CHAPTER VIII.

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 developments, 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 1956 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 1956 by approximately 2,460,000 to reach a total of 9,428,000. 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, 1955, thermal power equipment represented 79 per cent., hydro plant 15 per cent. and internal combustion equipment 6 per cent. of the total installed generating capacity.

Most of Australia is poorly supplied with water, only 15.2 per cent. receiving an annual rainfall of 30 inches or over. This is confined largely to Tasmania and to the narrow coastal strip on the east coast. The possibility of establishing large hydro or steam stations in inland areas is, therefore, strictly limited by the lack of sufficient water for feed and condensing purposes.

The only region on the mainland of Australia where land is high enough to receive reliable winter snowfall, and from which reasonably constant water supplies throughout the year can therefore 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 a small proportion of 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 1956, 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 who undertake local reticulation.

In addition to the private, local government and statutory organizations who 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 total power produced.

(ii) *Power Production and Generating Capacity.* In the period between 1938–39 and 1955–56, production of electric power in Australia increased more than threefold from 4,688 to 16,782 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 20 per cent. These factors, together with extension of electricity supplies to rural areas and the increased use of domestic electric appliances, have all contributed 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, 1955, installed generating capacity in Australia totalled approximately 3.95 million kW compared with 1.62 million kW in 1939, an increase of about 144 per cent. In 1938–39, each kW of installed capacity produced an average of 3,000 kWh per annum, compared with an average of 3,869 kWh in 1954–55. 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.

3. **Future Developments.**—Each central authority has embarked upon constructional programmes to overcome the lag between supply and demand. Industrial and commercial expansion, however, has continued on a high level, and several projects have been commenced or planned in various parts of the Commonwealth for suburban and main railway line electrification. Other fields directly connected with the demand for power, such as house building, must also be taken into account.

An important factor to be considered in respect of future development is the increasing relative importance of the generation of electric power from water resources.

B. SNOWY MOUNTAINS HYDRO-ELECTRIC SCHEME.*

1. **Geography of Area.**—The Snowy country in south-eastern New South Wales is the only part of the continent in which any 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, which flows southwards to Bass Strait.

2. **Description of Scheme.**—(i) *General.* The proposals at present being implemented by the Snowy Mountains Hydro-electric Authority fall into two groups, Tumut Development and Snowy-Murray Development, each having its associated plans for hydro-electric power production. The features described hereunder may be identified by reference to the map on page 273. It should be remembered that, as the final designs for practically every element of the Scheme have not yet been completed, and in many cases will not be completed for some years, any figures which are now quoted in respect of those elements will undoubtedly be subject to modification in the future.

(ii) *Tumut Development.* The central feature of this part of the Scheme is diversion to, and regulation of, the waters of the Tumut River, a stream which is at present completely unregulated but contributes approximately half of the flow of the Murrumbidgee River at Gundagai below the existing main storage on the Murrumbidgee at Burrinjuck. To the Tumut will be diverted the waters of the Eucumbene, a major tributary of the Snowy, and the headwaters of the Tooma, a tributary of the Upper Murray. The headwaters of the Murrumbidgee itself will also be diverted to the Tumut, principally to secure desirable electric power.

* *See also* Chapter IX.—Water Conservation and Irrigation, §3, para. 4 of this issue and special detailed article in Official Year Book No. 42, pp. 1103–1130.

A major dam is being constructed on the Eucumbene River at Adaminaby, creating an ultimate usable storage of at least 3.5 million acre feet, and from here, water will be conveyed by a 14-mile tunnel to Tumut Pond, on the upper reaches of the Tumut River, where it will be joined by the waters from the Tooma, diverted by aqueducts and tunnels. From Tumut Pond, the water will be conveyed by another tunnel to power station T1 with an installed capacity of 320,000 kW and by a further tunnel to power station T2 with a capacity of 280,000 kW thence discharging into a smaller storage at Lob's Hole also on the Tumut River.

Between the foot of the Lob's Hole storage and the top of the Blowering storage will be power stations T5 and T6. The total capacity of these stations will be 410,000 kW.

The Blowering storage with its capacity of about 800,000 acre feet, is an adjunct to the Snowy Mountains Hydro-electric Scheme and will be required for the regulation both of the Tumut waters and of the waters diverted into the Tumut. This regulation is essential if the waters impounded are to be fully utilized for irrigation purposes. At the foot of the Blowering Dam will be the last of the Tumut Power stations, T7, with a capacity of some 60,000 kW, but this station will operate only when water is released for irrigation. The State of New South Wales will be responsible for the construction of the Blowering works.

As originally planned, the waters of the Upper Murrumbidgee were to be brought from a major storage at Tantangara by tunnel discharging into a pond on the Yarrangobilly River, a tributary of the Tumut, and thence into the Lob's Hole Reservoir. This part of the Scheme has now been amended and the waters to be stored at Tantangara, 616,500 acre feet, will now be diverted to the Adaminaby storage through 9 miles of tunnel, and augment the flow through power stations T1, T2, T5, T6, and T7 on the Tumut River.

The total extra new water which will reach the Murrumbidgee is expected to average 528,000 acre feet per annum and the total installed capacity of the various power stations is estimated at 1,310,000 kW (excluding T7).

(iii) *Snowy-Murray Development.* The central feature of this part of the Scheme is the diversion of the waters of the Upper Snowy itself from a major dam to be constructed at Jindabyne on that river, a little below its junction with the Eucumbene and the Crackenback Rivers. This reservoir will have a storage capacity of approximately 1,100,000 acre feet and from it a tunnel approximately 28 miles in length will run right through the Great Dividing Range finally discharging into Swampy Plains River, not far above its junction with the Murray proper.

Into this tunnel will be collected a considerable quantity of water from the very high altitude country of the Kosciusko area and from a number of smaller tributaries of the Murray. The collection from the Kosciusko area commences at the Kosciusko Reservoir at an altitude of 5,765 feet, not many miles below the source of the Snowy. A tunnel will convey water from this reservoir to power station M.1.A. with an installed capacity of 60,000 kW and thence to a pond on the Snowy River, at its junction with the Guthega River.

From the Guthega Pond, a further tunnel and penstock lead to station M.1.B. with a capacity of 60,000 kW (ultimate capacity 90,000 kW), which discharges into a pond at the junction of the Munyang and Snowy Rivers. Construction of this part of the scheme has been completed. Munyang Pond will discharge into a tunnel leading to station M.2.L., with installed capacity of 60,000 kW. This station also receives the flow of a tributary of the Snowy River via station M.2.H. From station M.2.L., the water discharges into a reservoir at Island Bend on the main stream of the Snowy.

From the Island Bend reservoir, a vertical shaft, 1,100 feet deep, will lead to the main tunnel from Jindabyne reservoir previously referred to, passing on its way through power station M3 with installed capacity of 265,000 kW. Into this main tunnel will also be collected waters from the Upper Murray tributary streams previously mentioned.

Of these, the most important is the Windy Creek-Geehi River series. A pond on Windy Creek, a small tributary of the Geehi, situated at an altitude of over 5,000 feet, will provide water through a tunnel to station M4 with an installed capacity of 75,000 kW thence by aqueducts and tunnel to station M5.H. with an installed capacity of 40,000 kW discharging into the M5.L. Intake Pond on the Geehi River.

A vertical shaft will lead this water into the main tunnel, passing through station M5.L. with an installed capacity of 20,000 kW. The combined waters thus collected into the main tunnel will pass through station M6 with an installed capacity of 540,000 kW and then discharge into a pond on Bogong Creek, another of the Upper Murray tributaries. At this point, the water is still at an altitude of nearly 2,000 feet, and the main tunnel will thence continue to station M7 with a capacity of 540,000 kW.

From M7 the total collected waters will flow into the Swampy Plains River at a point some seven miles, in a direct line, above its confluence with the Murray. It will be necessary, however, to provide a further storage on the Murray for the proper regulation of these waters for irrigation purposes.

The total water flowing to the Murray from these works will amount on the average to 722,000 acre feet per annum, but since 280,000 acre feet which now reaches the Murray from the Tooma will be, as indicated previously, diverted to the Tumut, the total extra water actually reaching the Murray will be, on the average, 442,000 acre feet per annum ; the total installed capacity of the power stations will be 1,700,000 kW.

An integral part of each development is the construction of hundreds of miles of aqueducts to collect and divert water from the many streams in the area into storages and tunnels.

3. **Utilization of Power.**—The total capacity of all stations in the Scheme will be of the order of 3,000,000 kW. By comparison, the present total installed capacity of all the generating stations in the Commonwealth is over 4,000,000 kW.

If, however, the demand for power continues to increase as expected, the major source of power must still be thermal stations. The operation of the whole Scheme is dependent on the appropriate development and integration of these stations, as otherwise there would be a serious loss in ultimate economy ; all economic estimates therefore postulate that thermal capacity will be expanded so as to preserve an appropriate ratio.

It has been estimated with a reasonable degree of probability that the power available from the Scheme will save coal to the order of five million tons annually.

The first call on the power generated under the Snowy Scheme will be by the Commonwealth Government for supply to the Australian Capital Territory of power which it needs in that area, particularly for certain projects with defence significance, and no indication can at present be given as to how great that call will be. It is not likely, however, to amount to more than a relatively small fraction of the total power available, and it has been agreed that the balance will be divided between the States of New South Wales and Victoria in a proportion of two-thirds to New South Wales and one-third to Victoria.

The first power station in the scheme, M1.B., the Guthega Project, is now producing power. A 132,000 volt transmission line extends from the power station via Cooma to the Australian Capital Territory where it feeds into the main New South Wales transmission network. The construction of the Eucumbene-Tumut diversion tunnel, Tumut Pond Dam and Power Station T1 is in progress. The construction of the Adaminaby Dam is being carried out by the Public Works Department of New South Wales on behalf of the Authority and a contract for this work was let in May, 1956, to a group of American engineering contractors who were already engaged on the construction of the Eucumbene-Tumut tunnel and Tumut Pond Dam for the Snowy Mountains Authority. Power Station T1 will enter the New South Wales network via a 330,000 volt transmission line early in 1959.

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 1945–1948 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 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, consists of five members of whom one is a full-time 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, 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 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 the Sydney County Council, Southern Electricity Supply and the Department of Railways has now been effected. The date of transfer of the undertaking owned by the Electric Light and Power Supply Corporation Ltd. is dependent upon the determination of the valuation of the undertaking. On 1st July, 1956 the Commission acquired the power station and bulk supply 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 distribution 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 a grouping of shire and/or municipal councils) or private franchise holders. At 1st July, 1956, there were 116 of these supply authorities throughout the State of which 35 also generated part or the whole 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 238 shires and municipalities in New South Wales, 145 are included in one or other of the 29 electricity county districts. Twenty-four (24) of these county districts have been constituted since 1945. The largest of the county councils is the Sydney County Council which at 30th June, 1956, was supplying 379,381 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 1945–1948, 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 to see 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 below).

(*c*) *Safety.* The Electricity Development Act 1945–1948 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). The Authority may, for example, refuse approval for the establishment of a new power station if it is more economical and in the general interest for the supply authority concerned to purchase in bulk from another body.

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, mainly dependent on steam power stations. During the year ended 30th June, 1955, coal-fired stations generated 96 per cent. of the State's energy requirements, hydro-electric stations 2 per cent. and internal combustion plants 2 per cent.

The proportion of power generated in hydro-electric stations will increase considerably in the future with the development of the Snowy Mountains Scheme by the Commonwealth Government. Nevertheless, coal-fired steam power stations 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 major coal-fields, where the big industrial centres and most of the population are also located.

As at 1st July, 1955, the major power stations within the main inter-connected system and their installed capacities were as follows :—*Steam*—Bunnerong " A " and " B " (Sydney), 362,000 kW ; Pyrmont " A " and " B " (Sydney), 182,000 kW ; White Bay (Sydney), 118,000 kW ; Ultimo (Sydney), 80,000 kW ; Balmain (Sydney), 97,000 kW ; Port Kembla, 64,500 kW ; Zarra-street (Newcastle), 72,000 kW ; Tallawarra (Lake Illawarra near Wollongong), 60,000 kW ; Maitland, 20,000 kW ; Penrith, 20,000 kW ; Lithgow, 22,000 kW. *Hydro*—Burrinjuck (near Yass), 20,000 kW. There were also various other steam, hydro and internal combustion stations aggregating 66,650 kW. The total installed capacity of the main inter-connected system was 1,183,150 kW.

It will be seen, therefore, that the greater part of the State's generating plant is concentrated within a hundred mile radius of Sydney—that is, at Sydney itself (five stations), Port Kembla, Newcastle, Maitland, Penrith and Lithgow. The largest single station outside this area is located at Tamworth.

(iii) *Interconnected Network.* Over 90 per cent. of electricity consumers in New South Wales are now supplied through the main inter-connected systems. In this network, transmission lines operating mainly at 132,000, 66,000 or 33,000 volts interconnect the various power stations and distribute power to load centres throughout most of the south-eastern portion of the State and the north coast region. At 30th June, 1955, there were 660 circuit miles of 132 kV and about 1,500 circuit miles of 66 kV transmission lines in service in the interconnected system. The total installed capacity of the interconnected systems, which includes an aggregated capacity of 54,593 kW for various stations, including the Northern Rivers and Bega Valley County Districts linked with the main system, was 1,237,743 kW (as at 1st July, 1955).

(iv) *Separate Systems and Total State Installed Capacity.* There are a number of separate systems and isolated plants which have not yet been interconnected with the main network and which at 1st July, 1955, had an aggregate installed capacity of 67,634 kW. The most notable are the Tamworth and Muswellbrook Coal Company systems. The Tamworth system (23,000 kW), now taken over by the Commission, supplies power to an extensive district in the north of the State through 66,000 volt and 33,000 volt transmission lines. Both the Tamworth and Muswellbrook systems are to be interconnected with the main system within the next five years. Some councils along the Victorian border receive bulk supplies from Victorian authorities.

The aggregate installed capacity for the whole of the New South Wales systems and isolated plants was 1,305,377 kW (as at 1st July, 1955).

(v) *Future Development.* Construction is proceeding on new major power stations on the coalfields at Lake Macquarie, near Newcastle (330,000 kW), Tallawarra, near Port Kembla (320,000 kW), and Wallerawang, near Lithgow (240,000 kW). These stations will be linked with Sydney by 132,000 volt transmission lines, and extensive additions are also planned to the 132,000 volt system to supply increasing loads at various centres. A 132,000 volt system is being established around the outer Sydney Metropolitan Area for the supply of load centres previously fed through 33,000 volt circuits direct from the inner Sydney power stations. The construction of a hydro-electric power station on the Hume Reservoir of 50,000 kW capacity, connected to the New South Wales network through a 132,000 volt transmission line between Hume and Wagga Wagga is almost complete. Plans provide for the construction of a hydro-electric power station on the Warragamba Dam of 50,000 kW capacity to be connected to the 132 kV Sydney metropolitan network.

In addition to the power stations mentioned above which are under construction or planned for the system controlled by the Electricity Commission, a number of local government bodies have plans in hand for the development of independent power stations. Of these the more important are as follows :—The Northern Rivers County Council is extending a steam power station at Koolkhan (near Grafton). Plans provide for an installed capacity of 25,000 kW. The first three units, totalling 17,500 kW, were in operation at 30th June, 1956. The North-West County Council is proceeding with the establishment of a 12,000 kW steam power station on the Ashford coal-field. The New England County Council and the Bega Valley County Council are extending small hydro-electric power stations on the Oakey River (near Armidale), and Georges Creek (near Bega) respectively.

(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. 266). Apart from this area, there is, at present, only one hydro-electric station in New South Wales with an installed capacity of more than 10,000 kW. This is the 20,000 kW station at Burrinjuck Dam on the Murrumbidgee River the largest of the other installations being the 7,500 kW station at Wyangala Dam on the Lachlan River. The output of both these plants is dependent on the release of waters for irrigation purposes.

Similar schemes, for which the water release will be dependent upon other than electrical requirements, are being constructed at the Hume Irrigation Dam on the Murray River and at Warragamba Dam which is being constructed to provide a water supply for the Sydney Metropolitan Area. At Hume, two 25,000 kW units are to be installed and the output of the station will be shared equally between New South Wales and Victoria. At Warragamba, a 50,000 kW unit is to be installed.

Of the remaining hydro installations, the largest is that of the Northern Rivers County Council on the Nymboida River, a tributary of the Clarence. This station, has a capacity of 4,600 kW.

The New England County Council has constructed a 2,500 kW hydro scheme near Armidale on the Oakey River, a tributary of the Macleay River, and plans to increase the capacity to 5,000 kW.

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

The Bega Valley County Council operates a hydro-electric scheme at Brown Mountain, utilizing the headwaters of the Bemboka River. This installation now has a capacity of 1,900 kW and work is in progress on extensions to provide for two further 1,000 kW units.

The Clarence Gorge Scheme is a proposal for combined flood mitigation and hydro-electric generation on the Clarence River about 40 miles from Grafton and 240 miles from Newcastle. In February, 1955, the Clarence Advisory Committee which was set up by the New South Wales Government to report on the scheme recommended, because of economic reasons, against the construction of a dam at the Clarence Gorge either solely for flood mitigation or for the dual purpose of hydro-electric power generation and flood mitigation.

There are also possibilities of relatively large scale developments on the Shoalhaven and Macleay Rivers. Investigations have been made by the New South Wales Government but no concrete proposals have as yet been adopted.

Generally, apart from the Snowy Mountains area, hydro-electric developments are not favourable in New South Wales when compared with coal-fired steam power stations.

4. **Rural Electrification.**—When the Electricity Authority of New South Wales was constituted in 1946, one of its first tasks was the devising of 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-third 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 supplies receive subsidies from the Electricity Authority towards the cost of new rural lines. The amount of subsidy is based on the estimated cost of a 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 is designed to encourage local electricity supply authorities to construct the more economic extensions first. This has been 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 is paid on higher cost extensions but the excess over an average of £400 is not subsidized.

Between August, 1946, and June, 1956, about 22,300 miles of new distribution lines in rural areas were erected at a cost of over £13,750,000. These lines served 28,250 farms and 19,750 other rural consumers. At 30th June, 1956, the Electricity Authority was committed to the payment of almost £6,250,000 in subsidies of which nearly £2,500,000 had actually been paid. At that time the percentage of farms connected had been raised from 22 per cent. (in 1946) to nearly 62 per cent.

§ 2. Victoria.

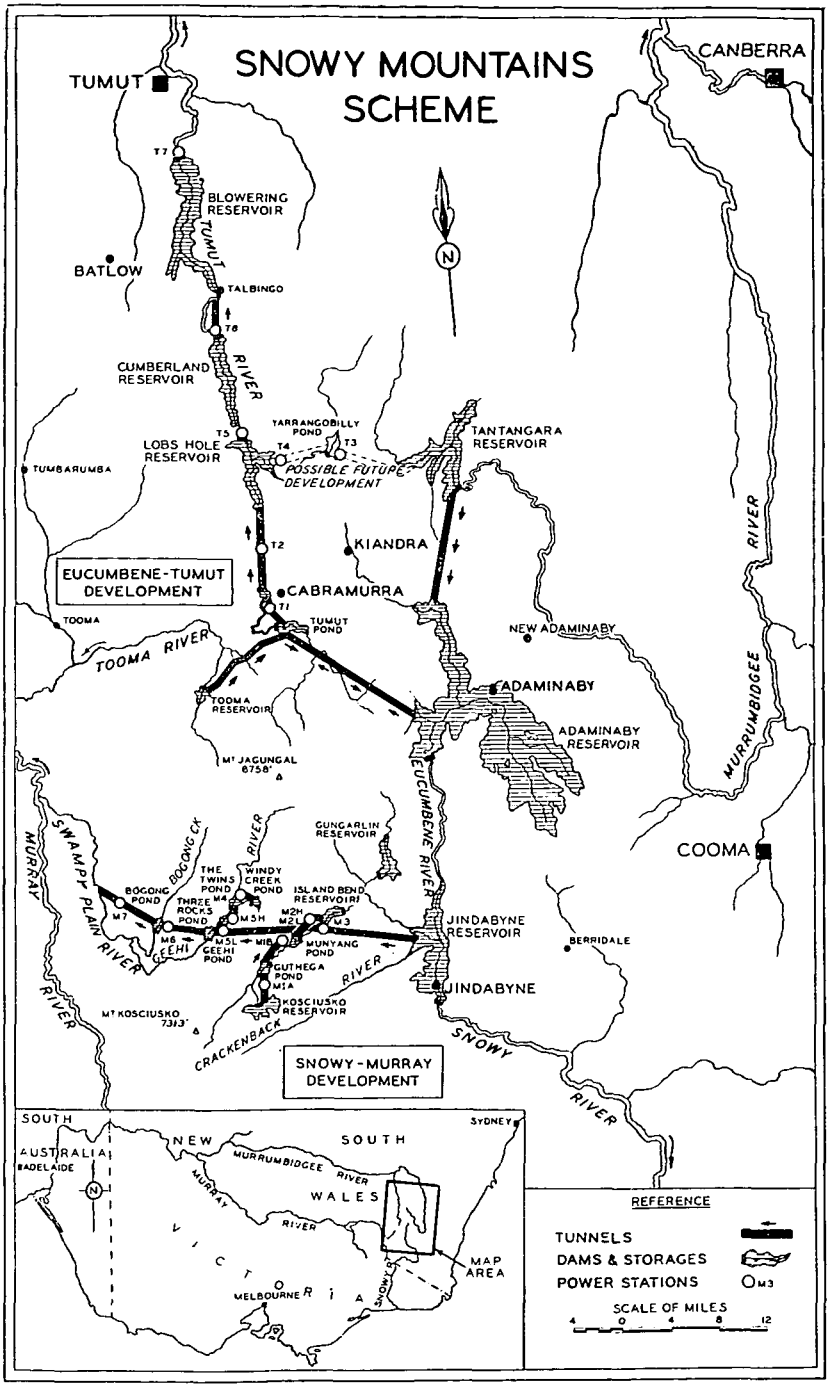
1. **General.**—In Official Year Book No. 39 a detailed description is given of the development of electricity generation in the cities of Melbourne, Geelong, Bendigo and Ballaarat up to the time of transfer of control of electricity undertakings in these cities to the State Electricity Commission of 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 95 per cent. of the population through a supply net-work covering approximately two-thirds of the populated area of the State.

Development of Victoria's State electricity system is based on the development of Victoria's extensive brown coal resources for both power and fuel in the Latrobe Valley in eastern Gippsland, with supplementary development of the hydro-electric potential of north-eastern Victoria. Sixty-nine per cent. of the State's electricity is generated from brown coal, either used in its raw state or manufactured into higher quality fuel in the form of brown coal briquettes. Ninety-six 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 1955–56 from the three open cuts at Yallourn, Yallourn North and Morwell totalled 9,502,409 tons, of which 6,285,073 tons were used in the Commission's own power stations, and 2,528,540 tons were manufactured into 634,099 tons of brown coal briquettes, 52 per cent. of the briquette output being then 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 factories is first used to operate turbo-generators in associated power plant which functions as part of the briquette works.

(ii) *Status and Powers.* Constituted by Act of the Victorian Parliament, the State Electricity Commission is a semi-government authority administered since 1921 by a full-time Chairman and three part-time Commissioners. The principal duty of the Commission is


SNOWY MOUNTAINS SCHEME
TUMUT
CANBERRA
BLOWERING RESERVOIR
TUMUT RIVER
BATLOW
TALBINGO
CUMBERLAND RESERVOIR
TARRANGOBILLY POND
LOBS HOLE RESERVOIR
TANTANGARA RESERVOIR
TUMBARUMBA
POSSIBLE FUTURE DEVELOPMENT
KIANDRA
EUCUMBENE-TUMUT DEVELOPMENT
CABRAMURRA
TOOMA
TUMUT POND
TOOMA RIVER
NEW ADAMINABY
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Mt JAGUNGAL 6758'
EUCUMBENE RIVER
GUNGARLIN RESERVOIR
COOMA
SWAMPY PLAIN RIVER
MURRAY
BOGONG CK
THE TWINS POND
WINDY CREEK POND
ISLAND BEND RESERVOIR
BOGONG POND
THREE ROCKS POND
JINDABYNE RESERVOIR
BERRIDALE
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MUNYANG POND
GUTHEGA POND
JINDABYNE
KOSCIUSKO RESERVOIR
Mt KOSCIUSKO 7313'
CRACKENBACK
SNOWY MURRAY DEVELOPMENT
SNOWY RIVER
SOUTH AUSTRALIA
ADELAIDE
NEW SOUTH WALES
SYDNEY
MURRUMBIDGEE RIVER
MURRAY RIVER
VICTORIA
MELBOURNE
MAP AREA
REFERENCE
TUNNELS
DAMS & STORAGES
POWER STATIONS
SCALE OF MILES
4 0 4 8 12

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 Ballaarat and Bendigo. For the accommodation of its employees at Yallourn, the Commission owns and administers the town of Yallourn and owns large housing settlements in the surrounding area. In the Kiewa hydro-electric works area, it owns and administers the two townships of Mount Beauty and Bogong.

(iii) *Electricity Supply.* At 30th June, 1956, consumers in Victoria served by the State system totalled 727,363. Outside the State system, there were 24,098 other consumers served by local country undertakings. The system supplies all the Melbourne metropolitan area and over 1,100 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 given at present to several New South Wales municipalities and irrigration settlements bordering the River Murray. Rural electrification is now four-fifths 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 the Melbourne metropolitan area (286,008) have more than doubled, and the number of farms connected to supply (32,734) has more than trebled in the past 10 years. More than two-thirds of the new consumers annually connected to supply are outside the metropolitan area. New farm connexions average about 2,500–3,000 a year.

The Commission's retail consumers totalled 561,892 at 30th June, 1956. Retail supply is administered through the metropolitan branch, seven extra-metropolitan branches (namely Ballaarat, 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) respectively. At 30th June, 1956, there were branch and district supply offices in 75 towns in Victoria.

(iv) *Electricity Production.* Electricity generated in the State system totalled 4,429 million kWh in 1955–56 or 99 per cent. of all the electricity generated in Victoria. The system comprises 22 steam, hydro and diesel power stations with a total installed generator capacity at 30th June, 1956, of 961,049 kW. Eighteen of these power stations, totalling 939,195 kW, are interconnected, and feed electricity into a common pool for general supply. The major power station in this interconnected system is the brown coal burning power station at Yallourn, which alone generates over 40 per cent. of Victoria's electricity. Other power stations in the interconnected system comprise steam stations in Melbourne (Newport, Richmond and Spencer Street), Geelong (two stations) and Ballaarat (two stations); hydro-electric stations at Kiewa (two stations) and Eildon, and on the Rubicon and Royston Rivers (four stations), near Eildon; and three diesel stations at Shepparton, Warrnambool and Hamilton. All are Commission owned, except Spencer Street power station, which remains the property of the Melbourne City Council, although operated as a unit in the inter-connected system.

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 diesel, 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 a combination that will most economically meet the system load 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.

(*b*) Metropolitan and provincial steam stations and provincial diesel stations situated close to load centres are designed to operate as peak load stations to assist in meeting the heavy, short period load. Pending the completion of extensions to Yallourn power station, a substantial proportion of the base load on the system is carried by Newport power station.

(*c*) Hydro stations are operated at all times in accordance with the availability of water. They are designed to effect, where possible, a saving of the more expensive fuels used in the metropolitan and provincial thermal stations.

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, and two local diesel stations at Horsham and Murtoa which have been acquired as the first step in a large-scale plan to extend the State electricity system to the Wimmera.

(v) *Transmission and Distribution.* The electrical transmission and distribution system in the State supply network at 30th June, 1956, comprised 22,746 miles of transmission and distribution power lines, ten terminal receiving stations and over 13,000 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 inter-connexion between the power stations. The 220 kV system connects Yallourn and Kiewa with metropolitan terminal stations. From Yallourn also, there are four 132 kV transmission lines to Melbourne. The 66 kV lines radiate from Melbourne to Geelong and Warrnambool, Ballaarat and Bendigo, 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.* In conformity with its dual responsibility for producing and supplying Victoria's electricity and producing a large proportion of the State's solid fuel, the Commission's developmental programme is in two parts, which are, however, closely dependent one upon the other. The major part of this programme is for the development of the brown coal undertakings at Yallourn and Morwell in the Latrobe Valley ; and the second and lesser part for the development of the hydro undertakings at Kiewa and Eildon, joint participation with New South Wales in the Hume Dam hydro undertaking (now being built by the Electricity Commission of New South Wales) and construction of a high voltage transmission line for the supply of power to be purchased from the Snowy Mountains Hydro-electric Authority. 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 the establishment of a 220 kV power transmission grid designed ultimately to encircle central Victoria, linking all principal power stations and all major centres of distribution.

Yallourn power station is being greatly enlarged. One 100,000 kW extension was completed in the latter months of 1956. A second 100,000 kW extension is being built. One of its two 50,000 kW generators is due to be in service in 1957 and the other in 1958. The associated boiler plant will not, however, be fully in service until 1959. A third extension of at least 150,000 kW capacity is under consideration. 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 about 11 million tons in 1962.

At Morwell, six miles from Yallourn, the Commission is developing a second brown coal power and fuel project which may at some future date become even larger than the Yallourn undertaking. The new project will comprise a large brown coal open cut and a major new power station which will operate in association with a large new briquetting plant. Some of the electricity generated at Morwell will be needed to operate the briquette works, but most of the output of the power station will be transmitted through Yallourn to metropolitan terminal stations for general supply through the State network. The power station and two units of the briquetting works are now being built, and the power station will start generating electricity in 1959. In 1961, electricity output for general supply will be 91,000 kW, and briquette production will be over 1,500,000 tons per annum. Annual output of brown coal at the Morwell open cut will increase progressively to about six million tons in 1962.

The new hydro station built to operate on the waters of the greatly enlarged Eildon Reservoir is due for completion in the first half of 1957. The total installed capacity will be 136,000 kW, inclusive of the two small generating sets, totalling 16,000 kW transferred from Sugarloaf power station, the original power station which was demolished when the new Eildon Dam was built. As the primary purpose of Eildon Reservoir is to provide water for irrigation, generation of electricity will be 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. At the Kiewa hydro-electric undertaking, construction work has been greatly retarded by the shortage of loan funds for capital works. Following the completion early in 1956 of a new 62,000 kW power station (the second to come into service at Kiewa), work is now in progress on a third power station of 96,000 kW capacity, which is due to have the first of its six generators operating in 1960 and the remainder in service by the beginning of 1962. Work is also in progress on the construction of Rocky Valley Reservoir, which is designed to provide the main high level storage for the operation of the Kiewa power stations. Hume hydro station is due for completion in 1957. Output (50,000 kW) is to be shared equally by Victoria and New South Wales. Since, however, the function of Hume Reservoir (like Eildon) is to provide storage for irrigation, no regular output of electricity can be expected during the non-irrigation months in the winter. The main value of this hydro station to the Victorian electricity system, therefore, will be to save fuel in metropolitan and provincial steam power stations during the summer months.

Connexion with the Snowy Mountains undertaking will be made by a new high voltage transmission line which will feed into the Victorian system via Dederang and Kiewa. It will operate at 330 kV. Two sections of the 220 kV transmission grid (Yallourn-Melbourne and Kiewa-Eildon-Melbourne) are in service and interconnected. Extensions of this new grid are due for completion as follows :—Melbourne to Geelong (1957) ; Geelong to Colac (1958) ; Kiewa to Shepparton (1958) ; Shepparton to Bendigo (1959). Eventually the 220 kV grid will be continued from Bendigo via Ballaarat to connect with the Melbourne-Geelong-Colac section.

3. **Local Country Electricity Undertakings.**—At 30th June, 1956, there were 45 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 1955–56, the total production of the independent undertakings was 43 million kWh. The number of consumers at 30th June, 1956, was 24,098. The operation of the independent undertakings is governed by the Electric Light and Power Act, 1928, 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 a considerable rural area in the south-east corner of the State from a modern power station at Bulimba, a suburb of Brisbane. Capacity is 95,000 kW at Bulimba " A " plus 10,000 kW, " packaged plant " at Abermain (near Ipswich) and 60,000 kW at a new generating station known as " Bulimba B ". The output from a 3,200 kW hydro-electric unit installed at Somerset Dam near Brisbane is fed into the Southern Electric Authority system. With these plants 616 million kWh were generated in 1954–55 while the total number of the Authority's consumers at 30th June, 1955 was 99,906.

The Brisbane City Council's electrical undertaking and power production in 1954–55 had an installed capacity of 105,000 kW plus a 10,000 kW " packaged " plant erected at Tennyson—units purchased and generated amounted to 500 million kWh, and there were 116,696 consumers connected. Since 30th June, 1954, 60,000 kW of plant at a new power station at Tennyson has been commissioned by the Council.

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 decade, 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, elsewhere than in the south-eastern portion of the State which surrounds the major centres of industry and population, an uneconomic proposition.

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 p. 1182 of Official Year Book No. 39.

3. **The State Electricity Commission of Queensland.**—In 1937, the State Government legislated to constitute a State Electricity Commission (legislation administering the generation and distribution of electricity in Queensland prior to the establishment of the Commission is referred to on p. 1181 of Year Book No. 39), which commenced to function during January, 1938, and to it was passed administration of the Electric Light and Power Acts 1896–1938. The Commission's 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. In addition, the Commission was empowered to co-ordinate the industry's development throughout Queensland. Between 1938 and 1955, the number of private companies was reduced by absorption and acquisition from twenty-one to five, while publicly owned undertakings, after amalgamation into Regional Authorities, and the development of nineteen new schemes for small Western Queensland towns, remain at forty-seven.

By agreement with the Commission in 1939, the City Electric Light Co. Ltd. became the co-ordinating authority for the provision of electricity in an area of some 10,062 square miles, extending from the New South Wales-Queensland border to Gympie, north of Brisbane. The Company acquired the undertakings at Boonah, Beaudesert, Gympie, Coolangatta, Ipswich, Nambour, Southport, Redcliffe and the Somerset Dam supply and transmission line to Brisbane. Certain restrictions were placed on the Company's dividend rate, namely limitation to the rate on Commonwealth bonds plus 2 per cent. During 1940, a similar agreement was made with the Toowoomba Electric Light and Power Co. Ltd. for the supply of electricity in the Toowoomba, Warwick, Killarney and Allora districts, subsequently being extended to cover a comprehensive area of 9,324 square miles, including Stanthorpe and other districts. Transmission line extensions since that year have made supply available to a number of adjacent districts on the Darling Downs. The City Electric Light Co. Ltd. was converted to a public authority as from 1st February, 1953 by the Southern Electric Authority of Queensland Act of 1952 (*see* para. 5 below).

Amending legislation, passed by the Queensland Parliament in March, 1948, changed the constitution of the State Electricity Commission from a body corporate to a corporation sole. On 1st July, 1948, a Commissioner for Electricity Supply was appointed in lieu of the previous Commission of four Commissioners. Since its inception in 1938, 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 or those having a predominantly primary producing economy, the Government in 1945, passed the Regional Electric Authorities Act. This legislation, as later amended, provides for the creation of regions of electricity supply and the constitution of Regional Electricity Boards. The Act provided for transfer to the Boards of local authority electricity undertakings in their regions, and for acquisition by the Boards of privately owned undertakings when purchasing rights fell due. Each Board comprises representatives of local authorities in the region and a representative of the Commission. Financial operations of the Boards are under the control of the Commission.

Soon after passage of the Regional Electric Authorities Act, four regions were defined and four Regional Boards 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 the organization is now known as the Wide Bay-Burnett Regional Electricity Board. As power was to be obtained from the Wide Bay Regional Board's station at Howard, the Commission decided that development of the two regions could be planned more effectively by a single authority.

Activities of the four Regional Boards in 1954–55 compared with operations of the stations located in regions in 1945–46, and totals for Queensland as a whole, are shown in the following table :—

QUEENSLAND : REGIONAL OPERATIONS.

Region.	1945–46.		1954–55.	
	Units Generated.	No. of Consumers.	Units Generated.	No. of Consumers.
	m.kWh		m.kWh	
Wide Bay–Burnett	13.7	11,467	53.1	23,736
Capricornia	19.5	11,196	80.5	18,124
Townsville	25.8	11,612	75.9	18,404
Cairns	22.7	9,722	73.0	18,024
Total	*81.7*	*43,997*	*282.5*	*78,288*
Queensland	**487.0**	**194,429**	**1,452.5**	**322,747**

Generator capacity of the four existing Regional Boards installed at 30th June, 1956 was :—Wide Bay-Burnett, 22,500 kW ; Capricornia, 37,500 kW ; Townsville, 40,330 kW ; Cairns, 18,445 kW ; total, 118,775 kW.

5. **Creation of Southern Electric Authority of Queensland.**—A further major step in electrical progress, comparable with that taken when the agreements with the City Electric Light Co. Ltd. and Toowoomba Electric Light and Power Co. Ltd. were first entered into, 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 new 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.

An important advantage gained by the creation of this Authority is that on 30th June, 1968, acquisition of the Authority by the State Government can be effected without the necessity of a cash payment, as the Government will have the power to convert the Authority's existing stock to inscribed stock. Furthermore, the replacement of the City Electric Light Co. Ltd. by the Southern Electric Authority as a public body relieves electricity consumers in the Authority's area of supply from the burden of taxation which has hitherto been payable by the City Electric Light Co. Ltd., but will not need to be met by the new Authority. An agreement has been signed between the State Government and the Southern Electric Authority giving effect to the principles contained in the new legislation.

As from 1st July, 1954, the Southern Electric Authority acquired the Toowoomba Electric Light and Power Co. Ltd., thus bringing this 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, the 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 old divide. With heavy monsoonal rainfall on their catchments and concentrated fall, these streams represent a considerable potential source of power, but storage, which can in most cases be provided, is essential to control the very variable flow.

The Barron Falls scheme, 14 miles north-west of Cairns, came into operation in 1935. The installed plant operates under a head of 410 feet and comprises three 2,000 h.p. turbines each connected to a 1,320 kW generator. Average rainfall varies from 80–150 inches along the ranges to less than 35 inches in the western portion of the catchment. There is extreme variation from year to year, resulting in great fluctuation of stream flow which, at Kuranda, has varied from a maximum of 117,000 cusecs in 1911 to a minimum of 30 in 1915. Storage to regulate the flow is possible but has not yet been provided. During periods of low flow the supply of electricity is supplemented by fuel plants at Cairns, Atherton and Innisfail. Power is distributed over 22,000 volt transmission lines serving the tableland and extending southward along the coast to Tully.

A small hydro-electric scheme on the Mossman River, 5 miles from Mossman, North Queensland, comprises two 120 h.p. turbines operating under a head of 200 feet.

The development of a hydro-electric power scheme at Tully Falls is now well advanced, the initial plant installation being 36,000 kW, and scheduled for commissioning early in 1957. Water controlled by Koombooloomba Dam to be built on the upper Tully River will be 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. Ultimate installation will be four 18,000 kW sets. Future automatic power plants upstream and downstream from Tully Falls will consist of two 7,500 kW sets under 405 feet head and one 5,400 kW set under 230 feet head. The combined peak load for the three plants will be 69,000 kW. Inter-connexion of the Townsville area, currently supplied by a thermal station, with the Tully scheme has been authorized and provision of the 160 mile duplicate 132 kV transmission line is under way. On present estimates, power from the Tully scheme will be sufficient to supply the inter-connected area until 1965, when additional power will be required. A full investigation by the State Electricity Commission of the electricity supply industry in North Queensland is proceeding and the terms of reference include the survey of additional hydro-electric projects.

Other northern schemes which have been investigated include Freshwater Creek (3,900 kW) ; North Johnstone–Russell Rivers (32,000 kW) ; Beatrice–North Johnstone Rivers (9,000 kW) ; South Johnstone River (25,000 kW) ; extension of Barron Falls scheme (22,000 kW) ; Herbert River (90,000 kW). The total potential of the plateau region is therefore about 250,000 kW at 50 per cent. load factor.

In the vicinity of Townsville, the Commission, acting on behalf of the Burdekin River Authority, has investigated the proposed hydro-electric development of the Burdekin. The Scheme plans for a power plant immediately below the Burdekin Falls Dam which will operate under an average head of 225 feet. This project is linked with the plan to conserve the waters of the river for irrigation and flood mitigation and surveys undertaken indicate that approximately 80,000 kW could be generated. It has been estimated that a hydro-electric station approaching this size should meet the requirements of Townsville and the coal mines in the region of Collinsville, for at least 20 years, and also transmit supply to Bowen and Proserpine and possibly to the Mackay area, and by obviating the continuous operation of thermal plant achieve significant savings in fuel.

South of the Burdekin River, no appreciable hydro-electric development is practicable. 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 is now nearing completion. 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 inter-connexion 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 scheduled for installation in 1956;

Rockhampton (Capricornia Region) of which 22,500 kW was placed in service during September, 1952 and a further 15,000 kW in May, 1956, with a further 15,000 kW on order ; 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 capacity of 52,500 kW and be steam-operated. In the Cairns Region, construction is proceeding on the Tully Falls hydro-electric scheme and two 18,000 kW turbo alternator sets should be giving a supply of electric power early in 1957 with a further two 18,000 kW sets to follow shortly afterwards. The scheme is designed for an ultimate installed capacity of 92,400 kW. To augment existing capacity and to meet anticipated demands pending operation of Tully Falls, the Cairns Regional Board has installed twenty-one diesel units with a total capacity of 14,485 kW.

The Tully Falls scheme (*see* para. 6, above) is planned to link with the Townsville Regional Electricity Board's system for the purpose of marginal supply, and construction of this interconnexion has now commenced. Plans for the development of the Burdekin Falls hydro-electric project are also in hand. These schemes and the existing Barron Falls hydro-electric plant will exploit North Queensland's principal hydro-electric potential estimated conservatively at more than 316,000 kW.

At Mackay, where supply was first given in 1924, and Bowen, both situated on the coast between the Capricornia and Townsville Regions, the local Councils operate power stations of 4,500 kW and 1,000 kW respectively. The Mackay City Council has embarked on a scheme for rural development under an agreement with the State Electricity Commission. To cater for the anticipated growth in demand, the capacity of its station has been increased to 9,500 kW. At Bowen, the Town Council, which established the service in 1925, has extended the station's capacity by the installation of one 1,000 kW unit. 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, totalling 18,445 kW, supplying an area of approximately 42,000 square miles.

(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 is assisting the scheme by subsidy—a feature of electrical development in Queensland. In general, the assistance provided 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 isolated areas.

In addition to improving supplies to the larger western towns, a scheme has been 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 now being implemented and at 30th June, 1956 twenty-six townships in the west of Queensland have been provided with the amenities of electricity. In addition, investigations of the possibility of supply have been carried out at a number of other small centres. The power is being supplied by small oil driven generating sets with automatic controls which can be run with a minimum of operating attendance.

Coal-burning gas producers have been successfully commissioned for public electricity supply purposes in the West. They have been installed at Longreach, Clermont, Dalby, Blackall and Barcaldine and further extensions 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 1956, new generating units totalling 335,300 kW. The Southern Electricity Authority is developing a station known as Bulimba " B " on a site adjacent to Bulimba "A". 60,000 kW has been installed to 30th June, 1956, with a further 30,000 kW to be commissioned during 1956–57, but 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 ultimately increased to 180,000 kW. At 30th June,

1956, generating plant of 60,000 kW was in service at this new station. To supplement capacity pending operation 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 Ipswich.

The power stations of the two major generating authorities at New Farm and Bulimba are interconnected at 33,000 volts.

§ 4. South Australia.

1. **General.**—An account referring to 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, a Bill 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 supplies. 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, would cease 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 persons who generate or supply electricity, arrange to inter-connect the mains of the Trust with those of other persons, 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 for their own use.

In 1954–55, total installed capacity in South Australia was 330,278 kW., an increase of 60,286 kW on the year before. The units generated totalled 1,119 million kWh compared with 955 million kWh in the previous year.

Of the total installed capacity, the Electricity Trust of South Australia operated plant with a capacity of 251,950 kW. It is thus the most important authority supplying electricity in the State. There were approximately 228,400 ultimate consumers of electricity, of whom 199,518 were supplied by the Trust. Its major steam stations were Osborne " A " (79,000 kW), Osborne " B " (120,000 kW) and Port Augusta " A " (45,000 kW) while the balance of the capacity controlled consists of house sets and a limited number of small internal combustion plants located in rural districts.

No hydro-electric potential exists in South Australia. Steam generating units comprise 95 per cent. of installed capacity and the balance, 5 per cent., 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, 1955, 483,603 tons of coal were sold. Of this amount, the Electricity Undertaking used 394,214 tons.

In order to cope with the rapidly increasing demand for power, the Electricity Trust is installing two additional 30,000 kW units at Osborne " B " Power Station. These will complete the " B " station which will then have a total capacity of 180,000 kW. Another major work under construction is the power station at Port Augusta with an ultimate capacity of 90,000 kW. This power station, which was commissioned in June, 1954, is located at Port Augusta because of its proximity to the Leigh Creek coalfield and will use Leigh Creek coal exclusively. A new standard gauge railway line to connect Leigh Creek with Port Augusta has been constructed by the Commonwealth Railways Department. The power station is inter-connected with the Metropolitan Area by two transmission lines which will also supply power at intermediate points. The Trust is to construct a second power station at Port Augusta to be known as Port Augusta " B ". This station will have a capacity of 180,000 kW making the combined capacity at Port Augusta 270,000 kW. In addition, the Trust is building steam power stations at Port Lincoln and Mt. Gambier to replace existing diesel stations. The station at Port Lincoln will have a capacity of 5,000 kW and will burn fuel oil while the station at Mt. Gambier will have a capacity of 16,800 kW and will burn either wood waste or fuel oil.

5. **The Municipal Tramways Trust.**—On 30th June, 1956 the Municipal Tramways Trust power station ceased operations and all power required for traction purposes is now supplied from the Electricity Trust system through converter stations and a 5,500 kW frequency changer. The installed capacity of the power station has been reduced from 19,100 kW to 9,000 kW and will only be used in case of emergency.

§ 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 now 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, p. 1189.

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

WESTERN AUSTRALIA : METROPOLITAN UNDERTAKING.

Particulars.	1938–39.	1954–55.	1955–56.
Plant capacity .. .. kW	57,000	149,000	179,000
Maximum load .. .. .. kW	33,000	106,000	127,000
Units generated .. .. Million kWh	137	462	517
Coal used per unit generated .. .. lb.	2.77	1.67	1.56
Coal used .. .. tons	168,722	328,832	361,164

As a result of a separate inquiry conducted at the same time as the early investigations into the proposed new station at South Fremantle, a recommendation was made favouring conversion of the East Perth 40 cycle system to the British and Australian Standard Frequency of 50 cycles per second. The recommendation was adopted and implemented by making the frequency of generation at South Fremantle 50 cycles and installing at East Perth a frequency changer able to convert 25,000 kW of energy from one frequency to the other. Change-over of consumers' plant is proceeding and a large number of important loads are now supplied at 50 cycles.

3. **Kalgoorlie.**—In Kalgoorlie, the Municipal Council is supplying approximately 3,800 consumers with either direct or alternating current from a diesel station of 1,825 kW generating capacity. 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 new boilers were installed a short time ago to permit steam-raising from Collie coal.

4. **General Pattern of Electricity Supply.**—The pattern of the generation and distribution of electric power in Western Australia consisted until recently of a number of isolated systems each supplying a particular area. Except in the metropolitan area and in the area embraced by the South-West Power Scheme (*See* para. 6 below), where in both cases electricity

supply is in the hands of the State Electricity Commission of Western Australia, local authorities are generally responsible for the supply of electricity for domestic, industrial and traction purposes. In the area between the Great Southern Railway from Northam to Albany and the west coast, however, the State Electricity Commission has now constructed transmission lines to give central station supply to the towns and their surrounding rural areas. In addition, there are several mining companies which generate electricity for use in their mines. In order to cater for the expected growth in demand, capacity of the State's major generating stations is being increased.

The system in the Metropolitan area has been inter-connected with the Bunbury area by means of a 132,000 volt transmission line.

The main load centre of the State is, of course, the Perth-Fremantle area into which is concentrated the major portion of the State's population and industry. The inter-connexion between the Metropolitan and Country systems is, however, expected to lead to a gradual decentralization of load.

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 proceeded with the task of increasing generating capacity in an endeavour to cater for a greatly increased demand for power. Long-range plans have been formulated to inter-connect the south-western portion of the State with the Perth-Fremantle system. One of its most important and immediate problems was to increase the capacity of the generating equipment serving Perth and Fremantle. During the 1939–45 War years, it became evident that the growth of demand for electric power would necessitate provision of additional generating equipment in the metropolitan area as soon as possible. Accordingly, the Government Electricity Supply authority commenced design work for a new station of 50,000 kW capacity. Contracts were let in 1945 and construction commenced on a site selected at South Fremantle, on the coast south of Fremantle proper. Responsibility for completion of this project was given to the Commission under the Act of 1946. As it was considered that an even larger station would be required, provision was made for the installation of two additional units giving an ultimate capacity of 100,000 kW. Steam is furnished by eight boilers designed to use pulverized coal from Collie, which is located about 120 miles from the station. At the end of 1954 four units had been placed in service and the output was being fed into the metropolitan system.

At the East Perth power station, a new 30,000 kW unit has just been commissioned, but the full output of this unit will not be available until an additional boiler has been installed. A 25,000 kW unit, commissioned in 1938 (generating 40 cycles) is also available at this station. Older plant with a total capacity of 24,000 kW is also installed, but the usefulness of this plant for standby purposes will be reduced as the 40 cycles load in the metropolitan area is converted to 50 cycles.

6. **South-west Development.**—At the request of the Government, the Electricity Advisory Committee in 1945 submitted a report recommending, amongst 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 inter-connexion 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. The capacity of the station 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 1,800 square miles. Contracts have been let for the first three 30,000 kW units for a new power station at Bunbury, which will be inter-connected by transmission lines to the Collie and the metropolitan stations, permitting an interchange of power between the metropolitan and south-west systems. Work has proceeded satisfactorily on the Bunbury power station.

§ 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 contributing factors 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 and at present is 61 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, pp. 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, it was decided to proceed with the Tarraleah Power Development. 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 St. Clair and at Lake King William, an artificial lake created by the 200-ft. high Clark Dam across the Derwent at Butler's Gorge. 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 the end of the war 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 Tungatinah scheme draws water from three separate catchment areas located on the Central Plateau between the Great Lake (Shannon–Waddamana) and the Lake St. Clair (Butler's Gorge-Tarraleah) catchments and control of practically the whole run-off from the Central Plateau has now been affected.

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 six 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 and with a capacity of 150,000 kW it is the largest hydro-electric power station in Australia. 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 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 2 miles of tunnel and pipeline to a power station on the Tamar River near Launceston. Three 20,000 kW generators were installed in mid-1955 and a fourth unit has since brought the total capacity of Trevallyn Power Station to 80,000 kW.

(ii) *New Capacity.* The Hydro-Electric Commission is still engaged in the most progressive construction programme in its history. Since 1948, the generating capacity of the system has been increased by 276,600 kW to a total of 447,100 kW and present construction is planned to bring this total to 575,800 kW by 1960. There will still remain very considerable resources for future development as it is considered that at least 2,400,000 kW can be economically developed.

The Wayatinah Power Development, now under construction, will comprise 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 has passed through Tarraleah or Tungatinah stations will be diverted, by a weir across the Nive River below Tarraleah, through 4 miles of tunnel and then steel pipes to Wayatinah "A" Power Station lower down on the Nive River where 83,700 kW will be installed by 1960.

A dam across the River Derwent, just below its junction with the Nive, will create a small lake into which will flow all the water from Wayatinah "A" plus water collected by the Derwent below Clark Dam. One mile of tunnel and one mile of pipeline will lead the water to Wayatinah "B" Power Station on the Derwent three-quarters of a mile below its junction with the Florentine River. The lower station, Wayatinah "B", is being constructed first for completion by 1958. Installed capacity will be 45,000 kW.

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.**—After 1930, every effort was made to keep pace with anticipated increases in demand by means of a progressive construction policy. The abundant and comparatively cheap supplies of electricity and other natural resources 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., 73,000 kW ; Australian Aluminium Production Commission, 30,000 kW ; Australian Newsprint Mills Ltd., 19,000 kW ; Associated Pulp and Paper Mills Ltd., 14,500 kW ; Australian Commonwealth Carbide Company Ltd., 7,800 kW ; and Goliath Portland Cement Company Ltd., 1,800 kW.

§ 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.* Supply was first established at Canberra during 1915. The Department of the Interior owns steam stand-by plant of 2,100 kW capacity which is operated in conjunction with the New South Wales Electricity Commission's generating equipment. The major portion of Canberra's power requirements are supplied in bulk from the New South Wales inter-connected system. Total population served with electricity at 30th June, 1956 was 34,000 and the total number of ultimate consumers was 9,953. Rapidly increasing domestic, government, and commercial load will absorb appreciable amounts of power from the Snowy Scheme.

(iii) *Northern Territory.* At Darwin, supply was established by the Town Council in October, 1934, but later, during April, 1937, responsibility for generation and supply was placed in the hands of the Northern Territory Administration. The power station is equipped with diesel generating plant of 5,390 kW capacity. Two new 970 kW diesel sets were installed in 1955–56. Small diesel generating units supply the requirements of Alice Springs (1,042 kW), Katherine (297 kW) and Tennant Creek (223 kW).

In 1948, it was announced that the Department of Works and Housing (now the Department of Works) had selected a site for a hydro-electric station on the Adelaide River, 72 miles from Darwin. The scheme is designed to augment supply to Darwin and suburbs when the diesel equipment at present installed is unable to cope with the demand for power. No constructional work has yet been undertaken on the project.

2. **External Territories—Papua and New Guinea.**—Responsibility for the operation and establishment of 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 5,963 kW. The generating capacity of the power plants at the main centres is—Port Moresby, 2,504 kW ; Rabaul, 1,280 kW ; Lae, 854 kW ; Madang, 280 kW ; Samarai, 200 kW ; Kavieng, 142 kW ; Wewak, 110 kW ; Lorengau, 100 kW ; Goroka, 100 kW ; and 223 kW distributed among eleven outstations where generating capacity is between 5 kW and 60 kW. New power plants at Lae and Rabaul have been completed and are now in operation. The townships of Wau and Bulolo are supplied by the Bulolo Gold Dredging Co., which operates a hydro-electric plant of 5,500 kW. This power is produced mainly to supply the alluvial dredges and, in addition, now supplies the recently constructed plywood mill at Bulolo.

The number of ultimate consumers served was 3,053 in 1954–55 and 3,584 in 1955–56.

Vast hydro-electric potential exists 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, it was announced that the Commonwealth Government had joined with 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 holds 51 per cent. of the shares and has a controlling interest on a board of five members. The agreement for the formation and operation of the Company is administered by the Commonwealth Department of Supply, except in matters requiring compliance with the law of New Guinea, when responsibility for administration rests with the Department of Territories. Surveys and comprehensive investigations are in progress.

The following hydro-electric schemes are under construction :—Port Moresby—at Rouna on the Laloki River providing 2,000 kW when complete with provision for expansion to 5,000 kW. It is anticipated that the power station should be in operation during 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 50,000 kW ; Aiyura (for the Agricultural Experimental Station) with an initial capacity of 30 kW. Stream gauging and other preliminary investigations for hydro-electric schemes have been carried out at Lae, Rabaul and Madang.

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, 1949-50 AND 1954-55.

The following table shows statistics for each State separately and for the six States combined for 1949–50 and 1954–55 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 in both years and the number of ultimate consumers of electricity in 1955–56.

For further statistics of the electricity supply industry (years 1938–39 and 1950–51 to 1954–55), *see* Chapter VII.—Manufacturing Industry.

CENTRAL ELECTRIC STATIONS.

Particulars.	N.S.W.	Vic.	Q'land.	S. Aust.	W. Aust.	Tas.	Total.
1949–50.							
Generating Stations—							
Government .. No.	10	10	..	2	12	2	36
Local Authority ,,	45	32	36	14	42	..	169
Companies .. ,,	37	25	9	20	61	1	153
Total	*92*	*67*	*45*	*36*	*115*	*3*	*358*
Installed Capacity of Generators—							
Steam .. '000 kW	889	548	211	(*a*)	78	(*a*)	1,923
Hydro .. ,,	33	52	4	(*a*)	..	(*a*)	284
Internal combustion ,,	59	19	32	(*a*)	41	(*a*)	162
Total	*981*	*619*	*247*	(*a*)	*119*	(*a*)	*2,369*
Persons employed(*b*) No.	3,968	2,294	967	(*a*)	1,029	(*a*)	9,433
Value of output(*c*) £'000	15,018	6,215	3,477	(*a*)	2,431	(*a*)	30,556
Value of production(*d*) ,,	7,197	2,522	857	(*a*)	754	(*a*)	12,884
Electricity generated(*e*) Million kWh	3,758	2,706	972	594	417	1,062	9,509
1954–55.							
Generating Stations—							
Government .. No.	22	16	1	7	9	6	61
Local Authority ,,	34	22	51	13	38	..	158
Companies .. ,,	29	24	7	22	47	3	132
Total	*85*	*62*	*59*	*42*	*94*	*9*	*351*
Installed capacity of Generators—							
Steam .. '000 kW	1,438	815	385	(*a*)	180	(*a*)	3,131
Hydro .. ,,	97	86	7	(*a*)	..	(*a*)	573
Internal combustion ,,	100	43	37	(*a*)	52	(*a*)	250
Total	*1,635*	*944*	*429*	(*a*)	*232*	(*a*)	*3,954*
Persons employed(*b*) No.	5,362	2,891	1,350	(*a*)	945	(*a*)	11,927
Value of output(*c*) £'000	34,663	19,046	10,202	(*a*)	6,262	(*a*)	78,286
Value of production(*d*) ,,	18,397	9,128	3,402	(*a*)	2,603	(*a*)	37,568
Electricity generated (*e*) Million kWh	5,951	4,152	1,658	1,119	702	1,589	15,171
Ultimate consumers(*f*) No.	960,332	693,165	322,747	228,420	127,890	101,503	2,434,057

(*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 to materials and fuel 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 synonymous with the number of persons served with electricity because one ultimate consumer may embrace three or four persons, e.g., in a household.