CHAPTER VII

ELECTRIC POWER GENERATION AND DISTRIBUTION

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

The information contained in the chapter relates to situations existing and projects contemplated in December, 1964, and may be considerably affected by changes in policy or plans, or by developments in the projects themselves.

INTRODUCTION

1. **Distribution of Population and Location of Power Resources.**—The two principal centres of population and industry in Australia, the metropolitan areas of Sydney and Melbourne, make the greatest demands for electric power, and their growth has been associated with the development of large deposits of coal located relatively close to the source of demand. This, together with the fact that the major water resources are also located in the south-eastern portion of Australia, materially influences the distribution of industrial population and the location of major electric power stations.

By far the most important source of energy used in the production of electric power in Australia is coal. At 30th June, 1963, thermal power equipment represented 72 per cent., hydro plant 25 per cent., and internal combustion equipment 3 per cent. of the total installed generating capacity.

Most of Australia is poorly supplied with water, only about 13 per cent. receiving an annual rainfall of 30 inches or over, and these areas are confined largely to Tasmania and to the narrow coastal strip along the east coast of the mainland.

The only region on the mainland of Australia high enough to receive reliable winter snowfall, and from which, therefore, reasonably constant water supplies throughou the year can be expected, is the mountain chain which stretches from the high plateaux oi south-eastern New South Wales to the north-eastern highlands of Victoria. The hydro-electric potential of this area is considerable, and plans have been formulated to develop more than 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 available is smaller than the potential of the Alpine region. In Tasmania, hydro-electric resources have been estimated at about 50 per cent. of the total Australian hydro-electric potential. On the mainland the chief source of energy is coal in Tasmania it is water.

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 with some measure of governmental control designed to provide standards of safety and to define the scope and obligations of the private organizations. A trend towards public ownership commenced during the 1914–18 War and became more pronounced after the 1939–45 War. By 1961 all major generating stations supplying the public were, in varying degrees, under the control of statutory organizations constituted with the object of unifying and co-ordinating the generation and distribution of electricity supplies. There are still a large number of small private and municipal enterprises generating power for supply to country towns, although central authorities are extending supply to these places wherever practicable. In many areas it has been, and remains, the practice for central authorities to sell power in bulk to local distributing organizations which undertake reticulation.

In addition to the private, local government and statutory organizations which generate and/or distribute electricity for sale, numerous firms generate power for use in their own establishments, particularly those engaged in mining pursuits remote from the main centres of population. This chapter, however, is concerned mainly with the activities of central electric stations, as the power regularly produced for such internal consumption is, in any case, a relatively small proportion of the total power produced.

(ii) *Power Production and Generating Capacity.* Since the 1939–45 War the demand for power has increased considerably, industry and commerce have expanded rapidly, many new houses have been built, the population has increased by approximately 50 per cent., electricity supply has been extended to rural areas, and the use of domestic electric appliances has increased. The measures taken by the various authorities to satisfy the demand created by these developments are described in the following pages.

At 30th June, 1963, installed generating capacity in Australia was 7.50 million kW compared with 7 22 million kW in 1962 an increase of nearly 4 per cent. In 1962–63 each kW of installed capacity produced an average of 3,904 kWh. These figures are based on Commonwealth totals; figures for the States vary, depending on such factors as the distribution of demand, number of consumers, and type of equipment employed. In 1962–63 the production of electric power in Australia was 29,279 million kWh. In 1963–64 production increased to 32,124 million kWh.

SNOWY MOUNTAINS HYDRO-ELECTRIC SCHEME*

1. **Snowy Mountains Hydro-electric Power Act 1949.**—In July, 1949, the Commonwealth Government established the Snowy Mountains Hydro-electric Authority, and empowered it to generate electricity by means of hydro-electric works in the Snowy Mountains Area; supply electricity to the Commonwealth (i) for defence purposes, (ii) for consumption in the Australian Capital Territory; and supply to a State, or to a State Authority, electricity not required for defence purposes or for consumption in the Australian Capital Territory.

The Authority is constituted by a Commissioner and two Associate Commissioners, the three appointments being made by the Governor-General. It is empowered to construct, maintain, operate, protect, manage and control works:—

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

The Snowy Mountains Act is supported by a detailed agreement between the States of New South Wales and Victoria and the Commonwealth with regard to the construction and operation of the Scheme, the distribution of power and water, charges to be made for electricity, and other such matters. The Snowy Mountains Council, established under the terms of the Agreement and consisting of representatives of the Commonwealth, the Authority and the two States, directs and controls the operation and maintenance of the permanent works of the Authority and the allocation of loads to generating stations.

2. **Geography of the Area.**—The Snowy Mountains area in south-eastern New South Wales is the only part of the continent in which altitudes exceed 7,000 feet and in which there is a substantial area over the altitude of 6,000 feet. The precipitation which results from the presence of this barrier on the line of the prevailing winter depressions of Antarctic origin amounts to as much as 150 inches a year in the vicinity of Mt. Kosciusko, the highest point in Australia. The drainage from the snowfields is practically all to three systems—those of the Murray and Murrumbidgee Rivers, which flow inland, and that of the Snowy River, which flows southward to Bass Strait.

3. **Description of the Scheme.**—(i) *General.* The broad basis of the scheme is to transfer waters, which would otherwise flow to the sea unharnessed, from the Snowy River and its tributaries to the inland system, so that the water may be used for irrigation and to provide power. It involves two main diversions, the diversion of the Eucumbene, a tributary of the Snowy, to the Upper Tumut River, and the diversion of the main stream of the Snowy River at Island Bend and Jindabyne to the Swampy Plain River. These two diversions divide the scheme geographically into two sections, the Snowy-Tumut

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

Development and the Snowy-Murray Development (*see* map p. 209). For purposes of both power production and irrigation it is necessary to regulate run-off, and this will be achieved by the use of Lake Eucumbene (formed by the construction of Eucumbene Dam) and other smaller storages to control the waters of the Eucumbene, Murrumbidgee, Tooma, and Tumut Rivers for the Snowy-Tumut Development and of the Snowy and Geehi Rivers for the Snowy-Murray Development. A sectional diagram of the Scheme appears on page 210.

(ii) *Snowy-Tumut Development.* This development comprises works for the diversion and regulation of the waters of the Eucumbene, Upper Tooma, Upper Murrumbidgee and Upper Tumut Rivers and their combined development through a series of power stations down the Tumut River. A major dam has been constructed on the Eucumbene River to create Lake Eucumbene, which has an ultimate usable storage of 3.5 million acre feet. The waters of the Upper Murrumbidgee River are diverted into Lake Eucumbene by a dam at Tantangara and a 10½-mile tunnel from Tantangara Reservoir. From Lake Eucumbene, the water flows through a 14-mile tunnel to Tumut Pond Reservoir on the upper reaches of the Tumut River, where it joins the waters of the Tumut River itself and the waters of the Tooma River diverted to Tumut Pond Reservoir by a diversion dam and a 9-mile tunnel. The 14-mile Eucumbene-Tumut Tunnel is used during periods of high flow to divert waters of the Tumut River from Happy Jacks Shaft or the combined waters of the Tumut and Tooma Rivers from Tumut Pond Reservoir back to Lake Eucumbene for storage.

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

Tumut 3 Power Station, the largest station of the scheme (capacity 1,500,000 kW of which 500,000 kW will be provided by pump turbines) will be constructed below Talbingo Reservoir and will discharge into Jounama Pondage on the Tumut River. This pondage will provide a downstream pumping pool and also re-regulate discharges from Tumut 3 Power Station as required. Releases from Jounama Pondage will then enter Blowering Reservoir formed by Blowering Dam. This dam is under construction by the Snowy Mountains Authority as an agent for the State of New South Wales and will provide for the regulation of power station discharges for irrigation use in the Murrumbidgee Valley. The Authority will construct a power station at the foot of the dam to generate power from releases of water for irrigation purposes.

(iii) *Snowy-Murray Development.* The principal features of the Snowy-Murray Development are the diversion of the main stream of the Snowy River by tunnels, shafts, and pipelines westwards through the Great Dividing Range into the Swampy Plain River in the catchment of the Upper Murray, and the development of power on the western slopes of the Alps. The main works of the development will be as follows.

(*a*) A tunnel from the Snowy River near Island Bend through the Great Dividing Range to Geehi Reservoir on the Geehi River, and two power projects between Geehi Reservoir and the Swampy Plain River near Khancoban. The power stations associated with these two power projects, Murray 1 and Murray 2, will have a combined capacity of 1,500,000 kW.

(*b*) A tunnel from a small dam on the Snowy River near Island Bend to Eucumbene Dam to carry Snowy water to Lake Eucumbene for storage at times of high river flows. When river flows are lower than average, this stored water will be returned towards Island Bend and thence through the Snowy-Geehi Tunnel to Geehi Reservoir and Murray 1 and Murray 2 Power Stations.

(*c*) A dam on the Snowy River near Jindabyne to store the residual flow of the Snowy and Eucumbene Rivers downstream from Island Bend and Eucumbene Dams, including the flows of major tributaries, the Crackenback and Mowamba Rivers; and the construction of a pumping plant, pipeline and tunnel to lift this water from Jindabyne Reservoir to the Snowy-Geehi Tunnel near Island Bend, where it will join the flow to the Geehi Reservoir for use through Murray 1 and Murray 2 Power Stations.

The power output of this section of the Scheme will be increased by the construction of subsidiary hydro-electric projects on the Upper Snowy River above Island Bend and on Windy Creek, a tributary of the Upper Geehi.

4. **Utilization of Power.**—The future electric power plants on the mainland of Australia will be predominantly thermal or thermo-nuclear installations, and in an electrical system in which the greater part of the energy is generated in thermal plants it is usually found that the hydro installations operate to the best advantage on peak load. However, the existing New South Wales and Victorian systems include a proportion of relatively old and less efficient installations which, for reasons of fuel economy, are also best used for the production of peak load power. Therefore, in order to utilize the potential of the Snowy Mountains Scheme most effectively, the order of development is being arranged so that the early stations operate, initially, somewhat below the peak of the system load, with a progressive change to predominantly peak load operation as construction proceeds and as the load increases in magnitude.

The Snowy Mountains Scheme is situated about midway between the principal load centres of Sydney and Melbourne and is connected to those cities by 330 kV transmission lines. It is, consequently, in a position to take advantage of the diversity in the power requirements of these two load systems, a most important factor in so far as it affects the economy of operation of the supply systems of the two States.

Although most of the output from the scheme will go to the States of New South Wales and Victoria, the Commonwealth Government has the right to draw from the scheme its requirements of power and energy for the Australian Capital Territory and for defence purposes. For convenience, the Commonwealth's requirements are drawn from the New South Wales transmission network by an exchange arrangement between the Commonwealth and the Electricity Commission of New South Wales. Electricity over and above that required by the Commonwealth Government is divided between the States of New South Wales and Victoria in the ratio 2 : 1.

5. **Progress and Future Programme.**—The scheme's first power station, Guthega, of 60,000 kW initial capacity, came into operation in February, 1955. It was followed by Tumut 1, an underground power station with a capacity of 320,000 kW, in 1959, and by the 280,000 kW Tumut 2 underground power station in 1962. The total installed capacity of the scheme at present is 660,000 kW. Eucumbene Dam, which provides the major regulating storage for the scheme, was completed in May, 1958. Tumut Pond Dam, completed in September, 1958, provides the balancing storage for the power stations of the Upper Tumut Works. The first trans-mountain diversion of water from Lake Eucumbene to the Tumut River at Tumut Pond was made possible when the 14-mile Eucumbene-Tumut Tunnel was completed in June, 1959. The 10½-mile Murrumbidgee-Eucumbene Tunnel and the 9-mile Tooma-Tumut Tunnel came into operation early in 1961. Following the completion of the Upper Tumut Works, construction activity has been concentrated on the Snowy-Murray development. Construction is well advanced on the 15-mile Eucumbene-Snowy Tunnel, the 9-mile trans-mountain Snowy-Geehi Tunnel, the 7½-mile Murray 1 Pressure Tunnel, the 1-mile Pressure Pipeline and the 950,000 kW Murray 1 Power Station. These works, together with the Khancoban Dam, which will regulate power station releases before discharge into the Murray River, are to be substantially completed in 1966. At this time, the first trans-mountain diversion of water from the Snowy River to the Murray River and the first generation of electricity from the Murray 1 Power Station will occur.

STATES AND TERRITORIES

§ 1. New South Wales

1. **General.**—In Year Book No. 39, an account was given in some detail of the origin and development of electricity generation and distribution in New South Wales. At present, the following three main Acts govern electricity supply in New South Wales.

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

The Electricity Development Act, 1945–1964, which established the Electricity Authority of New South Wales as the body responsible for the co-ordination of electricity supply throughout the State.

The Electricity Commission Act, 1950–1961, 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 is directly responsible to the Minister for Local Government, consists of five members, of whom one is full-time Chairman and one is full-time Vice-Chairman.

The main function of the Commission is the generation and transmission of electricity, which it sells in bulk to distributing authorities (mainly local government bodies) throughout a large part of the State, to the Government railways, and to certain large industrial consumers. As the major generating authority, it is also responsible for the development of new power sources except in the Snowy Mountains region.

(ii) *Other Electricity Supply Authorities.* The retail sale of electricity to the public is, in general, carried out by separate electricity supply authorities—municipal and shire councils, electricity county councils (consisting of groups of shire and/or municipal councils), or private franchise holders. At 30th June, 1964, there were 51 supply authorities throughout the State, of which 13 also generated part or all of their power requirements. Most of the small power stations which had operated in many country centres have closed down as the main transmission network has been extended.

Over recent years there has been a distinct trend towards the consolidation of supply areas, many of which have been individually too weak 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 only for electricity supply purposes, and administered by a county council of representatives elected by the constituent councils. Of the 225 cities, municipalities and shires in New South Wales, 215 are included in one or other of the 34 electricity county districts. The majority of these county districts have been constituted since 1945. The largest of the county councils is the Sydney County Council, which at 30th June, 1964, was supplying 515,634 consumers in the Sydney Metropolitan Area.

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

The following are the main functions of the Authority.

Distribution. The approval of the Authority is required for the establishment or acquisition of an electricity trading undertaking by a local government council, for the granting or renewing by such a council of electricity franchise agreements or corresponding agreements with other councils, and for the giving or taking of bulk supplies of electricity. It also has power to formulate proposals for the establishment of county councils.

In exercising these powers, the Authority is concerned mainly with seeing that distributing authorities are sufficiently strong to provide an economical, efficient and satisfactory service. Its most important activities in this regard are in investigating supply areas and in making recommendations to the Minister for the consolidation of such areas into county districts.

Rural Electrification. The Authority administers the rural electricity subsidy scheme under which rural electrification throughout the State is progressing very rapidly (*see* para. 4, p. 211).

Safety. The Electricity Development Act, 1945–1964, contains provisions for the making of regulations relating to most aspects of safety, and these powers are being used more and more extensively. Safety regulations now in force cover such matters as inspection of consumers' installations, licensing of electricians and electrical contractors, approval of electrical appliances, safety of linesmen and overhead line construction.

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

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 dependent mainly on steam power

stations. During the year ended 30th June, 1964, coal-fired stations generated 92.4 per cent. of the State's energy requirements, hydro-electric stations 7.1 per cent. and internal combustion plants 0.5 per cent. In addition, 934 million kWh were purchased from the Snowy Mountains Hydro-Electric Authority during the year.

With the future plant development of the Snowy Mountains scheme, an increasing amount of power will be generated by the Authority, but at no stage of its development will the scheme supply more than 15 per cent. of the State's energy requirements. Coal-fired steam power stations, therefore, will continue to supply the greater part of requirements for the foreseeable future.

(ii) *Major Generating Stations.* In New South Wales the generation of electricity has followed the general world trend towards large centralized power stations supplying large areas through interconnected transmission networks. Whereas until a few years ago the greater part of the coal-fired generating plant was located in the industrial areas of Sydney, Newcastle and Wollongong, where most of the population is also located, major power stations are now being located on the coalfields to the north, south and west of Sydney, and power is transmitted to the load centres through high voltage transmission lines.

At 30th June, 1963, the major power stations of the State system of the Electricity Commission of New South Wales and their installed capacities were as follows:—*Steam*—Vales Point (Lake Macquarie), 400,000 kW; Bunnerong (Sydney), 375,000 kW; Wangi (Lake Macquarie), 330,000 kW; Tallawarra (Lake Illawarra), 320,000 kW; Wallerawang (near Lithgow), 240,000 kW; Pyrmont (Sydney), 200,000 kW; White Bay (Sydney), 172,000 kW; Balmain (Sydney), 107,000 kW; Port Kembla, 60.500 kW; Zarra Street (Newcastle), 42,500 kW; Muswellbrook, 30,000 kW; Lithgow, 27,000 kW; Tamworth, 27,000 kW; Maitland, 20,000 kW; Penrith, 20,000 kW; Liverpool, 20,000 kW; *Hydro*—Hume—(near Albury), 50,000 kW; Warragamba (near Penrith), 50,000 kW; Burrinjuck (near Yass), 20,000 kW. There were also various other steam, hydro and internal combustion stations aggregating 27,470 kW. The total installed capacity of the Electricity Commission's system was 2,538,470 kW.

The greater part of the Commission's generating plant is concentrated within a hundred mile radius of Sydney—the largest stations outside this area being located at Hume, Muswellbrook and Tamworth.

(iii) *Major Transmission Network.* The retailing of electricity to 97 per cent. of the population of New South Wales is in the hands of local distributing authorities, which obtain electricity in bulk from the Commission's major State network. This network of 330 kV, 132 kV, 66 kV and some 33 kV and 22 kV transmission lines links the Commission's power stations with the load centres throughout the eastern portions of the State, extending geographically up to 400 miles inland.

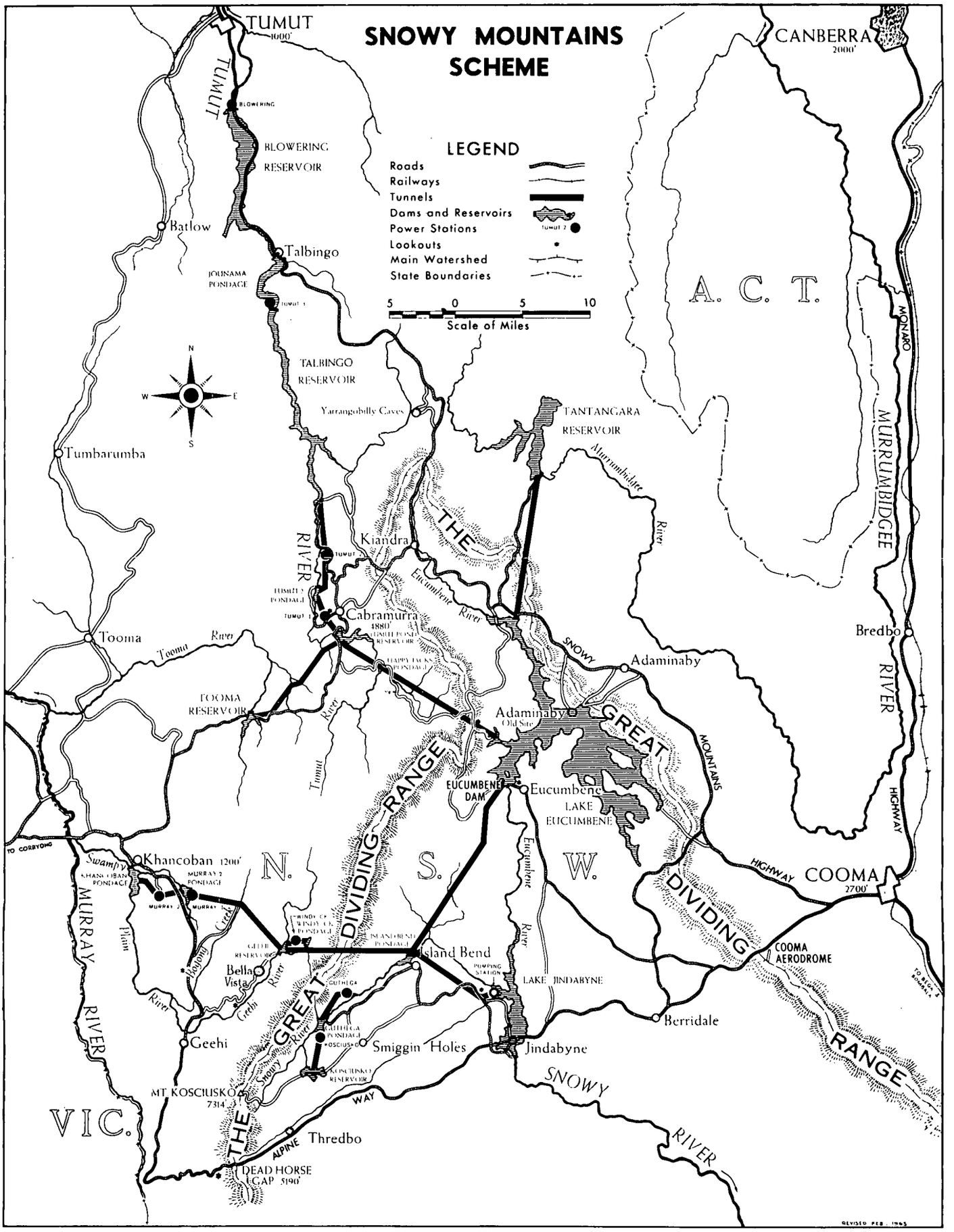
At 30th June, 1964, there were in service 838 route miles of 330 kV (including 153 miles operating for the time being at 132 kV) and 1,811 miles of 132 kV transmission lines (including 243 miles operating for the time being at 66 kV or lower). There were also in service 2,399 miles of transmission line of 66 kV and lower voltages.

The installed transformer capacity at the Commission's 103 sub-stations was 7,751,080 kVA.

(iv) *Separate Systems and Total State Installed Capacity.* A number of small plants which supply isolated towns and villages have not yet been interconnected with the main network.

Some local government bodies have undertaken the development of independent power stations. Of these, the more important are:—the Northern Rivers County Council, which has constructed a steam power station at Koolkhan (near Grafton) with an installed capacity of 28,750 kW, and the North-West County Council, which has established a 12,500 kW steam power station on the Ashford coalfield.

The aggregate installed capacity for the whole of the New South Wales systems and isolated plants was 2,703,757 kW at 30th June, 1964, and the number of ultimate consumers at this date was 1,295,353.


SNOWY MOUNTAINS SCHEME
LEGEND
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Railways
Tunnels
Dams and Reservoirs
Power Stations
Lookouts
Main Watershed
State Boundaries
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Scale of Miles
TUMUT 1000'
CANBERRA 2000'
BLOWERING RESERVOIR
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JOUNAMA PONDAGE
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Khancoban 1200'
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MURRAY RIVER
N. S. W.
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Island Bend
Eucumbene River
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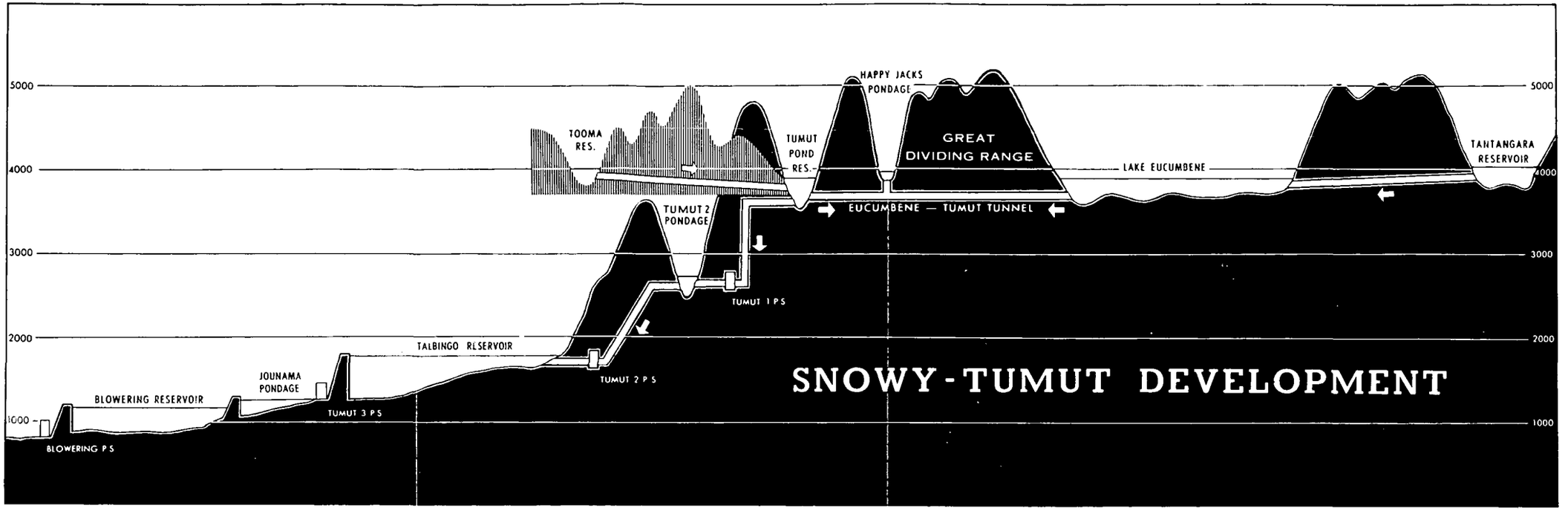
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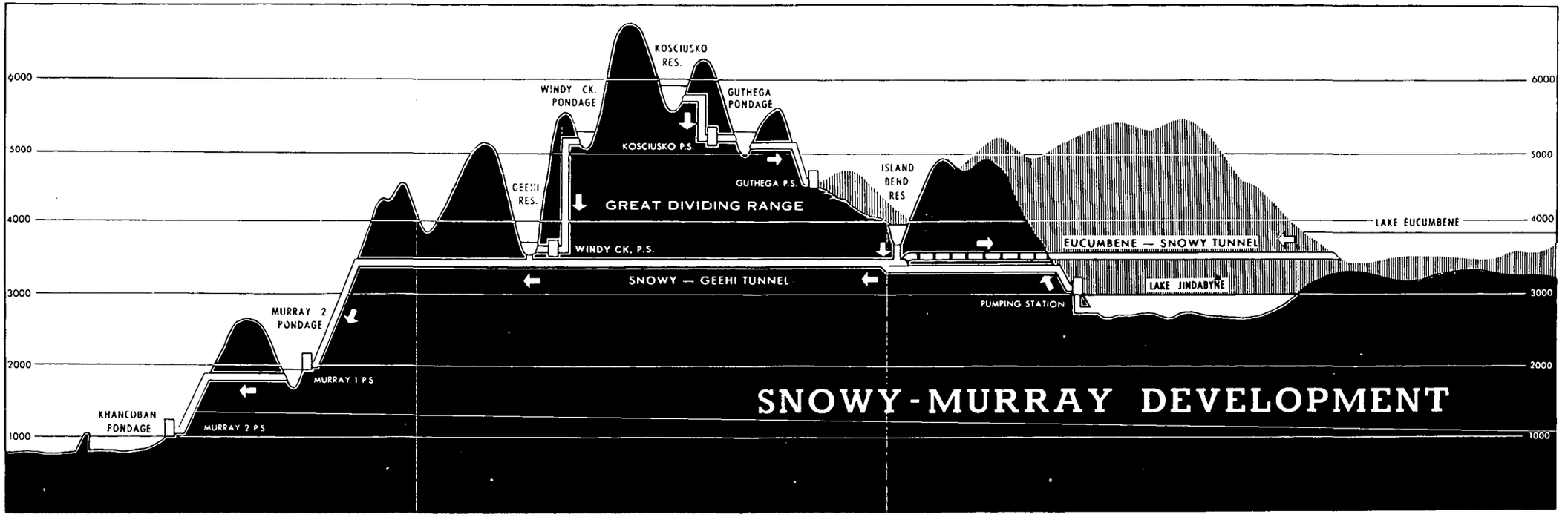
SNOWY - TUMUT DEVELOPMENT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GEEHI RES.
GREAT DIVIDING RANGE
LAKE EUCUMBENE
WINDY CK. P.S.
EUCUMBENE — SNOWY TUNNEL
SNOWY — GEEHI TUNNEL
LAKE JINDABYNE
PUMPING STATION
MURRAY 2 PONDAGE
MURRAY 1 P S
KHANCOBAN PONDAGE
MURRAY 2 P S
SNOWY - MURRAY DEVELOPMENT

(v) *Future Development.* The major new thermal stations already built and those now being developed on the coalfields will become the main base load centres for the northern, southern and western regions. Wangi, on Lake Macquarie, Wallerawang, near Lithgow, and Tallawarra, on Lake Illawarra, have been completed.

At Vales Point, on Lake Macquarie, work is in progress on a large thermal station with a designed capacity of 875,000 kW. The plant will consist of three 200,000 kW units and one 275,000 kW unit. Two 200,000 kW units have been commissioned and construction of the remaining two is progressing.

Construction of the Munmorah Power Station, located between Lakes Munmorah and Budgewoi (on the central coast), has commenced. The plant at Munmorah will comprise four 350,000 kW generating units, coming into operation from 1967 onwards.

The development of the 330 kV main system is continuing. With duplicate transmission completed over the whole distance from the Snowy Mountains to the northern coalfields, the main work now in hand is the construction of a third circuit between the Snowy area and Yass and between the Vales Point–Munmorah area and Sydney. Development of the 330 kV network around the Sydney metropolitan area is proceeding.

Work is considerably advanced on the Sydney West 330 kV Substation which is located near Mount Druitt. Plans to augment the transmission system during the next five years provide for the construction of 400 route miles of 330 kV lines and four associated substations, over 1,000 route miles of 132 kV line and 20 substations, as well as additions to existing substations and a number of lower voltage works.

(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. 204). Apart from this area, major hydro-electric stations are in operation at the Warragamba Dam (50,000 kW), Hume Dam (50,000 kW), Burrinjuck Dam (20,000 kW), and Keepit Dam (6,000 kW). The output of Warragamba Power Station depends upon the availability of water surplus to the requirements of the Sydney Metropolitan Area, and the output of the other stations on the release of water for irrigation.

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

The Northern Rivers County Council operates a hydro-electric power station on the Nymboida River, a tributary of the Clarence River. This station has a capacity of 4,500 kW.

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

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

4. **Rural Electrification.**—When the Electricity Authority of New South Wales was constituted in 1946 only 16,000 New South Wales farms were being served with electricity—less than one-quarter of those within reasonable reach of public electricity supply systems. Under a subsidy scheme approved in August, 1946, local electricity suppliers receive subsidies from the Electricity Authority towards the cost of new rural lines. The amount of subsidy is based on the estimated cost of the proposed extension and the number of consumers able to be served by the new lines. The scheme was designed to encourage local electricity supply authorities to construct the more economic extensions first by fixing a limit to the cost for which suppliers could be subsidized. Originally this limit was £250 per consumer when averaged over the cost of the whole extension, but the limit was raised to £400 in December, 1953. Some subsidy was paid on higher cost extensions, but the excess over an average of £400 was not subsidized.

To assist supply authorities in extending supply to less populated, and thus high-cost, areas of the State the subsidy scheme was extended from May, 1959, to provide for payment of increased subsidy in respect of extensions where the average capital cost per consumer lies within the range of £600–£800.

Between August, 1946, and June, 1964, applications for subsidy had been made by electricity suppliers to the Authority covering rural extensions costing £35 million to give supply to some 55,000 farming properties and 33,500 other rural consumers and involving 51,000 miles of line. The greater part of this work had been completed at 30th June, 1964. At this date the Authority was committed to the payment of £14,524,623 in subsidies, of which £7,497,735 had been paid.

§ 2. Victoria

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

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 nearly 98 per cent. of the population.

Development of Victoria's electricity system is based on the utilization for both power and fuel of Victoria's extensive brown coal resources in the Latrobe Valley in eastern Gippsland, with supplementary development of the hydro-electric potential of north-eastern Victoria. Victoria is entitled to one-third of the electricity from the Snowy Mountains Hydro-electric Scheme, after the Commonwealth has taken the power it needs for its purposes. Victoria also shares with New South Wales in the electricity generated at Hume Hydro Station on the River Murray. About 75 per cent. of the State's electricity is generated from brown coal, either used in its raw state or manufactured into higher quality fuel in the form of brown coal briquettes. All the brown coal and briquette fuel is supplied by undertakings which the Commission itself owns and operates. Output of brown coal in 1963–64 from the three open cuts at Yallourn, Yallourn North and Morwell totalled 18,165,267 tons, of which 12,567,455 tons were used in the Commission's own power stations, and 5,191,919 tons were manufactured into 1,882,626 tons of brown coal briquettes, 38 per cent. of the briquette output then being used for electricity production in metropolitan and provincial steam power stations.

The two functions, generation of electricity and production of fuel, are closely integrated. Apart from the large proportion of brown coal and briquette fuel consumed in the power stations, the process of briquette manufacture results also in the generation of electricity, since the steam needed for processing the raw coal for briquetting is first used to operate turbo-generators.

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

The Commission is the controlling authority for all electrical undertakings in Victoria. It is responsible for the registration of electrical contractors, the licensing of electrical mechanics, the control of installation methods and material and the testing and approval of electrical equipment and appliances. Incidental to its main operations, the Commission owns and operates the tramway systems in Ballarat and Bendigo. For the accommodation of its employees at Yallourn, the Commission owns and administers the town of Yallourn. It also owns large housing estates in the surrounding area, but is progressively selling houses in these estates to Commission employees. In the Kiewa hydro-electric works area it has built the two townships of Mount Beauty and Bogong, municipal administration of the former now being vested in the Shire of Bright. With construction at Kiewa now complete, many houses at Mount Beauty have been sold for holiday homes.

(iii) *Electricity Supply.* At 30th June, 1964, the number of ultimate consumers in Victoria was 1,017,355. Of these, 1,005,694 were served by the State system and 11,661 by local country undertakings. The State system supplies all the Melbourne metropolitan area and over 1,900 other centres of population.

Complete electrification of the State is now within sight. By 30th June, 1964, about 855,000 of the 888,000 homes in the State and 57,300 of Victoria's 71,750 farms were supplied with electricity. By 1970–71, allowing for extensions then in progress, only about 6,000 homes and fewer than 1,250 farms in remote areas will be out of reach of public electricity supply, but efforts will be continued to supply as many of these as possible.

The Commission sells electricity retail in all areas except part of the metropolitan area, where it sells in bulk to eleven municipal undertakings which operate as local retail supply authorities under franchises granted before the Commission was established. Bulk supply is also being provided at present to several New South Wales municipalities and irrigation settlements bordering the River Murray. The number of consumers served by the State system outside the Melbourne metropolitan area is 454,916. Of the new consumers connected to supply each year, more than two-thirds are outside the metropolitan area. New farm connexions average about 3,000 a year.

The Commission's retail consumers numbered 804,304 at 30th June, 1964. Retail supply is administered through the metropolitan branch and ten extra-metropolitan branches (Ballarat, Eastern Metropolitan, Geelong, Gippsland, Midland, Mildura, Northern, North-Eastern, South-Western and Wimmera). At 30th June, 1964, there were branch and district supply offices in Melbourne and 89 other cities and towns in Victoria.

(iv) *Electricity Production.* Electricity generated in the State system or purchased by it totalled 8,647 million kWh in 1963–64 or more than 99 per cent. of all Victoria's electricity. The system comprises a series of thermal and hydro-electric power stations. Inclusive of generator capacity both within the State and available to the Victorian system from outside the State, the total installed generator capacity at 30th June, 1964, was 1,888,000 kW. Power stations are interconnected, and feed electricity into a common pool for general supply. The major power station in this interconnected system is the brown coal burning power station at Yallourn, which alone generates nearly half of Victoria's electricity. Other power stations in the interconnected system comprise two further base load brown coal burning power stations, Morwell and Hazelwood (which began partial operation, with one generating set in service, late in 1964); steam stations in Melbourne (Newport, Richmond and Spencer Street), Geelong and Ballarat and also at Red Cliffs, which has, in addition, some internal combustion plant; hydro-electric stations at Kiewa, at Eildon, on the Rubicon and Royston Rivers near Eildon, and at Cairn Curran; and an internal combustion station at Warrnambool. All within Victoria are Commission-owned, except Spencer Street Power Station, which remains the property of the Melbourne City Council, although operated as a unit in the interconnected system. A 330 kV transmission line links the Victorian system with the Snowy Mountains undertaking, and also provides facilities for interconnexion between the Victorian and New South Wales State generating systems. Also linked with the Victorian interconnected system is the hydro station at Hume Dam on the River Murray. This power station is operated by the Electricity Commission of New South Wales. Output and operating costs are shared by Victoria and New South Wales.

In meeting the total demand on the system, which fluctuates throughout the day and from month to month, each group of stations in the interconnected system is assigned a predetermined function dependent upon the availability of power from each group and the economics of generation. The various stations are utilized in the combination that will meet the system load most economically at a given time.

(v) *Transmission and Distribution.* The electrical transmission and distribution system in the State supply network at 30th June, 1964, comprised 42,432 miles of power-lines, 19 terminal receiving stations, 89 main transmission sub-stations and nearly 38,000 distribution sub-stations. Main transmission is by 220 kV, 132 kV and 66 kV power lines which supply the principal distribution centres and also provide interconnexion between the power stations. The 220 kV system now totals 1,054 miles.

(vi) *Future Development.* Major new construction is concentrated on the erection of a large new brown coal burning power station (Hazelwood) on the brown coal fields of the Latrobe Valley, which is designed to operate on raw brown coal fuel supplied by belt conveyor direct from the Morwell open cut. Hazelwood Power Station is the largest project yet undertaken by the Commission and is designed to have a capacity of 1,200,000 kW in 1969. By that year the State's power resources, including Victoria's share of the output of the Snowy scheme, will have increased by 78 per cent. to 3,200,000 kW. The first of Hazelwood's six 200,000 kW turbo-generators was commissioned in October, 1964. A second generating set of the same capacity is due to go into service in 1965, and four other 200,000 kW sets will follow at yearly intervals. Power generated at Hazelwood Power Station is transmitted at high voltage to Melbourne metropolitan terminal stations for distribution through the State supply network.

3. **Local Country Electricity Undertakings.**—At 30th June, 1964, there were 14 independent electricity undertakings in country centres in Victoria generating and distributing their own local supply. All except three of these undertakings were in the west and north-west of the State. Under the State Electricity Commission's rural electrification programme, almost all the independent local country undertakings will ultimately be acquired and absorbed into the State system. For the year 1963–64 the total production of the independent undertakings was 37 million kWh. The number of consumers at 30th June, 1964, was 11,661. With the exception of the Wonthaggi undertaking (which is operated by the State Coal Mine), the operation of the independent undertakings is governed by the *Electric Light and Power Act* 1958, which is administered by the State Electricity Commission.

§ 3. Queensland

1. **General.**—In Year Book No. 39 an account is given of the growth of electricity generation in Queensland, with particular reference to south-eastern Queensland.

The generation and distribution of electric power in Queensland in earlier years had tended to lag behind developments in this field in other States of Australia. By 1935 a total of 62 Orders in Council to supply electricity had been issued (41 to local authorities and other public bodies and 21 to private companies). With only four exceptions these were in respect of circumscribed areas which extended only to the limits of the cities or towns within which the generating facilities had been established. The exceptions were areas around Brisbane, Ipswich, Toowoomba and Cairns.

Because of the unco-ordinated and isolated development which had occurred, the Queensland Government, in 1935, 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 alternative proposals put before it will be found on page 1182 of Year Book No. 39). The Commission recommended that a commission to control the generation and distribution of electric power be vested in the State; but if the establishment of an operating commission was not found practicable, then electrification under public control with ultimate public ownership should be implemented by means of a controlling commission capable of being converted into an operating commission. In 1937 the State Government constituted the State Electricity Commission of Queensland.

2. **The State Electricity Commission of Queensland.**—The Commission commenced to function in January, 1938. Generally, the Commission is the statutory authority concerned, *inter alia*, with the administration of electricity supply legislation, the general control, organization and efficient development of the electricity supply industry in Queensland, the forward planning of such development, the control of electricity charges, the administration of regulations and rules relating to safety, the raising of capital, the provision of engineering and consulting services, the promotion of the use of electricity, particularly in manufacturing and rural industries, and the fixing of standards. In addition, it is an authority to which consumers may appeal on matters in dispute between them and their electric authorities. The Commission is also empowered to own directly and operate generating stations and transmission lines and to sell electricity in bulk, but up to the present it has not been found necessary or desirable to implement this power.

3. **Legislation.**—Electricity supply in Queensland is governed by the following Acts which are administered by the Commission.

" *The State Electricity Commission Acts*, 1937 *to* 1964." These Acts constituted the Commission and define its powers, duties and responsibilities.

" *The Electric Light and Power Acts*, 1896 *to* 1964." These Acts relate to the constitution of electric authorities, and define their powers, duties and responsibilities, and the conditions under which electricity is to be supplied and used, and also provide for the making of regulations governing safety and other matters.

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

" *The Southern Electric Authority of Queensland Acts*, 1952 *to* 1964." These Acts established the Southern Electric Authority as a public authority and successor to the City Electric Light Co. Ltd., and define the powers and responsibilities of the Authority.

"*The Northern Electric Authority Acts*, 1963 *to* 1964." These Acts established the Northern Electric Authority with responsibility for the generation and main transmission of electricity in north Queensland and for its sale in bulk to regional distributing authorities. They also define its powers and responsibilities.

"*The Electrical Workers and Contractors Acts*, 1962 *to* 1964." These Acts deal with the execution of electrical works, the competency of electrical workers, and the licensing of electrical contractors.

4. Development and Organization.—Following the 1939–1945 War, regional systems of electricity supply were established in and adjacent to the eastern coastal area which is over 1,300 miles long. Five Regional Electricity Boards were established to replace the numerous individual electricity undertakings which had supplied only the larger centres of population. Under this system supply was delivered from central generating stations at or near the principal load centres. Each region comprised a homogeneous area, possessing relatively common interests, within which integrated transmission and distribution systems were established. Transmitted supply was taken to load centres previously served by relatively costly local generating stations and a vigorous policy of rural electrification was pursued. In south-eastern Queensland regional electrification was undertaken by the Southern Electric Authority and the Dalby Town Council. The Brisbane City Council supplies the metropolitan area.

In the pastoral areas west of the Great Dividing Range supply has been provided by means of small diesel-operated generating stations run by local authorities. These independent units are fairly uniformly scattered throughout western Queensland and no town or village with more than 50 potential consumers is without electricity. With increasing consumption there has been a trend in this area for local generating stations to be superseded by transmitted supply from larger centres. From such transmission lines it has been possible to provide electricity to many otherwise isolated rural properties.

Continued load growth led naturally to the interconnexion of regional systems and by this means the production of electricity was concentrated on the cheapest sources of power. The three northern Regional Electricity Boards (Cairns, Townsville and Mackay) were consolidated into one interconnected grid. In the south, the supply systems of the Southern Electric Authority, the Brisbane City Council, the Wide Bay-Burnett Regional Electricity Board and the Dalby Town Council also form an interconnected grid. The central Queensland network which is operated by the Capricornia Regional Electricity Board is not yet connected with either the northern or southern grids.

The natural sequel to the interconnexion of regional supply systems has been the severance of the production and distribution functions. For the northern grid, the Northern Electric Authority (which commenced operations on 1st July, 1964) is responsible for the operation of generation and main transmission facilities, with the Cairns, Townsville and Mackay Regional Electricity Boards buying in bulk and acting as distributing authorities. In the south, the Southern Electric Authority is responsible for generation and transmission, with the other authorities purchasing in bulk and performing the distribution function. However, the Southern Electric Authority also distributes over a large rural area surrounding Brisbane and the Wide Bay-Burnett Board generates on a small scale. The Capricornia, Townsville and Cairns Boards operate a number of small isolated diesel generating stations.

All electricity undertakings in Queensland are now publicly owned, and with the exception of the Southern Electric Authority are controlled by representatives of local authorities within the areas concerned. Further interconnexions and amalgamations within the electricity supply industry will be effected as soon as they will produce greater efficiency and lower costs to consumers. A major co-ordinating factor has been the inclusion of the Commissioner for Electricity Supply on the Boards of the Southern Electric Authority, the Northern Electric Authority and the five Regional Electricity Boards since their inception.

5. Generation.—Electricity generated in the State is based primarily on black coal, 83.4 per cent. of the total production during 1963–64 being derived from this fuel. Hydro-electric stations, located mainly in north Queensland, provided 15 per cent., and the balance of the production, 1.6 per cent., was from internal combustion plants located mainly in western Queensland, utilizing oil, wood, coal or natural gas as fuel. Natural gas is the principal fuel used at the Roma power station. Electricity generated in Queensland in power stations in 1963–64 totalled 3,330 million kWh. At 30th June, 1964, the major power stations within the State were as follows:—*Steam*—Bulimba A (Brisbane), 92,500 kW; Bulimba B (Brisbane),

180,000 kW; New Farm (Brisbane), 75,000 kW; Tennyson A (Brisbane), 120,000 kW; Tennyson B (Brisbane), 120,000 kW; Howard (near Maryborough), 37,500 kW; Rockhampton, 52,000 kW; Mackay, 12,250 kW; Townsville, 37,500 kW; *Hydro*—Kareeya (Tully Falls), 72,000 kW; Barron Gorge (near Cairns), 60,000 kW.

The Mackay station also contains 3,000 kW of internal combustion plant. The Southern Electric Authority also operates two packaged plants each of 10,000 kW capacity.

The total installed capacity of all Queensland generating stations was 1,007,984 kW which comprised 834,750 kW of steam plant, 139,015 kW of hydro-electric plant and 34,219 kW of internal combustion plant.

6. **Transmission and Distribution.**—The electrical transmission and distribution systems within the State comprised 30,600 miles of power lines at 30th June, 1964. The main transmission voltages are 132 kV, 110 kV, 66 kV and in certain areas 33 kV. Extensive rural electrification has been undertaken by means of the single wire earth return system. At 30th June, 1964, the total number of electricity consumers was 457,600 of whom 185,000 were in metropolitan Brisbane. The total number of farming properties supplied with electricity was 24,182.

7. **Future Development.**—Major new construction is concentrated on the development of three new power stations sited on coalfields. These are at Swanbank (360,000 kW) on the West Moreton coal field near Ipswich, Callide (150,000 kW) on the Callide open-cut coalfield near Biloela, and at Collinsville (180,000 kW) on the Collinsville coalfield. These stations will supply the southern, central and northern network, respectively. Cooling water for the Callide station will be provided from a multipurpose dam on Callide Creek which will also satisfy irrigation needs. A similar multipurpose dam on the Broken River will serve the Collinsville station. The water requirements of the Swanbank power station will be pumped from the Bremer River and supplied from the Moogerah Dam via Warrill Creek.

The Swanbank station will consist of six 60,000 kW generating sets, the first of which will be commissioned in 1966, two more in 1967 and one each year until 1970. The first stage of the Callide station consists of two 30,000 kW sets, the first to be commissioned in mid-1965 and the second a year later. A third similar set is planned for installation in 1968. At Collinsville the first stage of two 30,000 kW sets is planned for commissioning in 1968.

Subsequent development will depend upon the outcome of current investigations. For southern and central Queensland the alternatives are a further power station on the West Moreton coalfield or a new station at Callide to serve both the southern and central grids. In north Queensland the choice lies between further development at Collinsville or further development of the area's hydro-electric resources.

The electrical development in the west of Queensland is being assisted by the progressive extension westwards of the boundaries of the major regional electricity undertakings to include smaller western undertakings, bringing with it the advantages of incorporation within larger authorities, lower tariffs and greater financial and technical resources. Organizational changes involving amalgamation of isolated undertakings and their interconnexion by transmission lines are being implemented as and when economic benefits to the consumers will result. In the extreme far west the isolated undertakings must inevitably continue to remain as such for the foreseeable future.

§ 4. South Australia

1. **General.**—An account of the companies generating electric power in South Australia prior to the establishment of the Adelaide Electric Supply Co. Ltd., and describing the development of that company's activities, was given in 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 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.

2. **The Electricity Trust of South Australia.**—In 1946 the assets of the Adelaide Electric Supply Co. Ltd. were transferred to a newly formed public authority, the Electricity Trust of South Australia, which became responsible for unification and co-ordination of the major portion of the State's electricity supply and which took over the powers previously vested in the South Australian Electricity Commission. In addition to the powers specified in the Adelaide Electric Supply Company's Acts, 1897–1931, the Trust may supply electricity direct to consumers within a district or municipality with the approval of the local authority, and by agreement with other organizations which generate or supply electricity, arrange to inter-connect the mains of the Trust with those of other organizations, and give or receive supplies of electricity in bulk.

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

Of the total installed capacity in South Australia, the Electricity Trust operated plant with a capacity of 606,000 kW, and is the most important authority supplying electricity in the State. There were approximately 352,000 ultimate consumers of electricity in the State, of whom 328,600 were supplied directly and approximately 11,000 indirectly (i.e. through bulk supply) by the Trust. Its major steam stations are Osborne " A " (60,000 kW), Osborne " B " (180,000 kW), and Port Augusta Playford " A " (90,000 kW) and Playford " B " (240,000 kW), the balance of the capacity controlled consisting of house sets and regional stations at Port Lincoln and Mount Gambier, where the Trust operates steam power stations of 5,000 kW and 21,800 kW capacity respectively, the former burning fuel oil and the latter either wood waste or fuel oil. Mt. Gambier is connected with the Metropolitan system by a 132 kV line.

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

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, 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, 1964, 1,617,973 tons of coal were produced, practically all of which was used by the electricity undertaking at the Port Augusta Playford Power Stations which use Leigh Creek coal exclusively.

A further 60,000 kW turbo-alternator with an associated oil fired boiler is being installed at Osborne " B " station and is due to be commissioned early in 1965.

A large power station is to be constructed on Torrens Island near Adelaide and two 120,000 kW turbo-alternators and associated oil fired boilers have been ordered, the first to be commissioned early in 1967.

§ 5. Western Australia

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

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

The Commission is empowered to co-ordinate all State and other power undertakings in the State; to encourage and promote the use of electricity and other power, especially for industrial, manufacturing and rural purposes, and to carry out investigations to determine the safest, most economical and effective means for promoting, establishing, extending and improving works for the generation, transmission, distribution, supply and use of electricity or other power throughout the State. 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 that their proposals are not inconsistent with the Commission's plans.

3. **General Pattern of Electricity Supply.**—(i) *General.* The State Electricity Commission gives central power station supply to the metropolitan area and an area of approximately 25,000 square miles defined in the report which formed a basis for the *South West State Power Scheme Act, 1945.* These areas include the more highly developed rural districts with a greater population density, which can more readily be connected to a central power station system. The policy of extending power supplies to rural consumers is continuing and at 30th September, 1964, some 4,753 rural consumers were connected. A similar scheme known as the Northern Areas State Power Scheme will be developed and a depot is being established in the Geraldton area. It is the intention of the Commission to purchase power in bulk from the Geraldton Town Council to supply surrounding districts as far north as Northampton.

In the other areas of the State, towns are supplied by the local authority or by a concessionaire operating under an agreement with the local authority and the Commission. Power stations operated under these conditions are exclusively diesel of varying sizes. The number of ultimate consumers at 30th June, 1964, was 182,094.

(ii) *Interconnected System.* At the request of the Government, the Electricity Advisory Committee, in 1945, submitted a report which recommended, among other things, a national power scheme for the south-west. 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. In 1946, the State Electricity Commission acquired the Collie Power Station, and since then it 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 most of the south-west towns as well as towns in the eastern wheat belt area as far east as Merredin have now been connected by transmission line to the interconnected system.

Statistics relating to activities of the interconnected system are shown in the following table.

WESTERN AUSTRALIA: INTERCONNECTED SYSTEM

Particulars		1962–63	1963–64
Plant capacity	kW	289,500	289,500
Maximum load	kW	231,000	263,000
Units generated	Million kWh	987	1,094
Fuel used per unit (kWh) generated	lb.	1.49	1.49
Coal used	tons	583,496	617,150

In Kalgoorlie, the large gold mines generate their own power requirements. The Power Corporation has ceased operations, and the Kalgoorlie Town Council operates a new 50 cycle diesel station to supply A.C. consumers in Kalgoorlie and Boulder. The D.C. stations of the Kalgoorlie and Boulder Town Council will continue to operate for some time at least.

4. **New Projects.**—Since its inception in 1946, the State Electricity Commission has made the provision of an adequate reserve of generating plant its primary object. With the commissioning of the first unit at South Fremantle Power Station in May, 1951, the lag

caused by shortages during the war and early post-war years was overcome. The system then developed rapidly to keep pace with the expansion of industry and housing. Generating plant has increased five-fold in the past eighteen years. The three major power stations have been interconnected with the South West Power Station at Collie enabling the most economical units to be used as a base load station. Continuous development of the transmission and distribution system is being undertaken to keep pace with the growth in consumer demand, which is being maintained at a high level.

Work has commenced on two 60,000 kW turbo alternators, boilers and buildings for the first section of a new station at Muja near Collie, adjacent to a source of open-cut coal. Contracts for a further two units have been completed and the overall construction of the new power station at Muja is running to schedule. The first unit is planned to be in service in 1965 with similar units to be ready for commercial service in 1967, 1968 and 1969. On the completion of this phase of construction the installed capacity of the system will be increased by 240,000 kW.

§ 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. Another factor contributing to the low cost is 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 and metallurgical works with high load factor, and as a consequence the system load factor is also very high (at present 67.0 per cent.).

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

2. **The Hydro-Electric Commission.**—(i) *Present System.* In 1929, the Government passed the *Hydro-Electric Commission Act* 1929, which established the Hydro-Electric Commission and 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. For details of projects undertaken by the Commission prior to 1957 *see* Year Book No. 48, pp. 243–4, and earlier issues.

Preliminary construction of the Catagunya Power Development began early in 1957. The scheme utilizes the whole of the waters flowing through Tarraleah and Tungatinah Power Stations and successively through the Liapootah and Wayatinah Power Stations plus water from the Florentine River. Four miles below Wayatinah, a diversion dam was constructed at Catagunya, and a power station with an installed capacity of 48,000 kW was completed at the end of June, 1962. The dam was designed and built as a pre-stressed concrete structure, 147 feet in height, and it is notable as being only the second of its type and the largest yet undertaken by this technique anywhere in the world.

In the Great Lake Power Development the water of the Great Lake, by its diversion to the north-east in the direction of the most precipitous fall, is used to much greater advantage than previously through Shannon and Waddamana. Eventually reaching the South Esk River, it is used again through the machines of the Trevallyn Power Station. The works consist of an intake at the Great Lake, a four-mile headrace tunnel through the Western Tiers, one mile of high pressure pipeline on the face of the Tiers, a vertical shaft leading to the Poatina Power Station some 500 feet underground, a two-mile tailrace tunnel discharging into a canal, and then a channel to the Lake River, a tributary of the South Esk. In this development the power is generated by the fall of water through a vertical distance of 2,730 feet to the underground Poatina Power Station. Three 50,000 kW generators had commenced operation by mid-1964 and a fourth in September, 1964. A fifth generator will be commissioned early in 1965 and a sixth at a later date will bring the station's installed capacity to 300,000 kW. A further section of the scheme, now nearing completion, includes a dam at Arthur Lakes from which water will be pumped via conduit into the Great Lake, thus increasing the storage for use through the Poatina Power Station.

With the commissioning of Poatina Power Station, Shannon Power Station was taken out of service in June, 1964. It is expected that the original Waddamana " A " Power Station will be taken out of service early in 1965. Waddamana " B " Station will be retained to provide peak load capacity and spare plant.

The total installed capacity of the present system throughout Tasmania in June, 1964, was as follows.

Power station	Installed capacity of alternators
	kW
Waddamana "A"	49,000
Waddamana "B"	48,000
Tarraleah	90,000
Butler's Gorge	12,200
Trevallyn	80,000
Tungatinah	125,000
Lake Echo	32,400
Liapootah	83,700
Wayatinah	38,250
Catagunya	48,000
Poatina	150,000
Total	756,550
King Island (diesel plant)	390

Approved construction will bring this total to approximately 1,240,000 kW by 1974. The number of ultimate consumers at 30th June, 1964, was 128,642.

(ii) *New Capacity.* Investigations are continuing into the very considerable resources as yet untouched, principally in the west and north-west of the State, and it is estimated that the potential which can be developed economically should ultimately harness 2,400,000 kW to the system.

The Hydro-Electric Commission is engaged on a construction programme which comprises the Lower Derwent Power Development and the Mersey-Forth Power Development. In the first-named, a three-stage development is under construction below Catagunya on the River Derwent. With dams and power stations named Repulse, Cluny and Meadowbank, the completion of this project by 1967 will add a further 85,000 kW to the system, and it will also bring to an end the exploitation of the power potential of the River Derwent and its tributaries.

The Mersey-Forth Power Development has been sanctioned for construction and is scheduled to be completed by 1974. In this development, the Mersey River will be diverted westward to the Forth River by the construction of the Parangana Dam about half a mile below the junction of the Mersey and Fisher Rivers. Thence the flow will be conducted by a tunnel and penstock to Lemonthyme Power Station on the Forth River. The combined flow will be used for power generation at three power stations on the Forth River situated at the foot of dams at Cethana, Devil's Gate, and Paloona. The Wilmot River will be diverted to the east by a dam through a tunnel to a power station on the Forth River upstream from Cethana Dam. The diverted flow of the Wilmot River will also be used to produce power at Cethana, Devil's Gate, and Paloona. A sixth power station will result from the development of the Fisher River, where a rapid fall from Lake Mackenzie on the plateau to the Mersey River enables a head of some 2,100 feet to be exploited.

The principal storage in the development, Lake Rowallan, will be situated on the upper Mersey River at Walters Marsh, and Rowallan Power Station will exploit the water released from this storage. Smaller storages will be provided by Lake Mackenzie and by Parangana, Wilmot, Cethana and Devil's Gate Dams.

The six stages of the development are to be completed progressively between 1969 and 1974 and will add a total of 298,500 kW to the system.

The Commission is conducting extensive surveys and investigation of other schemes with a view to further construction after the completion of the present programme.

3. **Power Usage by Secondary Industry.**—The abundant and comparatively cheap supplies of electricity and other natural resources have attracted to Tasmania a number of important secondary industries for which energy costs constitute a large proportion of the total cost of production. The continuous power demands of these organizations when plant is in full operation aggregates 276,000 kW, and a number of industrial undertakings are contemplating expansion of their activities.

§ 7. Commonwealth Territories

1. **Internal Territories.**—(i) *General.* The electricity supply undertakings at Canberra in the Australian Capital Territory and at Darwin, Katherine, Tennant Creek and Alice Springs in the Northern Territory are operated by the Commonwealth Government.

(ii) *Australian Capital Territory.* The supply authority is the A.C.T. Electricity Authority which took over the functions of the Canberra Electric Supply Branch, Department of the Interior, on 1st July, 1963. Supply was first made available in Canberra during 1915 and was met from local steam plant. Connexion to the New South Wales interconnected system was effected in 1929, and all requirements are now taken from this system. Locally owned plant consists of 4,000 kW of diesel alternators which are retained as a standby for essential supplies.

The total number of ultimate consumers at 30th June, 1964, was 23,473. During the year 1963–64, the bulk electricity purchased was 243,863,000 kWh and the system maximum demand was 63,000 kW.

(iii) *Northern Territory.* At Darwin, supply was established by the Town Council in October, 1934, but during April, 1937, responsibility for generation and supply was transferred to the Northern Territory Administration. The power station is now equipped with turbo alternators with a total capacity of 15,000 kW. A tender was let during 1964 for an additional 15,000 kW turbo alternator and boiler for installation at Stokes Hill, Darwin, power station. In addition, diesel generating plant of approximately 6,500 kW is available. A 66 kV transmission system is used.

At Alice Springs the power station is equipped with a diesel generating plant of 3,800 kW capacity.

At Katherine the power station is equipped with a diesel generating plant of 960 kW capacity, with an additional 1,100 kW planned to be commissioned early in 1965.

The diesel station at Tennant Creek was closed down in 1957, supply for the township being purchased in bulk from Peko Mines N.L.

During the early part of 1964 two small package fully automatic non-attended plants of 45 kW capacity were opened at Pine Creek and Elliott. The total number of ultimate consumers served in the Territory at 30th June, 1964, was 5,990.

2. **External Territories—Papua and New Guinea.**—Responsibility for the operation and establishment of the electrical undertakings in Papua and New Guinea is vested in the Papua and New Guinea Electricity Commission, whose headquarters are located at Port Moresby. The Commission came into operation on 1st July, 1963, and assumed the functions and responsibilities previously vested in the Electrical Undertakings Branch of the Department of Public Works.

The Commission, on its own behalf, operates the public supplies in the main centres of population, and, on behalf of the Administration, operates the supply in the minor centres and patrol posts, hospitals, agricultural establishments, etc., where the supply cannot be considered to be a fully commercial supply.

The Commission also has regulatory functions associated with the licensing of electricians and contractors, the control of franchise holders and the approval of appliances and electrical materials for use in the Territory. The Appliance Approval By-laws will be based upon complete reciprocity with the Australian approval authorities.

The generating capacity in the centres under the control of the Commission is as follows:—Port Moresby—diesel, 2,223 kW, hydro, 5,500 kW: Rabaul—diesel, 3,000 kW; Lae—diesel, 2,640 kW; Madang—diesel, 870 kW; Wewak—diesel, 870 kW; Goroka—hydro, 400 kW; Samarai—diesel, 300 kW; Kavieng—diesel, 204 kW; Kokopo—diesel, 64 kW.

On behalf of the Administration, the Commission operates generating sets totalling some 4,000 kW distributed over 130 centres, with capacities between 5 and 100 kW.

The townships of Wau and Bulolo are supplied by power generated by Bulolo Gold Dredging Limited, which operates hydro-electric plant of 5,500 kW capacity. Power produced by this plant is used mainly in the plywood mill and gold dredges at Bulolo.

The Commission has a policy to take increasing advantage of the hydro potential existing in the Territory. Work has been completed on the Sirinumu Dam on the Laloki River near Port Moresby, which will provide regulation of the river to give a minimum flow of 200 cusecs.

Tenders have been let for the supply of three 6,000 kW generating sets, which will be installed in an underground power station, which will take advantage of the fall in the Laloki River over the Rouna Falls. This station will have an ultimate capacity of 30,000 kW. It is planned to commission the station in August, 1967.

Preliminary investigations have indicated the economics of developing the potential of the Upper Ramu River adjacent to Kainantu in New Guinea, to provide a regional supply to Lae, Madang, Kainantu, Goroka and Mount Hagen. The present planning is to provide a station designed for ultimate capacity of 48,000 kW, and for the installation of two 8,000 kW generators in the first stage.

Some 400 miles of 66 kV and 132 kV transmission line will be constructed to bring power to the centres of consumption.

To meet the growing needs of the Territory, pending the commissioning of the hydro-electric power stations on the Laloki and Upper Ramu Rivers, the Commission is adopting the policy of installing skid-mounted diesel generating sets of a capacity which will permit their transfer at a later date to other growing centres. Trends indicate that a total of seven 500 kW sets will be needed at Port Moresby. These will later be transferred to Lae and Madang.

Extensive investigations have been made to locate a suitable source of hydro-electric power to supply the township of Rabaul and the quickly developing area along the Gazelle Peninsula. However, the geological reports on those sites so far investigated have not been encouraging, and at present no firm proposal has been put forward.

Several small hydro-electric installations have been made or are in process of construction to serve isolated centres. These are—Aiyura Agricultural Station—30 kW; Mount Hagen—120 kW; Mendi (under construction)—100 kW; Tapini (under construction)—30 kW.

The Commonwealth Department of Works has a Stream Gauging Section and maintains records of many of the main rivers in order to provide material for future investigations into some of the major hydro-electric potential which exists in the Territory.

In 1950, the Commonwealth Government joined with the British Aluminium Co. Ltd. of London to locate and develop large capacity hydro-electric schemes in New Guinea. A company was formed, known as New Guinea Resources Prospecting Co. Ltd., with a capital of £100,000. The Commonwealth Government held 51 per cent. of the shares, and had a controlling interest on the Board of five members, but it later sold its interest to a company formed by Consolidated Zinc Pty. Ltd. and British Aluminium Co. Ltd., both of London. This company carried out very extensive investigations into the rivers of the Gulf of Papua and, *in particular, into the Purari River.*

The number of consumers served by the Commission as at 30th June, 1964, was 8,000. The consumers in minor centres approximate 2,000.

STATISTICAL SUMMARY

The following table shows statistics for each State separately and for the six States combined for the year 1962–63.

Statistics of the electricity supply industry for the years 1958–59 to 1962–63 are given in Chapter VI. Manufacturing Industry.

CENTRAL ELECTRIC STATIONS, 1962-63

Particulars		N.S.W.	Vic.	Q'land	S. Aust.	W. Aust.	Tas.	Australia
Generating stations—								
Government ..	No.	27	13	..	10	10	11	71
Local authority	,,	13	8	50	8	41	..	120
Companies ..	,,	14	14	1	11	41	3	84
Total		54	35	51	29	92	14	275
Installed capacity of generators—								
Steam ..	'000 kW	2,484	1,291	745	596	305	..	5,421
Hydro ..	,,	809	333	79	..	2	627	1,850
Internal combustion	,,	73	33	34	13	74	1	228
Total		3,366	1,657	858	609	381	628	7,499
Persons employed(*b*)	No.	4,279	3,379	1,682	1,548	(*a*)	(*a*)	12,272
Value of output(*c*)	£'000	59,693	32,663	17,991	9,897	(*a*)	(*a*)	135,570
Value of production(*d*)	,,	42,961	21,257	8,866	5,516	(*a*)	(*a*)	89,556
Electricity generated(*e*)	million kWh	12,188	7,187	3,137	2,335	1,219	3,213	29,279
Ultimate consumers(*f*)	No.	1,257,445	984,129	434,022	337,000	173,883	125,572	3,312,051

(*a*) Not available for publication; included in the total for Australia. (*b*) Average employment in generating station, over whole year, including working proprietors. (*c*) Value, at generating station, of electricity produced plus certain earnings. (*d*) Value added in the process of generation. (*e*) Total generated including that generated by factories for their own use. (*f*) Approximate figures supplied by the electricity authority in each State. An " ultimate consumer " is a person, business, undertaking, etc., that has contracted to receive electric power from a public or private organization supplying this service. The number of ultimate consumers is not identical with the number of persons served with electricity because one ultimate consumer may represent three or four persons, e.g. in a household.