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 1963, 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, 1962, thermal power equipment represented 71 per cent., hydro plant 26 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 throughout the year can be expected, is the mountain chain which stretches from the high plateaux of south-eastern New South Wales to the north-eastern highlands of Victoria. The hydro-electric potential of this area is considerable, and plans have been formulated to develop more than 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 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, and the power regularly produced for such internal consumption is, in any case, a relatively small proportion of the total power produced.

(ii) *Power Production and Generating Capacity.* 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 45 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, 1962, installed generating capacity in Australia was 7.22 million kW compared with 6.67 million kW in 1961, an increase of nearly 8 per cent. In 1961–62, each kW of installed capacity produced an average of 3,700 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 29,215 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. 215). 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 River for the Snowy-Murray Development. A sectional diagram of the Scheme appears on page 216.

(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 will be constructed between Talbingo and Blowering Reservoirs. Blowering Dam is to be constructed by the Snowy Mountains Authority for the State of New South Wales and will provide for the regulation of power station discharges for use for irrigation in the Murrumbidgee Valley. The Authority will construct a power station at the foot of this dam to make use of irrigation releases for power purposes.

(iii) *Snowy-Murray Development.* The principal features of the Snowy-Murray development are the diversion of the main stream of the Snowy River by 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*) Construction of a tunnel from the Snowy River near Island Bend through the Great Dividing Range to Geehi Reservoir on the Geehi River, and two power projects between Geehi Reservoir and the Swampy Plain River near Khancoban. The power stations associated with these two power projects, Murray 1 and Murray 2, will be the Scheme's largest stations and will have a combined capacity of 1,500,000 kW.

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

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

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.

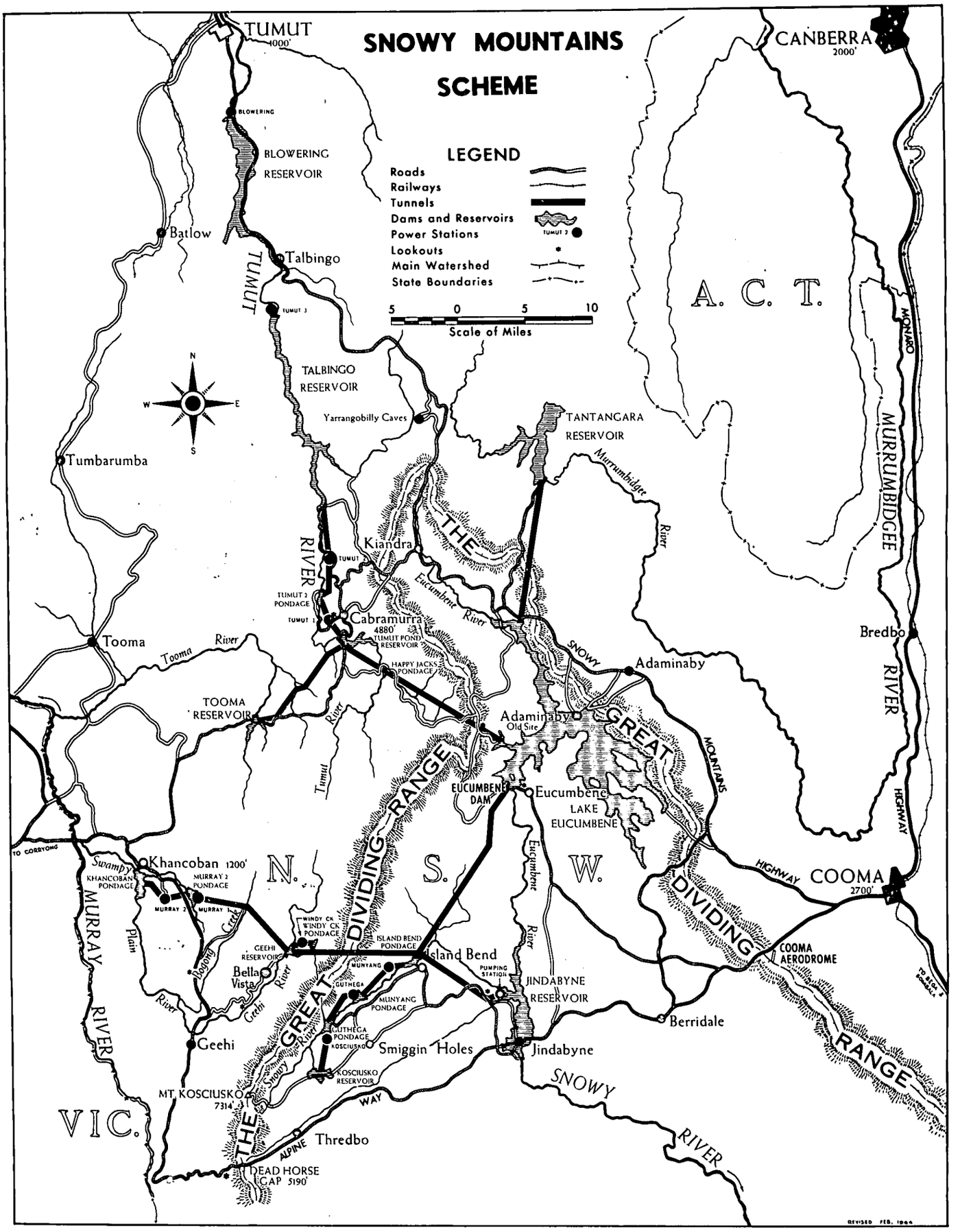
The *Electricity Development Act*, 1945–1957, which established the Electricity Authority of New South Wales as the body responsible for the co-ordination of electricity supply throughout the State.

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.

Outlet portal of the spillway tunnel at Geehi Dam.

The completed excavation for the Murray 1 Pipelines. These pipelines will carry water from the Murray 1 Pressure Tunnel to the Murray Power Station, 1,300 feet below.


SNOWY MOUNTAINS SCHEME
LEGEND
Roads
Railways
Tunnels
Dams and Reservoirs
Power Stations
Lookouts
Main Watershed
State Boundaries
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Scale of Miles
TUMUT
4000'
CANBERRA
2000'
BLOWERING
BLOWERING RESERVOIR
Batlow
Talbingo
TUMUT
TUMUT 3
TALBINGO RESERVOIR
Yarrangobilly Caves
TANTANGARA RESERVOIR
A. C. T.
MONARO
MURRUMBIDGEE
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Tumbarumba
THE RIVER
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TUMUT 1
Cabramurra
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TUMUT POND'G RESERVOIR
Eucumbene River
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TOOMA RESERVOIR
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SNOWY
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GREAT DIVIDING RANGE
MOUNTAINS
Bredbo
RIVER
EUCUMBENE DAM
Eucumbene
LAKE EUCUMBENE
HIGHWAY
TO CORRYONG
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Swamp
KHANCOBAN PONDAGE
MURRAY 2 PONDAGE
MURRAY 1
MURRAY RIVER
Plain
Dogong Creek
WINDY CK WINDY CK PONDAGE
ISLAND BEND PONDAGE
GEEHI RESERVOIR
Island Bend
MUNYANG
PUMPING STATION
Bella Vista
Geehi River
GUTHEGA
MUNYANG PONDAGE
JINDABYNE RESERVOIR
GUTHEGA PONDAGE
KOSCIUSKO
Geehi
Smiggin Holes
Jindabyne
Berridale
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COOMA AERODROME
KOSCIUSKO RESERVOIR
MT. KOSCIUSKO
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Snowy River
SNOWY RIVER
THE ALPINE WAY
Thredbo
DEAD HORSE GAP 5190'
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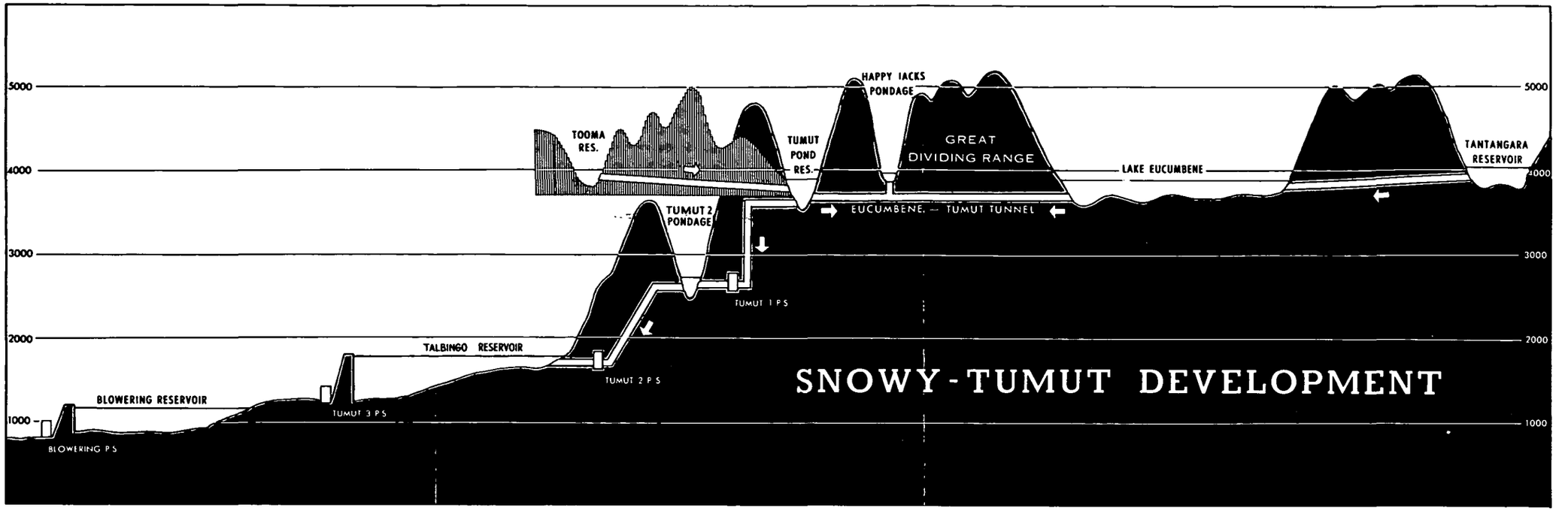
REVISED FEB. 1944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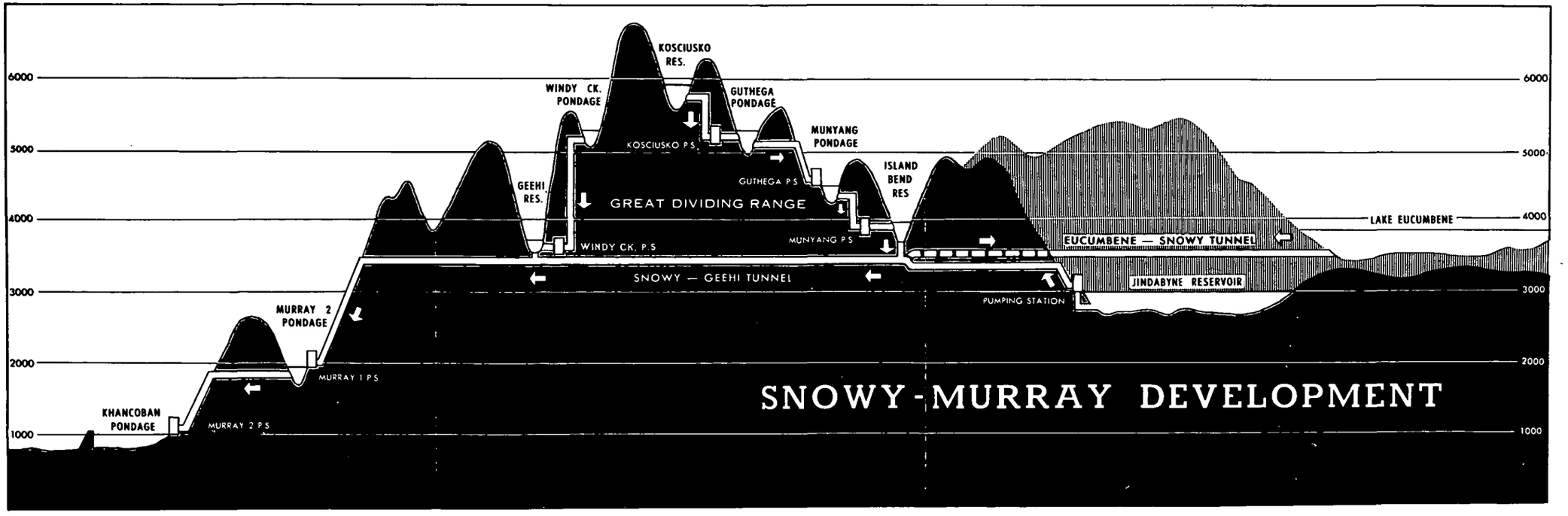
GREAT DIVIDING RANGE
LAKE EUCUMBENE
TANTANGARA RESERVOIR
EUCUMBENE — TUMUT TUNNEL
TUMUT 2 PONDAGE
TUMUT 1 P.S
TALBINGO RESERVOIR
TUMUT 2 P.S
TUMUT 3 P.S
BLOWERING RESERVOIR
BLOWERING P.S
SNOWY-TUMUT DEVELOPMENT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KOSCIUSKO RES.
WINDY CK. PONDAGE
GUTHEGA PONDAGE
MUNYANG PONDAGE
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ISLAND BEND RES
GEEHI RES.
GREAT DIVIDING RANGE
LAKE EUCUMBENE
WINDY CK. P.S
MUNYANG P.S
EUCUMBENE — SNOWY TUNNEL
SNOWY — GEEHI TUNNEL
JINDABYNE RESERVOIR
PUMPING STATION
MURRAY 2 PONDAGE
MURRAY 1 P.S
KHANCOBAN PONDAGE
MURRAY 2 P.S
SNOWY-MURRAY DEVELOPMENT

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 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, 1963, there were 53 supply authorities throughout the State, of which 14 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 the past few 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 35 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, 1963, was supplying 504,263 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. 219).

Safety. The Electricity Development Act, 1945–1963, 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, 1963, coal-fired stations generated 92.0 per cent. of the State's energy requirements, hydro-electric stations 7.5 per cent. and internal combustion plants 0.5 per cent. In addition, 1,100 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*—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; Vales Point (Lake Macquarie), 200,000 kW; White Bay (Sydney), 172,000 kW; Balmain (Sydney), 107,000 kW; Ultimo (Sydney), 80,000 kW; Port Kembla, 60,500 kW; Zarra Street (Newcastle), 45,000 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 34,470 kW. The total installed capacity of the Electricity Commission's system was 2,427,970 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, 1963, there were in service 680 route miles of 330 kV (including 131.5 miles operating for the time being at 132 kV) and 1,515 miles of 132 kV transmission lines (including 243 miles operating for the time being at 66 kV or lower). There were also in service 2,377 miles of transmission line of 66 kV and lower voltages.

Superimposed upon the 132 and 66 kV network will be a powerful 330 kV trunk system extending from the Snowy Mountains Hydro-electric Scheme in the south through Wollongong, Sydney and Newcastle to Armidale in the north. At 30th June, 1963, the 330 kV transmission line was in operation between the Snowy Mountains Upper Tumut Switching Station and the Commission's Vales Point power station, linking these major sources of power for the New South Wales network, and interconnecting the systems of the Electricity Commission of New South Wales and the State Electricity Commission of Victoria at the Upper Tumut Switching Station.

The installed transformer capacity at the Commission's 96 sub-stations was 5,986,800 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 2,536,144 kW at 30th June, 1963.

(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. The first 200,000 kW unit has been commissioned and construction of the remaining three is progressing.

Construction of the Munmorah Power Station, located between Lakes Munmorah and Budgewoi (on the central coast) has commenced. Initially the plant at Munmorah will comprise two 350,000 kW generating units.

The development of the 330 kV main system is continuing. The 330 kV line from the Snowy region has been extended to the Vales Point Power Station, a distance of 335 miles. The section between the Snowy Mountains Hydro-electric Authority's Upper Tumut Switching Station and the Commission's 330 kV Centre at Yass has been duplicated, and the section between Yass and Dapto has also been duplicated. A second circuit from Sydney North 330 kV Substation to Vales Point Power Station will be available for the commissioning of the second Vales Point unit early in 1964. Development of the 330 kV network around the Sydney metropolitan area is proceeding.

Work has commenced 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 480 route miles of 330 kV lines and three associated substations, 740 route miles of 132 kV line and 18 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. 210). Apart from this area, there are in operation the new hydro-electric stations at the Warragamba Dam (50,000 kW) and Hume Dam (50,000 kW), and stations at the Burrinjuck Dam (20,000 kW), Wyangala Dam (7,500 kW) (shortly to be closed during repairs and extensions to the dam), 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, 1963, applications for subsidy had been made by electricity suppliers to the Authority covering rural extensions costing £32.4 million to give supply to some 54,000 farming properties and 33,000 other rural consumers and involving 47,300 miles of line. The greater part of this work had been completed at 30th June, 1963. At this date, the Authority was committed to the payment of £13,504,878 in subsidies, of which £6,807,752 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 over 97 per cent. of the population through a supply network covering more than three-quarters of the populated area of the State.

Development of Victoria's electricity system is based on the utilization for both power and fuel of Victoria's extensive brown coal resources in the Latrobe Valley in eastern Gippsland, with supplementary development of the hydro-electric potential of north-eastern Victoria. Victoria is entitled to one-third of the electricity from the Snowy Mountains Hydro-electric Scheme, after the Commonwealth has taken the power it needs for its purposes. Victoria also shares with New South Wales in the electricity generated at Hume Hydro Station on the River Murray. About 80 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 1962–63 from the three open cuts at Yallourn, Yallourn North and Morwell totalled 17,244,345 tons, of which 11,868,590 tons were used in the Commission's own power stations, and 4,979,924 tons were manufactured into 1,805,347 tons of brown coal briquettes, 52 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, 1963, consumers in Victoria served by the State system numbered 972,741. Outside the State system, there were 11,388 other consumers served by local country undertakings. The system supplies all the Melbourne metropolitan area and over 1,800 other centres of population.

Complete electrification of the State is now within sight. By 30th June, 1963, about 827,000 of the 862,000 homes in the State and 54,200 of Victoria's 71,500 farms were supplied with electricity. By the end of this decade (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 connect 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 434,437. Of the new consumers connected to supply each year, more than two-thirds are outside the metroplitan area. New farm connexions average nearly 3,000 a year.

The Commission's retail consumers numbered 775,108 at 30th June, 1963. 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, 1963, there were branch and district supply offices in 87 towns in Victoria.

(iv) *Electricity Production.* Electricity generated in the State system or purchased by it totalled 7,688 million kWh in 1962–63 or 99 per cent. of all Victoria's electricity. The system comprises a series of thermal and hydro-electric power stations. Inclusive of generator capacity both within the State and available to the Victorian system from outside the State, the total installed generator capacity at 30th June, 1963, was 1,898,000 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 more than half of Victoria's electricity. Other power stations in the interconnected system comprise the important brown coal burning power station at Morwell; steam stations in Melbourne (Newport, Richmond and Spencer Street), Geelong and Ballarat and also at Redcliffs, which has, in addition, an internal combustion plan; hydro-electric stations at Kiewa; at Eildon; on the Rubicon and Royston Rivers, near Eildon; and at Cairn Curran; and internal combustion stations at Shepparton and Warrnambool. All within Victoria are Commission-owned, except Spencer Street Power Station, which remains the property of the Melbourne City Council, although operated as a unit in the interconnected system. A 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, 1963, comprised 39,650 miles of power-lines, 18 terminal receiving stations, 85 main transmission sub-stations and over 33,000 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 1,011 miles.

(vi) *Future Development.* Major new construction is concentrated on the erection of a large new brown coal burning power station (Hazelwood) near Morwell in the brown coal fields of the Latrobe Valley. At the same time, the Commission continues its programme of rural electrification and extension and reinforcement of the State system (particularly in western and north-western Victoria).

At Morwell, six miles from Yallourn, the Commission has almost completed a second brown coal power and briquette undertaking. The new undertaking comprises a brown coal open cut and power station operating in association with a briquetting plant. Some of the electricity generated at Morwell is needed to operate the briquette works, but most of the output of the power station is transmitted through Yallourn to metropolitan terminal stations for general supply through the State network. The installed generator capacity of Morwell Power Station is 170,000 kW. The briquette works have a production capacity of approximately 1,300,000 tons of briquettes a year. The Commission's new Hazelwood Power Station is being erected a short distance south of Morwell. It will operate on raw brown coal fuel supplied by belt conveyor direct from the Morwell open cut. The power station will have a capacity of 1,200,000 kW and will comprise six turbo-generators each of 200,000 kW capacity. Hazelwood is being built in stages. Contracts have been placed for four generating units (800,000 kW) and the related boiler plant, and work is well advanced on the first 400,000 kW stage. The first turbo-generator is due to be in service in 1964 and the second in 1965. Succeeding units are scheduled to be in service in 1966, 1967, 1970 and 1971. Power generated at Hazelwood Power Station will be transmitted at high voltage to Melbourne metropolitan terminal stations for distribution through the State supply network.

3. **Local Country Electricity Undertakings.**—At 30th June, 1963, there were 20 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 1962–63, the total production of the independent undertakings was 41 million kWh. The number of consumers at 30th June, 1963, was 11,388. The operation of the independent undertakings is governed by the *Electric Light and Power Act* 1958, which the State Electricity Commission administers.

§ 3. Queensland

1. **General.**—In 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. (taken over by the Southern Electric Authority) (*see* para. 3, p. 223).

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, and in 1935, the Queensland Government, being concerned with the need to develop the State's power resources in the public interest, appointed a Royal Commission to inquire into and make recommendations on matters relating to the generation and distribution of electric power in Queensland. (An account of the results of its investigations and of the alternative proposals put before it will be found on page 1182 of Official Year Book No. 39.) The Report of the Royal 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 State Electricity Commission of Queensland commenced to function during January, 1938, its main powers being to secure a proper and efficient supply of electric power, review tariffs, grant licences to supply electricity, secure the safety of the public, and control and advise electrical undertakings generally. It was thus a controlling authority as distinct from an operating authority. Details of its growth and development may be found in earlier issues of the Official Year Book (*see* No. 44, p. 284). Since its inception, the Commission has made considerable progress in its task of developing the State's power resources and promoting a more widespread use of electric power. The degree of utilization of electrical energy in Queensland now compares favourably with other States in the Commonwealth. Over 90 per cent. of the State's population is now supplied with electricity.

3. **The Southern Electric Authority of Queensland.**—A further major step in electrical progress was taken with the passing of the *Southern Electric Authority of Queensland Act*, 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 (including

the Commissioner for Electricity Supply) are included on the board of the Authority, whose establishment prepares the way for the complete amalgamation, in due course, of the electrical undertakings serving the south-eastern Queensland area of supply.

As from 1st July, 1954, the Southern Electric Authority acquired the Toowoomba Electric Light and Power Co. Ltd., thus bringing that company's area of supply under its control. The Southern Electric Authority is now responsible for the electrical supply and development of a consolidated area of over 17,000 square miles and is also providing bulk supply to the Western Downs area centred on Dalby. The Authority also supplies the Tweed area of northern New South Wales. Construction has reached an advanced stage on a 132 kV interconnexion with the area of the Wide Bay–Burnett Regional Electricity Board whereby the output of the Howard power station will be supplemented from the Southern Electric Authority's generating station.

The Southern Electric Authority previously supplied the requirements of the inner portion of the City of Brisbane and those of a considerable rural area in the south-eastern corner of the State from modern power stations at Bulimba, a suburb of Brisbane, and a " packaged plant " at Abermain (near Ipswich). The output of a small hydro-electric unit at Somerset Dam near Brisbane is fed into the Southern Electric Authority system. From 1st January, 1963, the Authority assumed control of the power stations previously operated by the Brisbane City Council at Tennyson and New Farm and main transmission facilities in the Brisbane area. At the same time it relinquished control of the distribution of electricity to the inner city, which is now a function of the Brisbane City Council. The Authority continues to control distribution in the rural areas surrounding Brisbane.

During 1961–62 and 1962–63, the Authority generated 974 million kWh and 1,465 million kWh respectively. The number of consumers served by the Authority at 30th June, 1962, was 121,540, while at 30th June, 1963, the Authority's reduced area of supply contained 105,178 consumers.

4. **The Brisbane City Council.**—The Brisbane City Council's electrical undertaking previously comprised power stations at New Farm and Tennyson (with a " packaged plant " also installed at the latter locality) and supplied suburban Brisbane. As from 1st January, 1963, these power stations were transferred to the control of the Southern Electric Authority together with main transmission facilities, whilst the Council's area of distribution was enlarged to include the inner city as well as suburban Brisbane. During 1961–62, the Council generated 826 million kWh, and during the first six months of 1962–63, 483 million kWh. At 30th June, 1963, its enlarged area of supply contained 173,668 consumers.

5. **Regional Electricity Boards.**—With a view to facilitating the control and development of electricity supply in areas of low population density and those having a predominantly primary producing economy, the Government passed the *Regional Electric Authorities Act* 1945, which provided for the creation of regions of electricity supply and the constitution of regional electricity boards. Prior to the establishment of these boards, no attempt had been made to unify or co-ordinate electricity supplies outside south-eastern Queensland, and rural electrification, apart from reticulation within certain townships, was practically unknown.

Soon after passage of the Act, four regional boards were constituted, Wide Bay, Capricornia, Townsville and Cairns. A fifth board, South Burnett, became an operating authority in October, 1947, but on 1st July, 1951, was absorbed in the Wide Bay Regional board, and this organization is now known as the Wide Bay-Burnett Regional Electricity Board. As from 1st March, 1957, a further regional board became operative, covering the areas of Mackay, Sarina, Proserpine and adjacent rural areas under the name of Mackay Regional Electricity Board.

The Townsville Regional Electricity Board's area was extended in July, 1957, to include that of the Bowen Electricity Undertaking, in October, 1959, to include the Hughenden Electricity Undertaking, and in September, 1960, to include the Collinsville Electricity Undertaking. The local authority areas of Thursday Island and Cook were included in the Cairns Regional Electricity Board's area from 1st July, 1956, and 1st July, 1957, respectively, and the Normanton Undertaking was transferred to this Board on 1st January, 1962. As from 1st January, 1958, the Capricornia Region was extended to include the Shires of Bauhinia, Belyando, Emerald and Peak Downs in central-west Queensland. Further expansion of the existing areas of the Regional Electricity Boards into more remote, but contiguous, areas is anticipated in the immediate future, and this trend is expected to continue in subsequent years as economic and technical considerations render it practicable in various areas of the State. As stated in para. 7 below, it is proposed to place the generating facilities of this northern interconnected system under unified control.

Activities of the five Regional Boards in 1961–62 and 1962–63 compared with operations of the stations located in regions in 1945–46 are shown in the following table.

QUEENSLAND: REGIONAL OPERATIONS

Region	1945–46		1961–62		1962–63	
	Units generated	No. of consumers	Units generated	No. of consumers	Units generated	No. of consumers
	Million kWh		Million kWh		Million kWh	
Wide Bay-Burnett ..	13.7	11,467	109.3	34,770	122.5	35,963
Capricornia	19.5	11,196	175.8	25,346	187.2	26,173
Townsville	25.8	11,612		31,332		32,426
Cairns	22.7	9,722	*a*399.9	24,649	*a*440.3	25,676
Mackay	6.5	4,283		13,353		14,099
Total	**88.2**	**48,280**	**685.0**	**129,450**	**750.0**	**134,337**

(*a*) Generated by interconnected Northern network.

Installed generator capacity of the five regional boards at 30th June, 1963, was:—Wide Bay–Burnett, 37,500 kW; Capricornia, 54,488 kW; Townsville, 41,725 kW; Mackay, 15,250 kW; Cairns, 146,180 kW; total, 295,143 kW.

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

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

In 1935, a small hydro-electric power station of 3,800 kW was placed in service at Barron Falls, ten miles north-west of Cairns. An output of 32 million kWh was attained during 1962–63, the station operating essentially as a run-of-river station, without any significant water storage capacity being available.

The hydro-electric power scheme at Tully Falls was commissioned in September, 1957, with an initial plant installation of 36,000 kW. Work was completed during 1958–59 on the installation of a further two 18,000 kW sets, making a total installation of 72,000 kW. An output of 318 million kWh was obtained from this station during 1962–63. Power is transmitted to the load centres at Cairns, Innisfail and Tully by means of 132 kV transmission lines. Further extensions of the Tully Scheme may be undertaken at a later date. Interconnexion of the Tully Scheme with the Townsville area, which is also being served by a thermal station, was completed in February, 1958, by the provision of a 160 mile double circuit 132 kV transmission line. In December, 1962, interconnexion with the Mackay Region by means of a 66kV transmission line was effected.

A new peak load power station was commissioned in September, 1963, at Barron Falls. This station will provide a firm (dry year) output of 60,000 kW at 25 per cent. load factor (i.e. firm output of 131 million kWh per annum), and will ensure an adequate supply of power to the Cairns, Townsville and Mackay areas until 1968. The completed scheme has an underground power station below the Barron Falls containing two 30,000 kW Francis turbines, operating under a head of 920 feet.

Other major schemes which have been, or are currently being, investigated include North Johnstone-Russell Rivers (32,000 kW); Beatrice-North Johnstone Rivers (9,000 kW); South Johnstone River (25,000 kW); Herbert River (90,000 kW); Burdekin River (80,000 kW); and Broken River.

The State Electricity Commission, in conjunction with other Government departments, is constantly reviewing the development of hydro-electric resources. It is estimated that full development of the hydro-electric potential of north Queensland would provide the equivalent of over 300,000 kW of power at 50 per cent. load factor or approximately 1,300 million kWh a year.

7. Generating Capacity.—(i) *Regions.* Within the areas administered by the regional electricity boards, development extending over a considerable period may be divided into two stages. The first stage, which is now virtually completed, saw the construction of central power stations at the principal load centres, and of transmission systems, taking supply to smaller centres, thus superseding local generation. The second stage provides for the interconnexion of regional transmission systems to take advantage of lower production costs at the larger power stations. At the same time, it is becoming more economic to locate power stations on coalfields rather than at load centres. The selection of the Callide and Collinsville coalfields as the sites for the next major generating stations in Central and north Queensland is illustrative of this fact.

As part of the first stage, the following new generating stations were commissioned:—Howard (Wide Bay-Burnett Region) which has an installed capacity of 37,500 kW, Rockhampton (Capricornia Region) with 52,500 kW, and Townsville (Townsville Region) which contains 37,500 kW of plant. In the Cairns Region, the Tully Falls hydro-electric power station has been completed with 72,000 kW installed capacity.

The Tully Falls Scheme (*see* para. 6, p. 224) was planned to supply power to the Cairns and to the Townsville Regional Electricity Board systems, and the interconnexion has now been extended southwards to embrace the Mackay Regional Board area also. The commissioning of the further hydro-electric station on the Barron River in September, 1963, has added a further 60,000 kW of hydro-electric generation capacity to these interconnected regional systems. The first stage of the scheme's development is estimated to cost £5,850,000, and initially, full use will be made of available storage capacity at Tinaroo Falls Dam, thus enabling construction of a £5,000,000 storage dam on Flaggy Creek to be postponed for a number of years.

At Mackay, where power was first supplied in 1924, a Regional Electricity Board has now been constituted, and the generating capacity of the station under the control of this Regional Board is 12,500 kW of steam plant and 3,000 kW of diesel plant. To supplement this output a 66 kV transmission line from the Townsville Region has been commissioned. The three North Queensland regions of Cairns, Townsville and Mackay thus form an interconnected system with integrated generation facilities, based mainly on hydro-electric generation.

To serve the needs of the Capricornia region, the construction of a power station capable of being developed to 150,000 kW capacity has commenced at a site on the Callide coalfields. Transmission to the main load centres will be at 132 kV. The Capricornia Region is not connected with either the northern or southern grids.

(ii) *Western Queensland.* In Western Queensland, prior to the war, small isolated internal combustion generating stations supplied power to a number of the larger towns. After the war, the capacities of these existing stations were augmented, they were modernized and converted from direct to alternating current. Supply was also established in larger towns without electrical facilities. Financial assistance towards this electrical development was given by the Government in the form of cash subsidies up to 50 per cent. towards the capital cost involved.

In addition to improving supplies to the larger western towns, a scheme was implemented from 1952 onwards whereby electricity supply was given to smaller western townships where consumers range from 50 to 200. Subsidies of 65 and 60 per cent. are granted if the number of consumers supplied is less than 100 and 200, respectively. At 30th June, 1963, 22 townships in western Queensland were provided with electricity supplied by small oil-driven generating sets with automatic controls which can be run with a minimum of operating attendance. It is planned to install at Birdsville a small generating plant using a pelton wheel driven by water supplied from an artesian bore. For a considerable time, 5 kW generating plant at Quilpie has also been powered in this manner.

Coal-burning gas producers have been successfully commissioned for public electricity supply purposes at Longreach, Clermont, Blackall and Barcaldine, and further extension of their use in western Queensland is predicted, as lower tariffs and more efficient production of electricity is expected to follow their use. The use of natural gas for electricity generation was pioneered in Australia in Western Queensland at Roma. Following the discovery of commercial supplies, and since April, 1961, this fuel has been used at the Roma power

station. During 1962–63, over 73 million cubic feet were utilized. Large boilers now being constructed in the south-eastern portion of the State are being designed to burn natural gas as an alternative fuel should it become available at competitive prices.

In a limited number of cases, transmitted supply from larger generating centres has replaced local generation in small townships, and in southern border areas, transmitted supply is provided from New South Wales to certain townships and rural areas. By teeing off from such transmission lines, supply has been given to many rural properties. The Single Wire Earth Return system of supply has been used extensively in the less populous rural areas.

The State Electricity Commission has acted as consultant for practically all the western local authorities operating electricity undertakings.

All electricity undertakings in western Queensland are operated by local authorities.

(iii) *South-eastern Queensland.* As from 1st January, 1963, all generating and main transmission facilities in south-eastern Queensland have been operated by the Southern Electric authority following a rationalization agreement with the Brisbane City Council. This arrangement will enable all units of generating plant to be operated in the most efficient manner, which was not possible under the previous duality of control. At 30th June, 1963, the combined installed capacity of the Authority was 517,500 kW, comprising 75,000 kW at New Farm, 92,500 kW at Bulimba A, 150,000 kW at Bulimba B, 180,000 kW at Tennyson, and two packaged plants of 10,000 kW each at Abermain (near Ipswich) and Tennyson. The Authority also receives into its system the output of a 3,200 kW hydro-electric plant at Somerset Dam which is operated by the Water Supply Department of the Brisbane City Council. Current plans include the installation by 1964 of a further 60,000 kW at Tennyson and 30,000 kW at Bulimba " B ".

To cater for the power needs of this portion of the State after the completion of existing stations, work has commenced on a new power station at Swanbank, on the West Moreton coalfields, with an ultimate capacity of 360,000 kW.

Power from this station will also be transmitted to the Wide Bay-Burnett region at 132 kV, which will obviate the installation of additional plant within this region.

§ 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.**—Early 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 551,000 kW, and is the most important authority supplying electricity in the State. There were approximately 337,000 ultimate consumers of electricity in the State, of whom 312,600 were supplied directly and approximately 11,000 indirectly (i.e. through bulk supply) by the Trust. Its major steam stations are Osborne " A " (64,000 kW), Osborne " B " (180,000 kW), and Port Augusta Playford " A " (90,000 kW) and Playford " B " (180,000 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. In March, 1963, Mt. Gambier was connected with the Metropolitan system by a 132 kV line.

No hydro-electric potential exists in South Australia. Steam generating units comprise 97 per cent. of installed capacity and the balance is internal combustion equipment. Until 1946, 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, 1963, 1,470,150 tons of coal were produced, practically all of which was used by the electricity undertaking.

The Playford " B " Power Station at Port Augusta will be completed in March, 1964, with the commissioning of the fourth 60,000 kW turbo-alternator. Leigh Creek coal is used exclusively in both power stations at Port Augusta.

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.**—In order to ensure an organized and co-ordinated future growth of electricity generation and distribution throughout the State, the Government passed the *State Electricity Commission Act* 1945 and the *Electricity Act* 1945. Under these Acts, the State Electricity Commission was established and given power 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 to purchase as a going concern and carry on the undertaking of any supply authority. 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. It has been announced recently that a similar scheme to be known as the Northern Areas State Power Scheme will be developed during approximately the next sixteen years to serve towns 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, with the exception of Kalgoorlie which is separately mentioned below.

(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 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		1961–62	1962–63
Plant capacity	kW	289,500	289,500
Maximum load	kW	191,000	229,000
Units generated	Million kWh	866	987
Fuel used per unit (kWh) generated	lb.	1.54	1.49
Coal used	tons	521,978	583,170

In Kalgoorlie, all gold mines now 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 been quadrupled in the past seventeen 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. The first unit is planned to be in service in the latter part of 1965, with similar units to be ready for commercial service in March, 1967, 1968 and 1969.

§ 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 costs 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 65.2 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.

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.

The Tarraleah Power Development was commenced in 1933. 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.

The Trevallyn Power Development, which commenced in 1949, was the first constructed by the Commission outside the Central Plateau region and was undertaken primarily to meet the requirements of the aluminium industry. The waters of the South Esk River are diverted through two miles of tunnel and pipeline to a power station on the Tamar River near Launceston.

The Tungatinah Scheme, on which construction started in 1948, draws water from three separate catchment areas located on the Central Plateau between the Great Lake (Shannon-Waddamana) and Lake St. Clair (Butler's Gorge-Tarraleah) catchments, and control of practically the whole run-off from the Central Plateau has now been effected.

The Wayatinah Power Development, started in 1952, comprises two power stations and headworks to utilize water which is, in the main, already regulated and which has been used several times. The volume of water available is much larger and the head smaller than in the case of other major stations.

For further details of these schemes *see* Year Book No. 48, pp. 243–4, and earlier issues.

The Catagunya Power Development 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. Preliminary construction on this development began early in 1957. 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.

The total installed capacity of the present system throughout Tasmania in June, 1963, was as follows.

Power station	Installed capacity of alternators
	kW
Shannon	10,500
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
Total	**617,050**
King Island (diesel plant)	390

(ii) *New Capacity.* The installed capacity of the system now stands at 617,050 kW, and approved construction will bring this total to approximately 1,230,000 kW by 1974. 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 Great Lake Power Development, the Lower Derwent Power Development and the Mersey-Forth Power Development. In the first named, the water of the Great Lake,

by its diversion in the direction of the most precipitous fall, will be used to much greater advantage than at present. Eventually reaching the South Esk River, it will be used again through the generators of the Trevallyn Power Station. In this development, the power will be generated by the fall of water through a vertical distance of 2,730 feet to an underground power station where generators of 300,000 kW capacity will be installed. The station will be known as Poatina Power Station. A further section of the scheme includes the provision of a dam at Arthur Lakes to increase greatly the storage of the system, and a pumping station and a conduit discharging into the Great Lake so that water from this catchment may be utilized through the Poatina Power Station.

In the Lower Derwent Power Development, a three-stage development is under construction below Catagunya on the River Derwent. With dams and power stations named Repulse, Cluny and Meadowbanks, the completion of this project by 1968 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 will be situated on the upper Mersey River at Walters Marsh. 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 286,000 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. These include the Electrolytic Zinc Company of Australasia Ltd., Comalco Aluminium (Bell Bay) Ltd., the Australian Newsprint Mills Ltd., the Associated Pulp and Paper Mills Ltd., the Australian Commonwealth Carbide Company Ltd., the Mount Lyell Mining and Railway Company Ltd., the Goliath Portland Cement Company Ltd. and the Tasmanian Electro Metallurgical Co. Pty. Ltd. A paper pulp mill constructed by Australian Paper Manufacturers Ltd. at Geeveston, south of Hobart came into operation towards the end of 1962. The continuous power demands of all these organizations when plant is in full operation aggregates 273,000 kW.

The associated Pulp and Paper Mills Ltd. is now constructing an entirely new particle board mill at Wesley Vale, near Devonport in northern Tasmania, and it is known that other industrial undertakings in the State are also 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, and 5,100 kW of locally owned steam generating plant was disposed of during 1962–63.

Total population served with electricity at 30th June, 1963, was 73,000 and the total number of ultimate consumers was 21,663.

During the year 1962–63, the bulk electricity purchased was 202,457,700 kWh and the system maximum demand was 54,756 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. Tenders were called in March, 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 diesel generating plant of 3,800 kW capacity.

At Katherine, the power station is equipped with a diesel generating plant of 960 kW capacity, and a 550 kW set is currently under contract.

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

The total number of ultimate consumers served in the Territory at 30th June, 1963, was 5,691.

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, 1,610 kW; Wewak—diesel, 615 kW; Goroka—hydro, 400 kW; Samarai—diesel, 300 kW; Kavieng—diesel, 194 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 150 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 recently 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 recently 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 50,000 kW, and for the installation of two 8,000 kW machines in the first stage.

Some 400 miles of 66 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 maintain 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, 1963, was 7,410. 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 1961–62.

Statistics of the electricity supply industry for the years 1957–58 to 1961–62 are given in Chapter VI. Manufacturing Industry.

CENTRAL ELECTRIC STATIONS, 1961-62

Particulars		N.S.W.	Vic.	Q'land	S. Aust.	W. Aust.	Tas.	Australia
Generating stations—								
Government ..	No.	26	14	..	12	11	11	74
Local authority	,,	13	10	51	8	37	..	119
Companies ..	,,	16	17	1	14	41	3	92
Total		*55*	*41*	*52*	*34*	*89*	*14*	*285*
Installed capacity of generators—								
Steam ..	'000 kW	2,284	1,290	685	(*a*)	305	(*a*)	5,165
Hydro ..	,,	809	333	79	(*a*)	2	(*a*)	1,826
Internal combustion	,,	73	38	33	(*a*)	67	(*a*)	224
Total		*3,166*	*1,661*	*797*	(*a*)	*374*	(*a*)	*7,215*
Persons employed(*b*)	No.	4,382	3,541	1,648	(*a*)	1,052	(*a*)	12,441
Value of output(*c*)	£'000	54,996	29,178	15,536	(*a*)	8,491	(*a*)	123,546
Value of production(*d*)	,,	38,167	16,508	6,936	(*a*)	4,467	(*a*)	76,579
Electricity generated(*e*)	million kWh	10,683	6,739	2,837	2,173	1,110	2,733	26,275
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.