will add 60,000 kW to the available hydro-electric generation capacity in the area. The first stage of the Scheme's development is estimated to cost £5,850,000, and, initially, full use will be made of available storage capacity at Tinaroo Falls Dam, thus enabling construction of a £5,000,000 storage dam on Flaggy Creek to be postponed for a number of years.

At Mackay, where supply was first given in 1924, a Regional Electricity Board has now been constituted and a 66 kV transmission line to Proserpine has been erected. The generating capacity of the station under the control of this Regional Board is 12,500 kW, and a further 3,000 kW of diesel plant is being installed. To supplement this output

a transmission line from the Townsville Region has been planned. At Bowen, the Town Council, which established the service in 1952, transferred control of its area to the Townsville Regional Electricity Board, and transmitted supply is provided by a 66 kV transmission line. During 1935, a small (3,800 kW) power house—Australia's first underground hydro station—was placed in service at Barron Falls near Cairns. When the Cairns Regional Board was established during 1946, operation of the station passed to the Board's control and now comprises part of its generating plant.

(ii) *Western Queensland.* In western Queensland, where a number of small isolated generating stations supply power to some of the larger towns, the Commission has evolved a plan to increase and modernize existing capacity. It involves installation of small internal combustion units ranging in size from 100 kW to 600 kW according to the load likely to be experienced, and conversion from direct to alternating current supply. The Government has assisted the scheme by subsidy—a feature of electrical development in Queensland. Assistance provided for regional electrical development comprises subsidies of up to one-third of capital cost on annual loan charges, with special subsidies of up to 50 per cent. for authorities in the larger towns outside the Regions.

In addition to improving supplies to the larger western towns, a scheme was devised for electricity supplies for smaller towns in the western districts, where consumers range from 50 to 200. Subsidies of 65 and 60 per cent. will apply in those cases where the number of consumers supplied is less than 100 and 200, respectively. This plan is being implemented and at 30th June, 1960, 29 townships in western Queensland had been provided with electricity. The power is supplied by small oil driven generating sets with automatic controls which can be run with a minimum of operating attendance. In addition, investigations of the possibility of supply have been carried out at a number of other small centres.

Coal-burning gas producers have been successfully commissioned for public electricity supply purposes at Longreach, Clermont, Dalby, Blackall and Barcaldine and further extension of their use in western Queensland is predicted, as lower tariffs and more efficient production of electricity should follow their use.

(iii) *South-eastern Queensland.* To increase the availability of electric power in the south-eastern area of the State, the two major generating authorities, in conjunction with the Commission, have power station projects under construction which are designed to place in service, by 1968, new generating units totalling 400,000 kW. The Southern Electricity Authority is continuing the development of the station known as Bulimba "B" on a site adjacent to Bulimba "A". 120,000 kW had been installed to 30th June, 1960, and the ultimate capacity may reach 180,000 kW. At Tennyson in the Brisbane area, the Brisbane City Council has constructed a new power station with an initial capacity of 60,000 kW which may be increased ultimately to 180,000 kW. At 30th June, 1960, generating plant of 120,000 kW was in service at this station. To supplement capacity pending completion of these projects, "packaged" generating units totalling 20,000 kW were obtained from overseas and commissioned early in 1953, one 10,000 kW set having been installed at Tennyson and another 10,000 kW set at Abermain near Ipswich.

The power stations of the two major generating authorities at New Farm and Bulimba are interconnected at 33 kV.

§ 4. South Australia.

1. General.—An account of the companies generating electric power in South Australia prior to the establishment of the Adelaide Electric Supply Co. Ltd., and describing the development of that company's activities, was given in Official Year Book No. 39. Also included in the account was some reference to the early measures of public control over electricity supply in South Australia and the extent to which they were applied, and also to the inquiries into the activities of the Adelaide Electric Supply Co. Ltd. in 1932 and 1935.

Following upon an inquiry instituted by the Government in 1943, relative to measures for increasing electricity supply to the metropolitan area and country districts, the Electricity

Act 1943 was passed which, *inter alia*, established the South Australian Electricity Commission. However, until the State assumed full responsibility for the supply of electric power, this body was not able to do much more than exercise the formal functions conferred on it by the Act.

2. **The Electricity Trust of South Australia.**—Early in 1946, legislation was passed transferring the assets of the Adelaide Electric Supply Co. Ltd. to the 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. This legislation provided that the Trust should take over the powers vested in the South Australian Electricity Commission under the 1943 Act, which, after establishment of the Trust, ceased to exist. In addition to the powers specified in the Adelaide Electric Supply Company's Acts 1897–1931, the Trust may, *inter alia*, supply electricity direct to consumers within a district or municipality with the approval of the local authority, and by agreement with other organizations which generate or supply electricity, arrange to inter-connect the mains of the Trust with those of other organizations, and give or receive supplies of electricity in bulk.

3. **Capacity and Production.**—There are three main categories of organizations generating electric power in South Australia, namely:—(*a*) Governmental, which include the Electricity Trust; (*b*) Local Authorities, e.g., municipal and district councils, and Renmark Irrigation Trust; and (*c*) other, including individuals and firms primarily engaged 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.

In 1958–59, total installed capacity in South Australia was 403,366 kW, and electricity generated totalled 1,546 million kWh.

Of the total installed capacity, the Electricity Trust of South Australia operated plant with a capacity of 370,600 kW. It is thus the most important authority supplying electricity in the State. There were approximately 276,000 ultimate consumers of electricity, of whom 252,577 were supplied directly by the Trust and approximately 11,000 supplied indirectly by the Trust (i.e. through bulk supply). Its major steam stations were Osborne " A " (70,000 kW), Osborne " B " (180,000 kW) and Port Augusta " A " (90,000 kW), the balance of the capacity controlled consisting of house sets and regional stations at Port Lincoln and Mount Gambier, where the Trust operates steam power stations of 5,000 kW and 16,800 kW capacity respectively, the former furning fuel oil and the latter either wood waste or fuel oil.

No hydro-electric potential exists in South Australia. Steam generating units comprise 96 per cent. of installed capacity and the balance is internal combustion equipment. Until recently, all fuel consumed in the thermal stations was obtained from sources outside the State, and at times power restrictions were necessary owing to the inadequacy of supplies.

4. **Leigh Creek and other New Capacity.**—With a view to reducing the dependence on external sources of fuel, steps have been taken to produce local coal and to install plant to use it. 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 Amendment 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 30th June, 1959, 713,521 tons of coal were produced, practically all of which was used by the electricity undertaking.

In order to cope with the rapidly increasing demand for power, the Electricity Trust is constructing a second power station at Port Augusta, to be known as Port Augusta " B ". This station will have a capacity of 240,000 kW making the combined capacity at Port Augusta 330,000 kW. The first 60,000 kW turbo-alternator and one boiler with a capacity of approximately 30,000 kW were commissioned in June, 1960, and the station is scheduled for completion about 1964. Leigh Creek coal will be used exclusively. The power station will be interconnected with the metropolitan area by two 275 kV transmission lines.

Consideration is now being given to the future establishment of some pumped-storage hydro plant, as being possibly the most economic way of handling the peak loads of the system. It is possible that an installation of this type of plant would serve the increasing needs of the system until the late 1960's.

§ 5. Western Australia.

1. **General.**—Electrical undertakings in Perth and Fremantle formerly owned by the Perth City Council, the Western Australian Government Electricity Supply, the Fremantle Municipal Tramways and Electric Lighting Board and other metropolitan, municipal and road board supply authorities have been taken over by the State Electricity Commission of Western Australia. For information on the early history of electricity supply in the metropolitan area, *see* Official Year Book No. 39, page 1189.

2. **Metropolitan Undertaking.**—Statistics relating to activities of the Metropolitan undertaking are shown in the following comparative table.

WESTERN AUSTRALIA: METROPOLITAN UNDERTAKING.
(Including Bunbury Power Station).

Particulars.		1938–39.	1958–59.	1959–60.
Plant capacity	kW	57,000	215,000	245,000
Maximum load	kW	33,000	133,000	149,000
Units generated	Million kWh	137	605	654
Fuel used per unit (kWh) generated ..	lb.	2.77	1.56	1.51
Coal used	tons	168,722	414,919	442,211

3. **Kalgoorlie.**—In Kalgoorlie, the Municipal Council supplies approximately 3,800 consumers with either direct or alternating current. A diesel station of 1,825 kW generating capacity provides direct current to the limit of its capacity. Alternating current is purchased from Kalgoorlie Power Corporation and retailed by the Council to some consumers, while portion is passed through a rectifier to convert it to direct current. Primarily established to supply power to the gold mines, the Kalgoorlie Electric Power and Lighting Corporation operates a steam station of 11,000 kW and maintains a 22 kV line of 21 miles to the Celebration mine. Alternating current is also supplied to about 1,400 consumers. The Corporation's undertaking generates approximately 35 million kWh per annum and boilers are fired by Collie coal.

4. **General Pattern of Electricity Supply.**—The State Electricity Commission gives central power station supply to the metropolitan area and an area of approximately 25,000 square miles defined in the report which formed a basis for the South West Power Scheme Act.

These areas include the more highly developed rural districts with a greater population density, which can more readily be connected to a central power station system.

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, with the exception of Kalgoorlie which is separately mentioned.

5. **The State Electricity Commission of Western Australia.**—(i) *Origin and Aims.* In order to ensure an organized and co-ordinated future growth of electricity generation and distribution throughout the State, the Government introduced a Bill in 1945 to establish the State Electricity Commission, which, together with an Electricity Bill, became law early in 1946. Under these Acts, the Commission was given power, *inter alia*, to secure the ultimate co-ordination of all State or other electrical undertakings in the State, to construct and operate power stations and transmission lines and purchase as a going concern and carry on the undertaking of any supply authority. Under the Electricity Act, which should be read in conjunction with, and is subject to, the State Electricity Commission Act, no person or organization is permitted to construct or extend an electricity supply undertaking without consent from the Commission. Local authorities are empowered to operate and construct power stations and other works associated with the supply of electricity, provided that authority is first obtained from the Commission and any proposals are not inconsistent with the Commission's plans.

(ii) *New Projects.* Since its inception in 1946, the Commission has made the provision of an adequate reserve of generating plant its primary object. With the commissioning of the first unit at South Fremantle Power Station in May, 1951, the lag caused by shortages during the war and early post-war years was overcome.

The system then developed rapidly to keep pace with the expansion of industry and housing.

Generating plant has been quadrupled in the past fourteen years. The three major power stations have been interconnected with the South West Power Station at Collie enabling the most economical units to be used as a base load station.

Tenders will be called later for a new station to be built at Muja near Collie. In common with the present trend in Australia, this station is to be located on the coal fields adjacent to the coal source.

Continuous development of the transmission and distribution system is being undertaken to keep pace with the growth in consumer demand, at present about 8 per cent. per annum.

6. **South-west Development.**—At the request of the Government, the Electricity Advisory Committee, in 1945, submitted a report recommending, among other things, that a national power scheme for the south-west be proceeded with. The plan provided for acquisition of the existing Collie Power Station and installation of additional generating capacity, construction of a power station at Bunbury and interconnexion of the south-west scheme with the metropolitan system. On 12th October, 1946, the State Electricity Commission acquired the Collie Power Station, which prior to 1946 was owned and operated by the Collie Power Company Limited. At the date of acquisition, the Station's installed capacity was 5,000 kW, comprising two steam units, but this was increased to 12,500 kW in 1952.

Since 1950, the Commission has acquired a number of electrical undertakings from municipal bodies and private organizations in the south-west area and is proceeding with arrangements for the purchase of others. In August, 1951, the first portion of the South-West Power Scheme was officially opened at Collie and many of the south-west towns have now been connected by transmission line to the Collie Power Station. When completed, a system of power lines will reticulate electricity over an area of approximately 25,000 square miles. The first three 30,000 kW units and associated boilers at Bunbury Power Station have been placed in service. Work is proceeding as programmed on a fourth unit to give the Station an ultimate capacity of 120,000 kW. The first section was officially declared open on 23rd August, 1957.

Diesel stations of 9,400 kW capacity at Albany serve the towns of Albany, Denmark, and Mount Barker in the extreme south of the State.

§ 6. Tasmania.

1. **General.**—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. Other factors contributing to the low costs are that rainfall is distributed fairly evenly throughout the year, with comparatively small yearly variations. The cheap power has led to the establishment in Tasmania of several large electro-chemical works with high load factor, and as a consequence the system load factor is also very high (at present 65.1 per cent.).

For information on hydro-electric development in Tasmania prior to the establishment of the Hydro-Electric Commission in 1930, *see* Official Year Book No. 39, pages 1192–3.

2. **The Hydro-Electric Commission.**—(i) *Present System.* In 1929, the Government passed the Hydro-Electric Commission Act, under which was established the Hydro-Electric Commission and which vests in the Commission, with some minor exceptions, the right to use the waters of the State of Tasmania and authorizes 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 first project undertaken by the Commission was the Shannon Power Development which utilizes 258 feet of the difference in level between the Great Lake (Miena Dam) and Waddamana forebay. A small earthen dam diverts the outflow from the Great Lake through 2½ miles of canal and then by two pipelines to the Shannon Power Station, where 10,500 kW was added to the system in 1934. After passing through Shannon Power Station, the water discharges into the Waddamana canals to be used again at the Waddamana power stations.

In 1933, the Tarraleah Power Development was commenced. In this scheme, the waters of the River Derwent are picked up near Butler's Gorge by a canal and conveyed 14 miles to the pipeline forebay 982 feet above the power station on the Nive River where three 15,000 kW generators were placed in service in 1938. Shortly afterwards, two more 15,000 kW units were added and a sixth machine installed in 1951 brought the total installed capacity at Tarraleah Power Station to 90,000 kW. Storage is provided at Lake King William, an artificial lake created by the 200-ft. high Clark Dam across the Derwent at Butler's Gorge and at Lake St. Clair. In the Butler's Gorge Power Station at the foot of the dam, a single 12,200 kW generator was installed in 1951. To increase the security of the system and to permit variable seasonal loading of Tarraleah Station, a second canal from Clark Dam to Tarraleah was completed in 1955.

Early in 1939, it was decided to make full use of the Great Lake storage by increasing the peak capacity at Waddamana. War conditions impeded progress, but by 1945, two 12,000 kW generators had been installed in a new power station, Waddamana "B", adjacent to the original station Waddamana "A". A third unit installed in 1946 and a fourth in 1949 brought the total to 48,000 kW. To enable a full peak capacity to be maintained at both Waddamana stations a duplicate of the original Waddamana Canal was constructed during 1947–48.

Between 1930 and 1948, the generating capacity of the system was increased by 121,500 kW but the demand for power continued to increase rapidly and it was obvious that a greatly accelerated construction programme would have to be undertaken. Construction of the Tungatinah Power Development was started in 1948 and the Trevallyn Power Development in 1949.

The Trevallyn Power Development, the first constructed by the Commission outside the Central Plateau region, was undertaken primarily to meet the requirements of the aluminium industry. The waters of the South Esk River are diverted through two miles of tunnel and pipeline to a power station on the Tamar River near Launceston where four generators, with a total installed capacity of 80,000 kW were brought into operation before the end of 1955.

The Tungatinah Scheme draws water from three separate catchment areas located on the Central Plateau between the Great Lake (Shannon-Waddamana) and Lake St. Clair (Butler's Gorge-Tarraleah) catchments and control of practically the whole run-off from the Central Plateau has now been effected.

The principal catchment utilized by the Tungatinah Scheme is drained by the Nive River. A 120-ft. high dam at Pine Tier diverts the waters of the Nive through 6½ miles of canal system to the first of a chain of four artificial lakes, created by dams constructed across the outlets from natural marshes and linked by large open cuts. From the southernmost lake, a tunnel and then five steel pipelines lead to the five 25,000 kW generators in Tungatinah Power Station, 1,005 feet below on the Nive River just upstream from Tarraleah Station on the opposite bank of the river. Power was first generated at Tungatinah in mid-1953 with a capacity of 125,000 kW. Water from the smaller Clarence River catchment is brought into one of the lakes in the Tungatinah system by means of a woodstave pipeline 5½ miles in length and the third catchment area utilized is the Lake Echo-Dee River catchment. Regulation of this catchment has been achieved by construction of a dam at Lake Echo to provide the main storage reservoir for the Tungatinah Scheme, construction of the Lake Echo Power Station (one 32,400 kW generator) to utilize 568 feet of the difference in level between Lake Echo and Dee Lagoon, and the diversion of water from Dee Lagoon through 2 miles of tunnel to the main Tungatinah system.

The Wayatinah Power Development, started in 1952, comprises two power stations and headworks to utilize water which is, in the main, already regulated and which has been

used several times. The volume of water available is much larger and the head smaller than in the case of other major stations. All the water which passes through Tarraleah or Tungatinah Stations is diverted, by a weir across the Nive River below Tarraleah, through 4 miles of tunnel and then steel pipes to Liapootah Power Station, completed in 1960, with a capacity of 83,700 kW.

A dam across the River Derwent, just below its junction with the Nive, has created a lake into which flows all the water from the Liapootah Station plus water collected by the Derwent below Clark Dam. A mile of tunnel and a mile of pipeline leads the water to Wayatinah Power Station on the Derwent below its junction with the Florentine River. This Power Station, completed in 1957, has an installed capacity of 38,250 kW.

(ii) *New Capacity.* Four miles below Wayatinah, a diversion dam is being constructed at Catagunya, where a power station, designed to add a further 48,000 kW to the system, is scheduled for completion by 1962. The dam is designed as a pre-stressed concrete structure, 140 feet in height, and is notable as being only the second of its type and the longest yet undertaken by this technique anywhere in the world. The Hydro-Electric Commission is engaged in a progressive construction programme comprising the completion of the Catagunya and the Great Lake Power Developments. In the nine years between June, 1951, and June, 1960, the installed capacity of the system has grown from 184,500 kW to 569,050 kW. Approved construction will bring this total to 917,000 kW by 1966. Investigations are continuing into the very considerable resources as yet untouched, and it is estimated that the potential which can be developed economically should ultimately harness 2,400,000 kW to the system.

The Great Lake Power Development, now in the early stages of construction, is the most recent project to be undertaken by the Commission. In this scheme, the water of the Great Lake, by its diversion in the direction of the most precipitous fall, will be used to much greater advantage than at present. Eventually reaching the South Esk River it will be used again through the generators of the Trevallyn Power Station.

The works will consist of an intake at the Great Lake, a four mile headrace tunnel through the Western Tiers, one mile of surface pipeline on the face of the Tiers, a vertical shaft leading to the power station some 500 feet underground, a two and a half mile tailrace tunnel discharging into a canal, thence through a regulating pond into a channel flowing into the Lake River, a tributary of the South Esk River.

In this development, the power will be generated by the fall of water through a vertical distance of 2,750 feet to an underground power station where generators of 300,000 kW capacity will be installed. The station will be known as Poatina Power Station. A further section of the scheme includes the provision of a dam at Arthur Lakes to increase greatly the storage of the system, and a pumping station and a conduit discharging into the Great Lake so that water from this catchment may be utilized through the Poatina Power Station.

There is every indication that the demand for power in Tasmania will continue to increase. The Commission is conducting extensive surveys and investigation of other schemes with a view to further construction after the completion of the present programme.

3. **Power Usage by Secondary Industry.**—The abundant and comparatively cheap supplies of electricity and other natural resources have attracted to Tasmania a number of important secondary industries for which energy costs constitute a significant proportion of the total cost of production. Some of the more important organizations and their continuous power demands when plant is operating are as follows:—Electrolytic Zinc Company of Australasia Ltd., 85,000 kW at Risdon and 4,100 kW at Rosebery; Australian Aluminium Production Commission, 34,000 kW; Australian Newsprint Mills Ltd., 21,500 kW; Associated Pulp and Paper Mills Ltd., 17,200 kW; Australian Commonwealth Carbide Company Ltd., 7,850 kW; Mt. Lyell Mining and Railway Company Ltd., 5,500 kW; and Goliath Portland Cement Company Ltd., 3,600 kW.

In addition to the above, the Broken Hill Pty. Co. is setting up a plant at Bell Bay on the Tamar, for the manufacture of ferro-manganese. This is to be completed early in 1962, with a power demand of the order of 12,000 kW. There are expectations of expansion by, and hence of increased supply to, some of these organizations, and of new supplies to other industrial undertakings contemplating establishment in the State.

§ 7. Commonwealth Territories.

1. **Internal Territories.**—(i) *General.* 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.

(ii) *Australian Capital Territory.* The supply authority is the Canberra Electric Supply. Supply was first established at Canberra during 1915 and was met from local steam plant. Connexion to the New South Wales interconnected system was effected in 1929, and all requirements are now taken from this system. Total population served with electricity at 30th June, 1960, was 51,000 and the total number of ultimate consumers was 15,554.

The average annual rate of increase of demand since 1947–48 has been 15.15 per cent. and of energy, 14.10 per cent.

During the year 1958–59, the bulk electricity purchased was 123,150,000 kWh and the maximum demand incurred was 33,551 kVA.

(iii) *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 power station is equipped with diesel generating plant of 6,770 kW capacity, two new 970 kW diesel sets being installed in 1955–56 and an additional 1,380 kW diesel set during 1957. At Alice Springs, the power station is equipped with diesel generating plant of 2,266 kW capacity. A 520 kW set was installed in 1957–58 and an additional 865 kW set in June, 1960.

At Katherine, the power station is equipped with a small diesel generating plant of 450 kW capacity. The diesel station at Tennant Creek was closed down in 1957, supply for the township being purchased in bulk from Peko Mines No Liability.

The total number of ultimate consumers served in the Territory was 4,556 in 1959–60.

In 1956–57, the Department of Works selected a site on the water front of Darwin for a 15,000 kW steam driven generating set. This steam station is being designed to supply Darwin and suburbs when the present diesel station has reached its maximum economical capacity. Construction work is planned to be completed during 1962.

2. **External Territories—Papua and New Guinea.**—Responsibility for the operation and establishment of the electrical undertakings in Papua and New Guinea is vested in the Administration of the Territory of Papua and New Guinea, whose headquarters are located at Port Moresby. The total generating capacity of the diesel engine driven generating sets amounts to 6,389 kW and of the hydro operated sets 3,230 kW. The generating capacity of the power plants at the main centres is—Port Moresby, diesel 2,303 kW, hydro, 3,000 kW; Rabaul, 1,300 kW; Lae, 1,286 kW; Madang, 770 kW; Samarai, 300 kW; Kavieng, 114 kW; Wewak, 415 kW; Lorengau, 76 kW; Goroka, hydro, 200 kW; Aiyura, hydro, 30 kW; and 450 kW distributed among outstations where generating capacity is between 5 kW and 60 kW. The townships of Wau and Bulolo are still supplied by the Bulolo Gold Dredging Co., which operates a hydro-electric plant of 5,500 kW. Power produced by this plant is used mainly to supply alluvial dredges and, in addition, by the plywood mill at Bulolo.

The total number of ultimate consumers served in the Territory was 5,790 in 1959–60.

There is a vast hydro-electric potential in New Guinea and it has been estimated at 15,000,000 kW, but because of the island's location, absence of large load centres and lack of industrialization, only a small proportion could, at present, be economically developed.

In 1950, the Commonwealth Government joined with the British Aluminium Co. Ltd. of London to locate and develop large capacity hydro-electric schemes in New Guinea. A new company was formed, known as New Guinea Resources Prospecting Co. Ltd. with a capital of £100,000. The Commonwealth Government held 51 per cent. of the shares and had a controlling interest on the board of five members. The Commonwealth Government later sold its interest to a company formed by Consolidated Zinc Pty. Ltd., and the British Aluminium Co. Ltd., both of London. This company is continuing investigations into the hydro-electric potential with the object of treating bauxite, which is to be mined in the Gulf of Carpentaria.

The following hydro-electric schemes are now in operation: Port Moresby—at Rouna Falls on the Laloki River, generating sets have been established with an initial capacity of 3,000 kW, with provision for expansion to 5,500 kW as stage 2, and to 17,500 kW as stage 3. The power station began operations in January, 1957. The present project utilizes only portion of the power available from the Laloki River and the economic ultimate development will be of the order of 40,000 kW. At Aiyura, a 30 kW hydro-electric station for the Agricultural Experimental Station has been operating since August, 1956.

At Goroka, two 100 kW hydro-sets are now in operation and a 200 kW set is on order. Investigations are now being carried out to ascertain the possibility of installing an additional 500 kW hydro-set.

Stream gauging and other preliminary investigations for hydro-electric schemes have been carried out at Lae, Rabaul, Madang, Wewak and Highland Stations.

There are possibilities for major hydro-electric development in the following localities:—Rouna Falls (near Port Moresby), Upper Snake and Busu-Erap-Leron (near Lae), Upper Ramu (near Markham-Ramu divide—80 miles from Lae) and Hathor Gorge (on Purari River) with an estimated average power of 100,000 kW, 150,000 kW, 2 million kW, 250,000 kW, and 3 million kW respectively. These have estimated run-offs of 1,400; 6,000; 12,000; 1,000; and 75,000 cusecs respectively.

In an area of 150,000 square miles of the Eastern New Guinea mainland, the power potential has been estimated at 150 kW per square mile which compares favourably with potentials of 170 kW per square mile for Switzerland and 95 kW per square mile for Norway.

D. STATISTICAL SUMMARY, 1953-54 AND 1958-59.

The following table shows statistics for each State separately and for the six States combined for 1953–54 and 1958–59 and relates to:—(i) the numbers and installed capacity of central electric generating stations, (ii) the values of production and output and the average numbers of persons employed in the generating side of the electricity supply industry and (iii) the amount of electricity generated and the number of ultimate consumers of electricity.

For further statistics of the electricity supply industry (years 1938–39 and 1954–55 to 1958–59), *see* Chapter VI.—Manufacturing Industry.

CENTRAL ELECTRIC STATIONS.

Particulars.	N.S.W.	Vic.	Q'land.	S. Aust.	W. Aust.	Tas.	Total.
			1953–54.				
Generating Stations—							
Government .. No.	20	15	1	7	8	6	57
Local Authority ,,	34	28	45	14	38	..	159
Companies .. ,,	30	24	8	23	47	3	135
Total	*84*	*67*	*54*	*44*	*93*	*9*	*351*
Installed Capacity of Generators—							
Steam .. '000 kW	1,288	750	355	(*a*)	155	(*a*)	2,802
Hydro .. ,,	37	39	7	(*a*)	..	(*a*)	381
Internal combustion ,,	97	40	37	(*a*)	44	(*a*)	234
Total	*1,422*	*829*	*399*	(*a*)	*199*	(*a*)	*3,417*
Persons employed(*b*) No.	5,140	2,690	1,289	(*a*)	961	(*a*)	11,395
Value of output(*c*) £'000	31,401	16,169	9,057	(*a*)	5,663	(*a*)	69,981
Value of production(*d*) ,,	13,996	6,862	3,154	(*a*)	2,309	(*a*)	30,098
Electricity generated(*e*) million kWh	5,450	3,693	1,511	955	627	1,471	13,707
Ultimate consumers(*f*) No.	921,229	687,949	305,636	216,289	118,117	97,400	2,346,620

See following page tor footnotes.

CENTRAL ELECTRIC STATIONS—*continued.*

Year.	N.S.W.	Vic.	Q'land.	S. Aust.	W. Aust.	Tas.	Australia.
1958–59.							
Generating Stations—							
Government .. No.	26	17	1	6	11	8	69
Local Authority ,,	20	14	60	11	37	..	142
Companies .. ,,	18	13	2	18	40	3	94
Total	*64*	*44*	*63*	*35*	*88*	*11*	*305*
Installed Capacity of Generators—							
Steam .. '000 kW	1,883	1,030	595	(*a*)	270	(*a*)	4,172
Hydro .. ,,	312	237	79	(*a*)	2	(*a*)	1,126
Internal combustion ,,	81	43	38	(*a*)	58	(*a*)	233
Total	*2,276*	*1,310*	*712*	(*a*)	*330*	(*a*)	*5,531*
Persons employed(*b*) No.	5,542	3,398	1,644	(*a*)	1,106	(*a*)	13,124
Value of output(*c*) £'000	45,626	29,099	13,733	(*a*)	7,356	(*a*)	107,549
Value of production(*d*) ,,	28,101	18,529	5,883	(*a*)	3,493	(*a*)	63,422
Electricity generated(*e*) million kWh	8,275	5,704	2,305	1,583	876	2,456	21,199
Ultimate consumers(*f*) No.	1,104,810	852,288	384,100	276,000	149,932	114,442	2,881,572

(*a*) Not available for publication; included in the total for Australia. (*b*) Average employment in generating station, 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. (*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 organization 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.