A DICTIONARY ON ELECTRICITY

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Contribution on

AUSTRALIA

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DICTIONARY ON ELECTRICITY

AUSTRALIA

Area:	7,682, 000 km²
Population:	17,892,000 (at August 1996) 20,264,082 (at July 2006)
Electricity Consumption:	149.29 Twh (year ended 30th June 1996)
Installed Generating Capacity:	38,269 MW as at 30th June 1996 38,698 MW (ESAA 1998) – comprising hydro 7,500.7 MW
Electrical Frequency:	50 Hz

HISTORICAL BACKGROUND

Australia was constituted as a self-governing nation on 1st January 1901 - a federation of six States. European settlement began in 1788 on the mainland, and over the ensuing years, six British Crown Colonies were established, later to become the founding States of the nation in 1901.

Electricity supply began in Australia's colonial era - in about 1880. The Federal Constitution of 1901 vested in the Commonwealth the right to make laws only in those matters named in the Constitution, being those considered important to the business of nationhood. The constitution was silent on the subject of electricity supply, which thus remained a legislative function of each individual State. A complete history of the Australian electricity supply industry is therefore the story of six separate States, and this brief account can sketch only an outline of the most significant factors in each State's electrical development.

The early decades of electricity supply in Australia - the 1880's and 1890's were pre-occupied politically with debate on a federal constitution and on the emergence of an active labour movement. The response of the States in legislating for electricity was uneven, and in some cases, influenced by conflicting political ideologies.

In NSW, Queensland and Western Australia there emerged a strong flavour of what has been termed "municipal socialism"[1]- a preference for vesting ownership and control of the industry in local authorities. In Brisbane, the capital city of Queensland, this was characterised by a long period of conflict between the founding private enterprise utility and its municipal competitor, and by the piecemeal allocation of franchise areas throughout Queensland by successive governments.

New South Wales failed to provide a comprehensive legal framework for the regulation of the industry until 1919. Significantly this was under the Local Government Act because of the predominant role of local municipal authorities in the business of electricity supply. Prior to that time each separate development had to be sanctioned by its own enabling Act, or, as in the case of the first two municipal undertakings in 1888 and 1889, without benefit of any legislative blessing whatever. Indeed the Sydney Council actively legislated against the introduction of electricity in central Sydney, making it the last major municipalities to be electrified in Australia.

In the politically more conservative States of Victoria, Tasmania and South Australia, it seemed easier for the infant electricity industry to develop in a more orderly and integrated fashion. In Victoria, the first power stations were constructed by private companies in and around the capital city of Melbourne - dating from 1880 - followed by the Melbourne City Council in 1894. State-wide ownership and control of the industry developed progressively from 1921 following the creation of a State Electricity Commission to develop the vast brown coal deposits of the Latrobe Valley.

The early development of the hydro-electric resources of the island State of Tasmania had been initiated by the Mt Bischoff Tin Mining Company in 1883 and later by several municipalities, the first of which was Launceston in 1895. A major hydro-electric development on the Great Lakes had been commenced in 1909 by private enterprise - the Hydro Electric Power and Metallurgical Company - but the company encountered financial difficulties which were made worse by the outbreak of World War I. In order to ensure that the scheme proceeded, the Tasmanian Government set up the Hydro Electric Department to take over the project. This Department then progressively assumed responsibility for electricity generation and transmission throughout the State.

In South Australia, municipal authorities generally were empowered to supply both gas and electricity in 1891 but none made any move to do so. In 1897 the South Australian Electric Light and Motive Power Company was authorised to supply power throughout the Colony of South Australia and this company and its successors, began by degrees, the supply of electricity to most of the settled areas of the Colony. By 1904 ownership had passed to the Adelaide Electric Supply Company which then operated successfully for the next forty years.

The first electrical installations in Perth[2] were made by private enterprise - a company set up by C J Otte, but after the initial demonstration projects, nothing further was heard of the company. The first commercial supply was set up by the Perth Gas Company in 1894, the start of an era of 100 years of combined gas and electricity supply in Western Australia. Both gas and electricity passed into public ownership in 1912 and this has been the pattern since then.

FIRST LIGHT

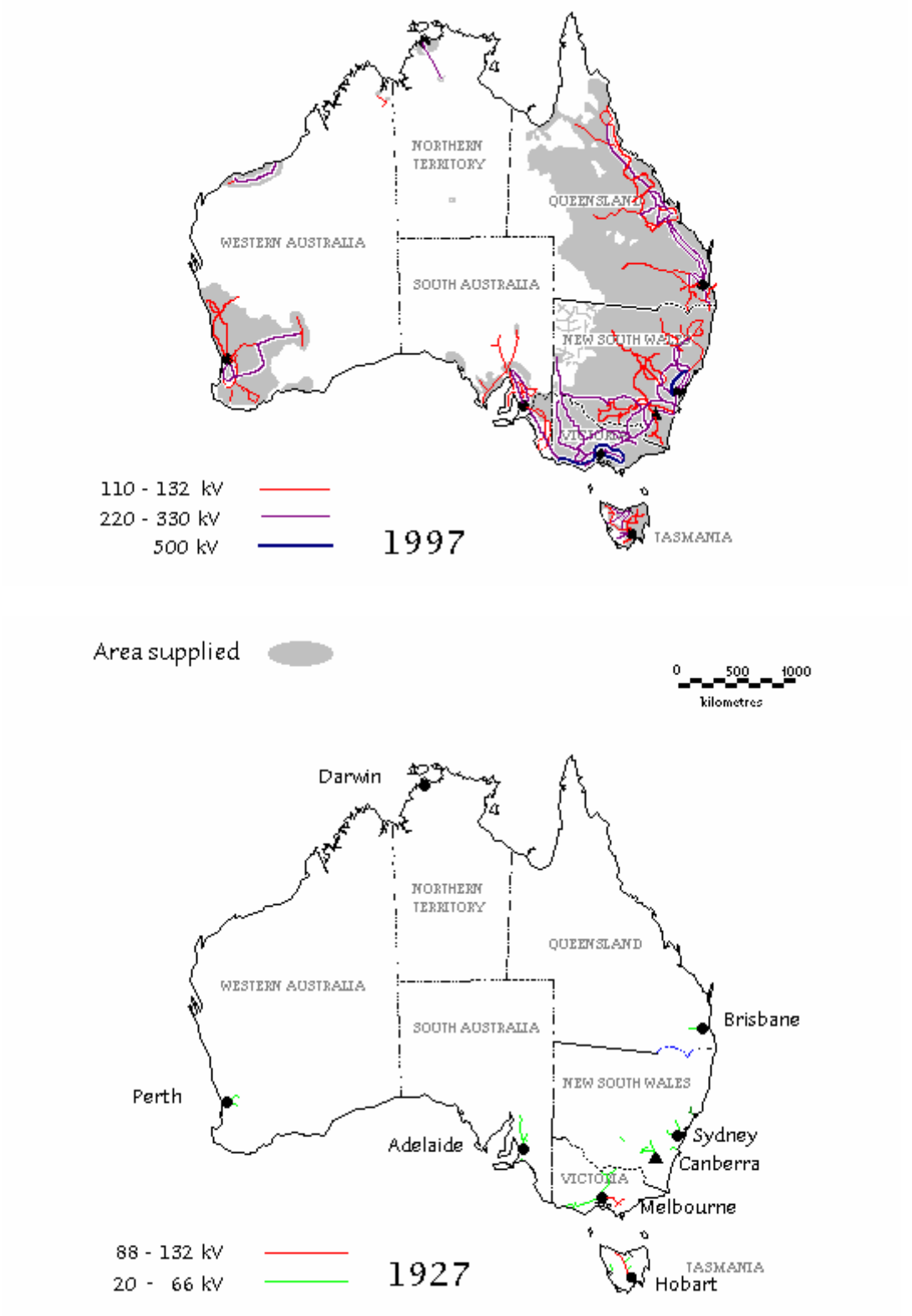
There are numerous claimants to the title of “First Light”. The earliest recorded displays were associated with “Royal” occasions. In 1863 a single arc light on Observatory Hill in Sydney honoured the marriage of the Prince of Wales; the visit of Royalty to the Colonies in 1867 was marked in at least two states, South Australia and Victoria, by displays of arc light powered by “voltaic batteries”.[3]

Electricity was used to illuminate the General Post Office in Sydney in 1878 and the first lighting company, the Victorian Electric Light Company, was formed in Melbourne in 1880 to light the Eastern Market and the Athenaeum Hall.

The first recorded increase in labour productivity attributable to electricity occurred in Sydney in 1879, at the Garden Palace, Botanic Gardens, where arc lighting was installed at the urging of the Premier, Henry Parkes, to allow construction work to continue at night. In 1883 one platform of the Adelaide Railway Station was illuminated. In 1888 the firm of Barton and White supplied power to the Brisbane Post Office and in Perth WA, Government House was lit by C J Otte.

However it is generally considered that the first supply of electricity to the public at large occurred in two small country towns in New South Wales. Tamworth, with a population of 3,000, switched on arc and incandescent street lighting on 9th November 1888[4]. In April 1899, the even smaller town of Young switched on its incandescent street lighting and shortly thereafter went on to connect shops, offices and homes within reach of its lines[5]. The Tamworth plant generated at 240 volts DC but Young had the further distinction of being the first supply in the country using three phase alternating current.

There are few statistics for the early years of the industry but in 1906 it was reported that throughout Australia there were 46 electric light and power supply stations, with an aggregate capacity of 23,000 kW. Eighteen of these were operated by municipal or local authorities. In addition there was a further 13,000 kW installed solely for traction purposes, taking the Australian total to 36,000kW. [6]



1997 map based on data from ESAA[7] 1927 map is after AJ Gibson[8]

Fig 1 AUSTRALIA - HIGH VOLTAGE TRANSMISSION SYSTEMS

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HIGH VOLTAGE TRANSMISSION - THE EARLY DAYS

As a consequence of being the world's driest continent, Australia is closely settled on only the coastal fringe. With a land area approximately the same as the contiguous States of the USA and a population at Federation (in 1901) of only 3,774,000 people, the early development of Australia was markedly influenced by what has been termed "the tyranny of distance". As a consequence, electricity generation close to the load centre was initially the norm for all of the major centres of population.

The first State to use transmitted supply was Tasmania - in 1916 - with a 100 km, 88 kV transmission line from the 6,800 kW Waddamana hydro-electric power station to the state capital, Hobart. This was the first instance in Australia of electrical development being shaped by the geographical location of the primary energy resource. The next such was in Victoria in 1924, when the State began a seventy year programme of power development based on the vast brown coal (lignite) deposits of the Latrobe Valley. The initial development consisted of the 50,000 kW Yallourn power station and a 160 km, 132 kV line to the state capital, Melbourne.

The institutional structure of the industry was also a factor in the pace at which transmitted supply developed. Both Tasmania and Victoria had moved early to set up central power authorities serving the entire State (Tasmania in 1916 and Victoria in 1921) and this allowed the industry in those States to take a broad view of their function. These two States, the smallest in the Commonwealth, led the way in the development of high voltage transmission and continued to do so, with Victoria moving to 220 kV in 1956 and 500 kV in 1970.

In NSW, Queensland and Western Australia, the "municipalisation" of electricity supply seemed to restrict the vision of electricity planners to their local government boundaries. Only those NSW enterprises with a state-wide or regional function showed any disposition to use high voltage transmission. The Southern Electricity Supply of the Department of Public Works introduced 132 kV transmission in 1942 but it was not until the formation of the Electricity Commission in 1950 that NSW saw the establishment of a widespread transmission network.

A similar pattern emerged in Queensland. The State Electricity Commission, established in 1936, had to await the conferring of additional powers in the difficult post-war years to begin the development of regional power stations and inter-regional interconnectors. In Western Australia the small size of the metropolitan load precluded the early adoption of transmission but this process was hastened by the formation of the State Electricity Commission in 1946, leading to the electrification of the South-West and the interconnection of Bunbury Power Station to Perth in 1957.

THE POST-WAR YEARS

The inability to install new generating capacity during wartime and the pent up demand of the post war years caused serious power supply shortages in all Australian States except South Australia in the late 'forties and early 'fifties. These were made worse by a prolonged and severe drought on the hydro-electric catchments of Tasmania, and coal shortages in all the mainland States. There followed one of the most rapid expansion phases the industry has seen.

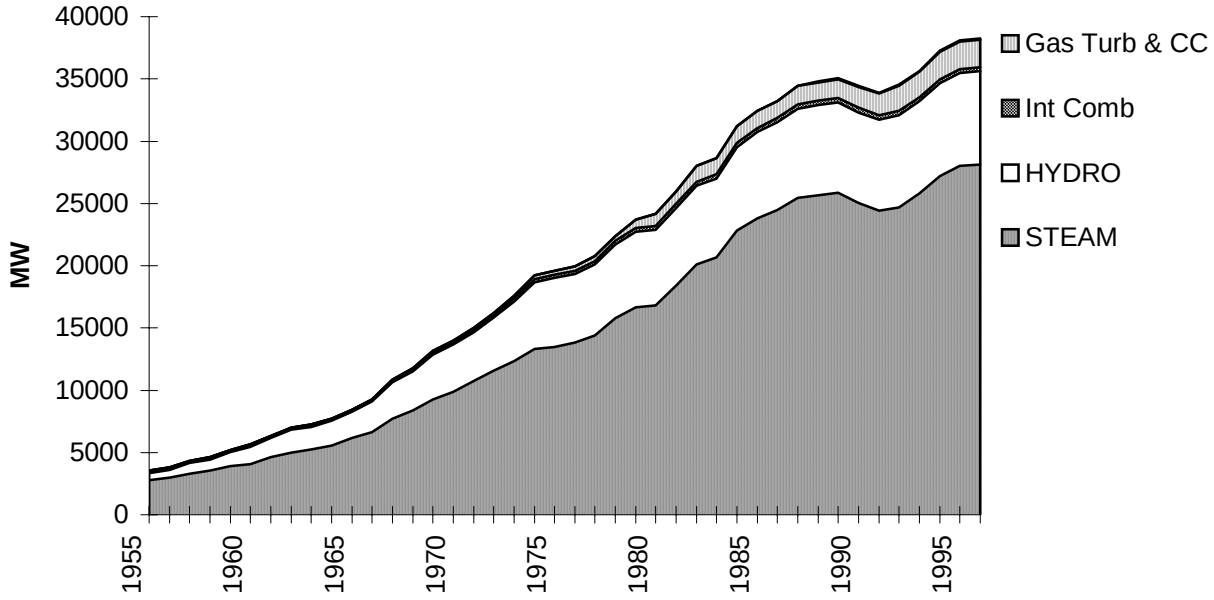

Fig 2 INSTALLED GENERATING CAPACITY - AUSTRALIA[9]

In 1952, NSW had power station construction work in progress at no less than 15 separate sites, many of them small "packages" and diesel power stations rushed into service to overcome severe and persisting shortages. The industry throughout Australia continued at full stretch throughout the 'fifties and 'sixties. Even as late as 1980, Victoria had construction in progress on five separate power station sites, this time involving units of up to 500 MW capacity.

ENERGY RESOURCES FOR ELECTRICITY GENERATION

Australia is totally self-sufficient in energy resources for electricity generation. Black coal is the base load energy source in NSW, Queensland and Western Australia; brown coal is the predominant source in Victoria, and hydro-electric energy supplies almost all of the power in Tasmania. Natural gas is of growing importance, being now the principal fuel in the Northern Territory and a significant contributor in South Australia, Western Australia and Victoria. Electricity imported from the NSW - Victorian systems currently supplies 36% of South Australia's requirements. The balance is supplied equally from power stations burning indigenous lignite and natural gas.

Australia is a major exporter of coal and natural gas, being the world's largest exporter of coal (steaming plus coking), and the third or fourth largest exporter of LNG. Because of the ready availability and low cost of fossil fuels there has been no economic justification for the introduction of nuclear power. However Australia possesses large uranium reserves and U_3O_8 is exported in substantial quantities to Europe and Asia.

The hydro-electric potential of Tasmania and the brown coal reserves of Victoria had been substantially identified in the early part of the century, but it was not until the 1950's that the comprehensive and systematic quantification of the black coal resources of NSW began in earnest - at the instigation of the electricity generating authority. This exploratory work was the foundation of the massive increase in coal-fired generating capacity which occurred in NSW in the next four decades. From 1963 onwards, all of the major power stations in NSW were supplied from "tied" mines, with about half the coal coming from mines owned and operated by the generating authority or from their leases, operated under contract.

As noted earlier, base load generation in Victoria has been supplied from the brown coal resources of the Latrobe Valley, a huge resource with some 35 billion tonnes of economically winnable coal, much of it in coal seams 150 to 200 metres thick, with an overburden depth of only 10 to 15 metres. The open-cut coal winning is carried out by the generating authority using massive bucket-wheel excavators, the coal being transported directly to the power stations.

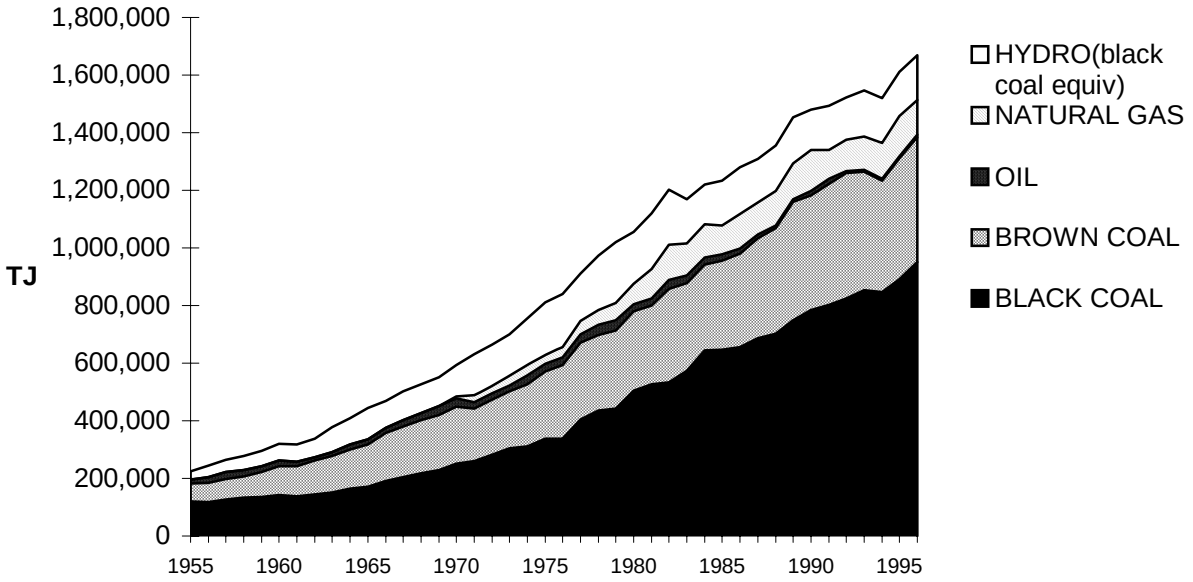

FIG 3 ENERGY SOURCES FOR ELECTRICITY PRODUCTION - AUSTRALIA[10]

In Queensland the State Electricity Commission had identified the potential for lower cost generation on the Central Queensland coalfields by the late 'fifties, but pressure to preserve employment in the southern coalfield and lack of hard data on costs and reserves in Central Queensland delayed their development for electricity generation by several years. By 1968, the development of coal exports to Asia and Europe from the Central Coalfields provided a sound basis for power station resource planning in the area. The electricity industry was able to secure the setting aside of coal reserves for its future use by 1971 and all major power stations since then have been located on those reserves, with coal sourced competitively from private enterprise.

In South Australia the Adelaide Electricity Supply Company (AES Co) had been effective in developing an interconnected supply to the major centres of the State's population but its generating capacity was based on sea-borne black coal from NSW. The desire of the State Government to diversify its fuel supply and to create local employment resulted in a decision to create the Electricity Trust of South Australia in 1946. The Trust compulsorily acquired the assets of the Adelaide Electric Supply Co and undertook the development of electricity generation based on lignite deposits at Leigh Creek, 560 km to the north of the state capital Adelaide. As in Victoria, the open cut is operated by the generating authority but the fuel is hauled 250 km by rail to Port Augusta, the nearest point at which cooling water is available for power generation.

A similar pattern emerged in Western Australia following the formation of the State Electricity Commission in 1946. With planning on a regional instead of a local basis, generation moved closer to the coalfields, but the power station sites were likewise restricted to the coastline because of a lack of identified cooling resources in the hinterland.

The electricity utilities in South Australia, Western Australia and the Northern Territory were to play major roles in the development of Australia's major natural gas fields by providing the essential power station market that would justify their development, including the construction of long pipe-lines, a 780 km line from the Cooper Basin to Adelaide in 1969, a 1500 km line from the North West Shelf to Perth in 1984 and a 1,600 km line from the Amadeus Basin to Darwin in 1986. The Northern Territory utility commissioned Australia's first Combined Cycle plant of 96 MW which went into service in 1987.

THE INFLUENCE OF ELECTRIC TRACTION

Electric tramways were of major significance in the early days of the industry and in Sydney, NSW they predated the general use of electricity for street lighting or other purposes. The first trams ran in Melbourne in 1890 and by the turn of the century there were electric tramways in each of the State capitals.

Melbourne is the only city to have retained its extensive and splendid tramway system. Elsewhere diesel buses displaced trams in the 1950's and '60s but there are signs of a renaissance of tramways relying on the mystique of a new name - "light rail".

Suburban electric rail systems were built in Melbourne in 1918 and in Sydney in 1926, served by their own 25 Hz power systems. Intercity services to provincial centres in NSW were built in the 1960's. These are in effect extensions of the 1500 volt DC suburban network, and debate continues on the construction of electrified high-speed rail links between Sydney and Melbourne and the National Capital, Canberra.

The possibility of urban railway electrification in Western Australia cast a long shadow decades before it actually happened - in the 1980's. In 1913 a decision was made to adopt 40 Hz as the frequency for the State's next and largest power station in view of the possibility of railway electrification - a decision which appeared to draw on the experience of the Government's UK consultants, Merz, in their home city of Newcastle on Tyne, England. That frequency was seen as a compromise between the needs of the general supply and the problems of commutation of 50 Hz supply on rotary converters in the DC-driven railway system. However, railway electrification did not proceed, and the State was burdened with its 40 Hz system until conversion to 50 Hz was completed in 1958. Ironically, when the railways were electrified a 25 kV AC system was chosen

Queensland embarked on a major railway electrification project in 1983 on the coal haulage railways of the Central Queensland coal district. This system, which operates on a 25-0-25 configuration supplying single-phase 25 kV locomotives is the largest AC traction system in Australia and hauls some 83 million tonnes of export coal to the Central Queensland ports over 1670 km of track. Design and operation of the system presented technical challenges to avoid electrical interference to other electricity users on a long radial 132 kV system. Nine load-balancing static VAR

compensators were installed at the thirteen traction substations on the system in order to avoid what would otherwise have been an expensive transmission augmentation. By 1989 Queensland had completed electrification of the Brisbane suburban system and the 639 km main line from Brisbane to Rockhampton, all at 25 kV AC.

ELECTRO-METALLURGICAL INDUSTRIES

The electro-metallurgical industries have had a significant influence on the character of the electricity industry at a number of stages of its development. The first such instance was the large scale development of hydro-electric power in Tasmania - begun by a metallurgical company but of financial necessity completed by the Tasmanian government. Fundamental to the Government's willingness to take over the project was an implied commitment by the electro-metallurgical company that it would absorb a major part of the low-cost electricity to be generated by the project. The first supply was given in 1917, the start of more than 70 years of hydro-electric development in Tasmania, much of it to supply electro-metallurgical and other energy-intensive industry.

One such project was the supply to the Bell Bay aluminium smelter set up by a Commonwealth Government agency, the Australian Aluminium Production Commission under a contract signed in 1948. This was conceived as a strategic measure in the Cold War years to ensure that Australia would not be cut off from aluminium supplies.

Australia is one of the world's largest exporters of alumina, and during the build-up of the alumina refining industry, several international aluminium smelters began to explore the possibility of installing smelting capacity in Australia, based not on hydro power, but on low-cost coal-fired generation. The first of those coal-based smelters was the Point Henry plant of Alcoa, established in 1963. This was supplied from the company's own brown coal fired station, with back-up from the Victorian public network.

This was followed by the Alcan smelter at Kurri Kurri, NSW in 1970, the Comalco smelter at Gladstone, Queensland in 1981, Pechiney at Tomago, NSW in 1983 and Alcoa at Portland, Victoria in 1986. Each of these projects has had an influence well beyond its direct and immediate consequences.

The Kurri Kurri smelter was the leverage point for negotiations with the underground coal mining unions in NSW which saw their acceptance, against long standing objection, of open-cut coal mining for power generation. Only through open-cut mining could energy costs be brought low enough to compete internationally for smelter business - the quid pro quo for the miners was job creation in the depressed mining area around Kurri Kurri.[11]

The Gladstone smelter of Comalco (the private enterprise successor to the original Australian Aluminium Production Commission) was the subject of power supply options dating from 1972 that were extended time after time. The State Electricity Commission had proposed a power station in Central Queensland since the late fifties, and by 1968 the prospect of a 600 MW smelter load at Gladstone appeared to crystallise plans in favour of the construction of a major power station at that location, close to the Central Coalfields and the proposed smelter, but distant 530 km from the major load centre, the State capital, Brisbane. This triggered the shift to the Central Coalfields for electricity generation, the start of the Queensland 275 kV transmission system, and ultimately, the interconnection of the State from north to south over a distance of 1500 km.

The Tomago and Portland aluminium smelters might be described as belonging to the "Great Aluminium Race", a period of intense rivalry between State Governments to attract new aluminium smelters onto their systems to promote employment and trade - a rivalry that was spurred on by the Commonwealth Government which saw a "window of opportunity" to increase Australia's downstream processing of its abundant mineral exports.

This notion of a "window of opportunity" was to lead to a vast expansion of generating capacity which was then overtaken by the international recession of 1982, resulting in a significant surplus in generating capacity Australia wide. As a result however, Australia has now largely renewed the generating capacity installed in the 'fifties and 'sixties, with a convoy of modern and highly efficient generating units in the range 350 to 660 MW. One important consequence of the establishment of the Portland smelter was that it required a long westerly extension of the Victorian 500 kV system which was later to be crucial to the interconnection of South Australia to the NSW- Victorian interconnection.

THE SNOWY MOUNTAINS HYDRO-ELECTRIC SCHEME

One of the milestones of the industry was the development of the Snowy Mountains Hydro-electric Scheme. There had been many proposals over the years to develop this resource but because of the distances involved, commitment had to await the growth of loads to the point that the investment was justified.

The post-war financial and political input of the Commonwealth Government was decisive. The Snowy River traverses two States, NSW and Victoria, and its development may well have been the source of argument between them were it not that the Commonwealth had been ceded entitlement to its waters under legislation to create a National Capital.

In the event, agreement was reached between all parties rapidly, and construction began in 1949 with the final stage completed in 1972. The Scheme occupies an area of 3,200 square kilometres, mostly within the Kosciusko National Park. It comprises seven power stations with a total capacity of 3,756 MW, pumped storage pumping capacity of 670 MW, 16 major dams with a total storage of 7,000 gigalitres, Australia's highest township - Cabramurra - 225 km of tunnels and aqueducts and 220 km of 330 kV transmission lines.

The generating capacity is sized to operate at an annual capacity factor of 17% in order best to integrate hydro generation with the predominantly thermal capacity of the New South Wales and Victorian systems. The storages of the Scheme are designed to survive a critical drought sequence of nine years. One of the major distinguishing features of the Scheme is that it diverts the headwaters of the easterly-flowing Snowy River through the Great Dividing Range into the low rainfall area of the Murray-Darling river system, providing on average, 2,200 gigalitres per annum of additional irrigation water into those rivers.

The output of the Scheme is transmitted to the NSW and Victorian systems at 330 kV, dating from 1959. This was the first time this voltage had been used in Australia, and the establishment of the Scheme created an interconnection between the NSW and Victorian systems decades ahead of the time that interconnection might otherwise have been justified on economic grounds. Automatic load-frequency control systems were installed in the two States and in the Snowy to control power flows on the interconnection, and associated with those systems, automated economy dispatch on the basis of incremental fuel costs. These automated dispatch procedures greatly facilitated the introduction of economy interchange transactions between the NSW and Victorian systems

Construction of the Scheme depended critically on the successful integration of the multi-cultural work force that came to it during Australia's massive post-war migration boom. No less significant was the contribution that the project made to the Australian ethos, engendering as it did a sense of confidence in the ability of Australian engineers to design and construct such a project.

SERVING THE "OUTBACK"

In those decades that the industry was run as a series of State-owned enterprises, governments used it as an instrument of policy to promote rural electrification, the loads and revenues of the metropolitan customers being used to support financially the construction and operation of vast, tenuous rural electrical systems. For all practical purposes there is now no settled, even sparsely settled, part of Australia that does not have electricity supply, most of it as transmitted supply from the main networks.

The early years of outback supply were marked by considerable ingenuity, but the most innovative plant must surely be the 50 Kw "pelton wheel" installed at Thargomindah, Queensland in 1898. Built by the local blacksmith, this plant was driven by hot water gushing from a bore drilled into the Great Artesian Basin which stretches for 1,750,000 km² over Queensland, NSW and the Northern Territory.

Many of Australia's remote areas are served by Single Wire Earth Return (SWER) lines and their total length of 186,000 km is now four times the combined circuit length of all high voltage lines from 132 kV to 500 kV.

Conventional three phase circuits have also played their part in subjugating the "tyranny of distance" and as the starting point for the vast SWER systems. The first of these was a 260 km 220 kV line built in 1979 to provide transmitted supply to the remote silver-lead-zinc mining centre of Broken Hill in western NSW. This supply was provided by linking the city to the north-western extremity of the Victorian system and by the temporary negotiated transfer to Victoria of part of the NSW entitlement to power from the Snowy Scheme. The connection of transmitted

supply to Broken Hill allowed the closure of the expensive local diesel station which served the city and later, the transfer to stand-by duty of the 40 Hz diesel station operated by the mining companies. This involved the installation (in 1986) of Australia's only solid state back-to-back frequency changer (with a rating of 40 MW) in order to allow the continued operation of the 40Hz supply, used in part for rotary conversion to DC to drive mine hoisting motors. This stage of the work required the construction of a 400 km 220 kV line within NSW to reinforce the earlier link.

Two other "outback" transmission projects are worthy of mention - the first is the 655 km 220 kV line to the Eastern Goldfields of Western Australia, a project that went into service in 1984. This line was designed for an initial load of 70 MW with the ability to increase that rating to 105 MW by the installation of shunt capacitor banks. Three saturated reactor compensators of 55 MVAr were installed, two at the receiving end, Kalgoorlie, and one at mid-line[12]. More recently, following the introduction of a competitive market and the construction of a 1200 km natural gas pipeline from the North West Shelf to the Eastern Goldfields, electricity supply in this area has been supplemented by a 100 MW power station built by TransAlta using aero-derivative gas turbines. This project presents an interesting test of the capacity of the new trading regime to accommodate the concept of "stranded assets".

The second "outback" project is the 400 km extension at 132 kV and 66 kV from Townsville to the Gulf of Carpentaria in the Far North region of Queensland. This extension went into service in 1992 and has replaced the costly diesel power stations which previously served the area. PLC-controlled static VAR compensators are used to achieve stability on a system whose remote end is distant some 1400 km from the Central Queensland coal fired generating stations and where the remote end fault current is only twice the expected peak load current.

HIGH VOLTAGE INTERCONNECTIONS

By the late 1950's all of the ingredients were in place for a rapid expansion of high voltage transmission throughout Australia - rapid load growth, an institutional framework which aggregated regional loads for planning purposes, low cost primary energy resources long distances from major load centres, and the organisational structures to plan, build and operate an integrated system of power stations and transmission lines. The major elements of the high voltage systems were determined principally by the need to connect remote low-cost energy sources to load centres, but as noted earlier, the construction of the Snowy Scheme had also resulted in the interconnection of the two largest systems, NSW and Victoria in 1959. As this interconnection matured and mutual confidence developed, there were several new interconnection points established between the two State-owned systems for mutual advantage, and to maintain the transfer capacity of the original 330 kV ties. This South-East System spanned 1,400 km from North to South, mostly at 330 kV, although each system had internal lines operating at 500 kV.

The next major interconnection was the linking of South Australia to the existing South-East system. This occurred in 1990 and created an interconnection of three State systems with a total capacity of about 19,000 MW and an electrical length between extremities of 2,500 km. The costs of the new interconnection were apportioned between the participating States in proportion to estimated shares of benefit from economy interchange.

The next major step in interconnection will be the linking of Queensland to the South-East interconnection. There already exists an electrical interconnection 1500 km long from north to south in Queensland and operating at 275 kV. Initially it was believed that an HVDC link would be necessary to connect the Queensland system with the extended South-East system. However further analyses have established that interconnection will be stable at 330 kV AC, and agreement has now been reached that work should proceed on the construction of a high voltage link between the Tarong Power Station in Queensland and the Armidale 330 kV Terminal in NSW - a distance of 555 km. The resulting interconnection will span more than 5,000 km from north to south, will serve a population of 16 million and loads aggregating some 24,000 MW.

This will leave the connection of the island State of Tasmania to the mainland as the last major interconnection likely to be economically sustainable. The economic feasibility of this 220 km submarine cable has been reviewed on a number of occasions and will continue to be assessed - particularly in the light of experience with the new trading regime emerging in Australia.

ELECTRICITY PRICES

Broadly speaking, the history of electricity prices in Australia has been one of progressive reduction in real terms as indicated in the graph , Fig. 4. Real prices rose briefly in the early 'eighties during a period of exceptionally high interest rates and massive capital expansion, but other than in that period, prices have tended downward in real terms.

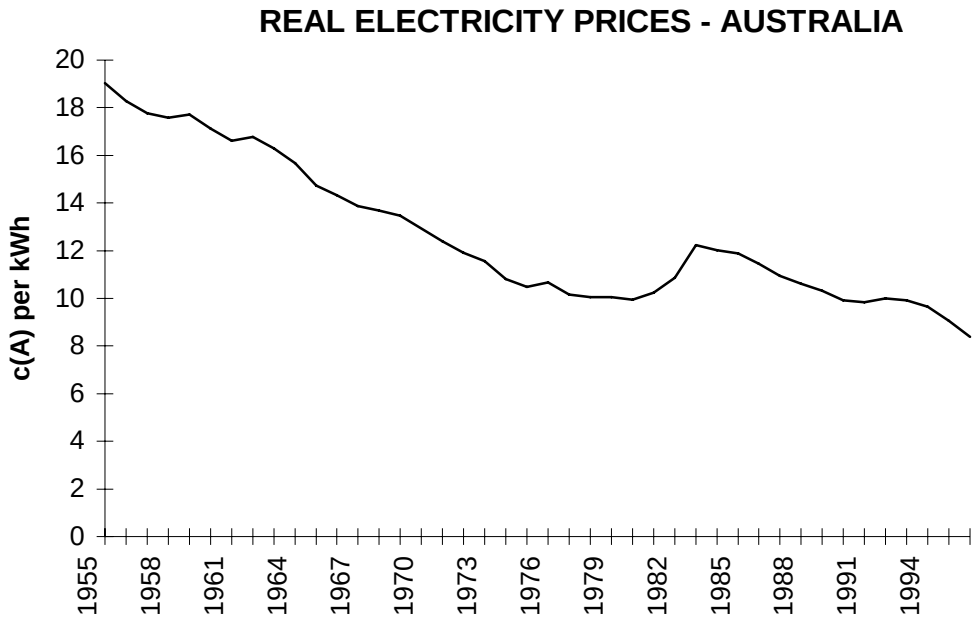

Fig 4 Price movement in Real terms - average selling price - cents (A) per kWh

Industrial average prices for 1995, compared with other OECD countries are shown in Fig 6.

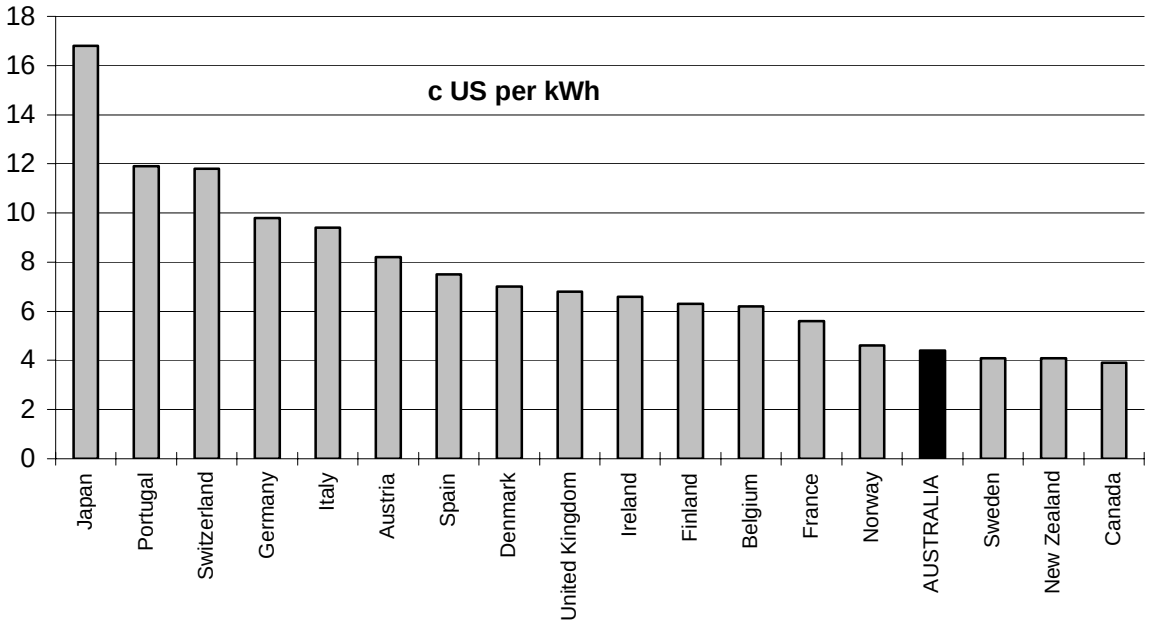

Fig 5 Industrial average prices, OECD countries 1995 Energy Prices and Taxes IEA 1995

Despite the favourable comparative position disclosed by these statistics, there emerged in the early 'nineties a political consensus on the need for "reform" of the industry

RESTRUCTURING OF THE INDUSTRY

At the urging of the Federal Government, Australian governments of all political persuasions have adopted a National Competition Policy as being in their view, necessary to ensure Australia's competitiveness in international trade. The first steps towards the development of this policy were taken in relation to the electricity supply industry in 1993, before the formal adoption of a Competition Policy by the Council of Australian Governments (COAG) in 1995.

The policy adopted by COAG in relation to electricity supply was that sustainable reductions in price would best be achieved by creating a competitive market model for the industry in place of state-owned utilities with natural monopolies. It was decided that the vertically integrated industry in each state should be disaggregated, that the transmission function be vested in multiple network corporations - with a national body, NEMMCO, responsible for market operation and security, that a competitive market be established between generators - including interstate competition, that generators should be broken into smaller units to heighten competition and to prevent abuse of market power by a large trader, that a retail function be created independent of the distribution function, that retailers should be free to enter into hedge agreements with generators, but obliged to make all purchases from the pool, that consumers should progressively have access to the retailer of their choice and that new generators be given right of access to the transmission network. However, no explicit provision was made for the recovery of "stranded costs". Generators and distributors would be allowed to acquire their own retail licences but would be required to operate the retail business at arms' length from their other function.

As a quite separate, but related matter, privatisation of the state-owned enterprises is happening or mooted. Victoria has virtually completed the sale of its disaggregated industry. Its 7,100 MW of generating capacity has been split into seven separate companies (six of which have been sold - mostly to overseas interests); the distribution industry has been split five ways and all sold overseas, and there are in excess of fifteen separate retail licences. Plans are proceeding for the sale of the company owning the transmission assets. There are no proposals at this stage for sale of the power exchange company which handles dispatching of generators and network operations. This is a remarkable change from total state ownership and complete vertical integration, into one in which all assets are held privately and there is no vertical integration other than that brown coal production is still carried on by individual generating companies (one of which buys coal from a neighbouring generator/coal producer).

The State with the largest installed capacity, NSW (12,200 MW), has split off the transmission and dispatch function into a separate corporation, has completed the disaggregation of the generating industry into three corporations, consolidated twenty five distributors into six state corporations and issued 22 retail licences. Proposals have been announced for total privatisation of the industry, a matter which, at time of writing, was being hotly debated by groups within the Government and the trade union movement.

South Australia and Queensland have split the transmission and generation functions. Queensland has split its generating assets (6,900 MW) into three corporations, has seven distributors and three new retail corporations for the entire State. There are no proposals for privatisation of the industry, but private generators are being given rights of access to the transmission network. South Australia (2250 MW) has not split its generating assets nor has it expressed any intention to privatise.

The industry continues to be vertically integrated as state corporations in Western Australia and the Northern Territory without pressure to do otherwise, as the distances of Western Australia and the Northern Territory from the other States precludes interconnection in the foreseeable future. In 1997 the Tasmanian Government established two committees; one to recommend changes to enable withdrawal of Government equity from the transmission, distribution and retail areas, and the other to recommend a program to build a Bass Strait submarine cable link as a private project within four years.

Trading on the first stage of the National Electricity Market (actually only NSW, Victoria and the Australian Capital Territory) began on 4th May 1997.The full National Market (NSW, Victoria, South Australia, ACT and Queensland) is programmed for the first half of 1998. The Queensland market will be physically separate from that in the other States until interconnection occurs in about 2001 but Queensland will operate its own market according to the national rules from October 1997 to March 1998. As will be seen, there now exists a diversity of structures within the overall framework of a competitive market, and history will have to be the objective judge of the merits of each. For the present, the excess capacity on the South-East interconnection is resulting in unsustainably low pool prices. The winners at present are the large industrial buyers rather than shareholders (including State owners), and the outcome of this vast experiment will continue to be watched with keen interest.

INDUSTRY ORGANISATIONS

The electricity supply industry in Australia is well served by two major associations for the mutual support of members. The first to be established was the Electricity Supply Association of Australia, (ESAA) founded in 1918 as a voluntary association comprised of State regulatory authorities, and of the major generating, transmitting and distributing bodies. It continued in this form until July 1991 when there was a re-organisation of the Association to recognise the new market arrangements then emerging. The association now comprises all of the Australian generation, transmission and distribution companies - public and private - and is beginning to embrace the retail companies as they emerge independently into the market. It also has affiliate members in New Zealand, the South Pacific, South East Asia and Hong Kong. The main emphasis of the Association has moved progressively from the exchange of information between Members towards advocacy and issues management.

The other major industry body is the Australian National Committee of CIGRE. The Australian National Committee (ANC) was established in the early 1950's largely at the instigation of Mr E L Merigan, then of the State Electricity Commission of Victoria and later Associate Commissioner of the Snowy Mountains Hydro-electric Authority. Mr Merigan and Mr Milne of the Electricity Trust of South Australia were successful in 1952 in persuading the ESAA to sponsor the formation of an Australian National Committee. Mr Merigan drafted the constitution of the new body, succeeded Mr R H Liddelow as Chairman of the National Committee and continued in that capacity until 1968[13]
The ANC is represented on all fifteen Study Committees of CIGRE and maintains Australian Panels which mirror each of the Study Committees. Two Regional Meetings of CIGRE have been organised under the auspices of the ANC, the first at Sydney, NSW in 1987 and the second at the Gold Coast, Queensland in 1993. The third Regional Meeting will be held at Melbourne, Victoria in October 1997

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Australian National Committee of CIGRE
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Some Key Dates in the Development of Electricity in Australia

STATE	1880 - 1900	1900 - 1920	1920 - 1940
QUEENSLAND *1,727,000 km^2*	***1882*** *Demonstration of street lighting in Brisbane* ***1883*** *Govt Printing Office lit* ***1888*** *First public supply in Queensland- General Post Office lit by Barton and White , (later acquired by Brisbane Electric Supply Co)* ***1893*** *Thargomindah first Qld town to light streets* ***1897*** *Electric tramway in Brisbane*	***1904*** *City Electric Light Co acquires Brisbane Electric Supply Co* ***1917*** *Street lighting in Brisbane* ***1918*** *AC supply in Brisbane* ***1920*** *Street lighting extended throughout Brisbane*	***1925*** *Brisbane City Council authorised to generate electricity* ***1928*** *BCC New Farm PS i/s* ***1935*** *Royal Commission into electricity supply industry* ***1938*** *State Electricity Commission (SEC) created* ***1939*** *City Elec Light Co plan for rural electrification of South East Qld approved by gov't* ***1939*** *SEC proposes interconnection of BCC and CEL*
NEW SOUTH WALES *802,000 km^2*	***1879*** *Arc lighting of night construction work on Garden Palace Sydney* ***1888*** *Tamworth first town in Australia with electric street lights (36 kW DC)* ***1889*** *Young first town in Australia to provide public supply to residents* ***1890*** *Electric Tramway Randwick - Waverly* ***1899*** *Ultimo central PS i/s to supply tramways - 2,550 kW DC*	***1904*** *Sydney Municipal PS at Pyrmont in service , 1,500 kW 5kV AC . Elec street lighting replaces gas* ***1909*** *Electric Light & Power Supply Corp begins ops* ***1912*** *Railway Dept builds White Bay power station in Sydney for electric trains* ***1919*** *Local Government Act establishes state- wide legislative framework for elec supply*	***1926*** *Sydney trains electrified after long deferment* ***1933*** *DC to AC conversion begins in Sydney CBD* ***1934*** *Electricity Advisory Committee formed* ***1937*** *Rendell Palmer Tritton of UK report on organisation of electricity industry in NSW* ***1938*** *66kV interconnection Sydney - Lithgow i/s* ***1939*** *50 MW unit in service at Bunnerong PS - largest 3000 rpm unit in world*
VICTORIA *228,000 km^2*	***1880*** *Victoria Elec Supply Co lights Eastern Markets and Athenaeum Hall, Melbourne* ***1889*** *Electric tramway, Box Hill to Doncaster* ***1891*** *Elec street lighting in Richmond and Prahran ; general public supply in Nhill* ***1894*** *Street lighting City of Melbourne from Spencer St PS* ***1899*** *Street lighting City of Geelong*	***1911*** *Royal Commission proposes one generating body for Melbourne and rail electrification* ***1917*** *Brown Coal Advisory Cttee proposes const of Brown Coal fired PS in Latrobe Valley* ***1918*** *Newport Rly PS i/s 12,500 kW 25Hz for suburban rail system* ***1919*** *Const authorised for 50MW Brown Coal fired PS at Yallourn & 132 kV line to Melbourne*	***1921*** *State Electricity Commission created* ***1923*** *44kV line from Geelong to Warnambool i/s 190 km* ***1924*** *Yallourn PS 50 MW i/s 132 kV steel-tower line to Melbourne i/s 160 km* ***1926*** *Rubicon hydro PS and 66kV line to Melbourne i/s 100km* ***1930-34*** *Power companies in Melbourne and Geelong acquired by SECV*
TASMANIA *68,000 km^2*	***1883*** *Mt Bischof Tin Mining Co Hydro PS i/s* ***1889*** *Waverley Woolen Mill PS i/s - Launceston* ***1893*** *Electric Tramway in Hobart* ***1895*** *Launceston City hydro PS i/s 60kW DC 300kW AC* ***1898*** *Hobart elec supply from Gas Co PS -52 kW producer -gas fired 90Hz single phase supply*	***1909*** *Complex Ores Co authorised to begin Great Lakes Hydro-electric Scheme* ***1910*** *Hobart frequency changed to 50Hz* ***1914*** *Mt Lyell Mining Co PS i/s - 4,800 kW 6.6 kV* ***1914*** *HydroElectric Dept formed to complete Great Lakes Scheme - constructed by "day-labour"* ***1916*** *Waddamana PS 6,800 kW 88 kV steel tower line to Hobart i/s 100km* ***1917 -18*** *Supply to Electrolytic Zinc Co and to Australian Commonwealth Carbide Co*	***1920-28*** *Extension of hydro generated supply to municipal distributors* ***1921*** *88kV line i/s Waddamana to Launceston 95 km* ***1928*** *HydroElectric Dept begins acquisition of distributors* ***1930*** *HydroElectric Commission formed , responsible for entire electricity industry in Tasmania* ***1934*** *Shannon PS i/s* ***1938*** *Tarraleah PS & 110 kV lines i/s Tarraleah-Hobart 93km* *" - Rosebery 117km*

	1940- 1960	1960-1980	1980-2000
Queensland	**1940** CEL & BCC interconnected at 33 kV **1944** Critical coal shortages **1945** SEC acquires greater powers - proposes formation of regional boards **1946** 110kV line Brisbane - Toowoomba **1952** Post war power shortages. SEC given greater powers of direction **1953** 132 kV steel tower line Cairns to Innisfail **1953** First Qld trial of SWER line **1958** HV Test Lab at Queensland University	**1960** Merz McLellan submit report on industry - propose major restructuring **1963** SEAQ acquires BCC power stns **1966** Swanbank PS i/s **1964** Callide PS i/s **1968** Collinsville PS i/s **1971** Coal reserves set aside for electricity generation **1972** Contract signed with Comalco for future supply to aluminium smelter **1976** Gladstone PS i/s **1977** Industry reorganised - North & South generating boards and separate distribution bodies	**1981** Comalco Aluminium Smelter i/s **1982** Industry reorganised - QEC as sole planning, generating, directing body **1984** Wivenhoe Pump Storage PS i/s **1984-86** Tarong PS i/s 4 x 350 MW **1985** Electrification of coal haulage in Central Queensland - rural electrification virtually complete **1988-89** Callide B PS i/s 2 x 350 MW **1993-96** Stanwell PS i/s 4 x 350 MW **1995** Transmission and generation functions separated and corporatised **1997** Generation split four ways and 3 retailers created
New South Wales	**1941** 66kV line Sydney - Newcastle **1942** 132 kV line Port Kembla - Burrinjuck **1946** Electrity Authority created - Rural Subsidy Scheme begins **1946-53** Post-war power shortages **1950** Electricity Commission (EC) responsible for generation and bulk supply **1951-56** Three metropolitan PwrStns i/s **1952-3** "Package " power stns i/s **1954** EC begins coal exploration **1954-59** Coalfields Pwr Stns i/s at Tallawarra, Wangi, Wallerawang **1957** EC acquires first coal mine **1959** 330kV line i/s Snowy - Yass linking NSW and Victorian power systems	**1962** 330kv lines from Snowy to Sydney - 380 km **1963-69** Pit-top Pwr Stns i/s at Vales Point & Munmorah - -2,275 MW total - coal from EC s and other "tied" mines **1962-80** 330 kv system expanded to circuit length of 3,065 km **1970** Supply to Alcan aluminium smelter at Kurri Kurri **1971-74** Liddell PS i/s 4x500MW units coal from adjacent open-cut mines, man-made lake for condenser cooling **1978** 660 MW unit i/s Vales Pt PS **1979** 220kv line i/s Broken Hill to Red Cliffs (on Victorian system)	**1980** 500 MW unit i/s at Wallerawang **1982-84** 4 x 660 MW units i/s at Eraring **1984** 500kV line i/s Eraring-Kemps Creek **1985-86** Bayswater PS i/s - 4x 660 MW **1992-3** Mt Piper PS i/s - 2x660MW **1995** Industry re-organised.. Transmission & generation functions separated in preparation for competitive National Electricity Market **1996** Generation split three ways, distribution bodies reduced from 25 to 6, distribution and retail functions separated **1997** Total industry proposed to be privatised and sold
Victoria	**1944-60** Kiewa Hydroelectric Scheme- 184 MW **1955** 220 kV transmission Kiewa to Melbourne **1956** 220 kV transmission Yallourn to Melbourne **1958** Morwell brown coal briquette factory i/s 60 MW cogeneration **1959** 330 kV transmission Dederang to Snowy linking NSW and Victorian power systems	**1964-71** 8x200 MW units in service at Hazelwood brown coal fired power station **1970** 500 kV transmission Hazelwood to Melbourne **1970** Electrification of Victoria virtually complete **1973-75** 2x 350 MW units i/s Yallourn W PS **1979** Jeeralang gas turbines i/s 4x 56.5 MW **1979-80** Construction work in progress on 5 separate power station sites	**1980** Newport gas fired PS i/s 1x500 MW **1980** Jeeralang gas turbines i/s 3x80 MW **1981-82** Yallourn W PS i/s 2x375 MW **1984-87** Loy Yang A PS i/s 4x500 MW **1992** Vertically integrated industry split into generation, transmission and distribution functions. **1994-96** Loy Yang B PS i/s 2x500MW **1995-97** Generation split into 7 bodies, 6 of which have been sold. Distribution split into 5 groups all of which have been sold
Tasmania	**1940** Uniform retail tariffs throughout Tasmania **1948** Contract with Australian Aluminium Production Commission for supply to smelter at Bell Bay **1951** Butlers Gorge PS i/s **1953** Tungatinah PS i/s **1955** Trevallyn PS i/s **1957** Wayatinah PS i/s	**1960** 220 kV transmission lines i/s Waddamana - Burnie and Liapootah - Hobart **1963** Rationing for seven months due to drought (lasted from 1958 to 1968) **1964-65** Poatina PS i/s 5 x 50 MW - static head of 832 m from Great Lakes to Midland Plain **1967** Cloud seeding begins. Rarioning for 12 months -storages to 14.6% of FSL **1968-73** Mersey Forth Scheme i/s 308 MW **1971-74** Bell Bay oil-fired PS i/s, the only thermal station in Tas - due to drought **1978** Gordon PS i/s 288MW - head storage formed by flooding Lake Pedder and damming Gordon River, creating largest storage in Australia	**1982** Gordon Stage 2 hydro scheme adopted by Tasmanian Parliament **1983** Construction of Scheme stopped by Federal Parliament on grounds of World Heritage Conservation **1983-87** Pieman River Power Development i/s -total capacity 390 MW **1992** John Butters PS i/s 144 MW named in honour of the first General Manager of the Hydro-Electric Department **1994** Tribute PS i/s 80 MW. Commissioning of this station marked the final stage of hydro-electric development in Tasmania - spanning the past century. The station is named in tribute to all who have contributed to development of the Tasmanian power system

	2000-		

Queensland			
New South Wales			
Victoria	***2005*** *the first power interconnect between to Tasmania is established.*		
Tasmania	***2005*** *the first power interconnect between to Victoria is established.*		

STATE	1880 - 1900	1900 - 1920	1920 - 1940
SOUTH AUSTRALIA *984,000 km²*	***1883*** *Adelaide Railway Station platform lit by electricity* ***1885*** *Adelaide Arcade Shopping Centre and Harrisons Flour Mill lit by electricity* ***1895*** *Australia's first domestic electric refrigerator at Urrbrae House - 32 volt DC* ***1897*** *SA Electric Light and Motive Power Co authorised to provide supply throughout SA* ***1899*** *Electricity supply to Port Adelaide from Nile St PS - 150kW DC*	***1901*** *Grenfell St PS i/s to supply city of Adelaide* ***1902*** *Motor generator sets installed to allow AC transmission to Adelaide suburbs* ***1904*** *Founding company sold to Adelaide Electric Supply Company (AES Co)* ***1907*** *Horse-drawn trams in Adelaide replaced by electric tramways - power from AES Co* ***1911*** *Tramway PS i/s*	***1923*** *Concrete and steel transmission line pole - the "Stobie" pole - invented by J C Stobie to eliminate termite attack on wooden transmission line poles* ***1923*** *Osborne A Power Station i/s* ***1925*** *Grenfell St power station closed down*
WESTERN AUSTRALIA *2,526,000 km²*	***1888*** *Western Australian Electric Light & Power Co set up by CJ Otte - Government House lit* ***1890*** *Midlands railway yards lit by electricity* ***1891*** *Legislative Assembly lit by C J Otte's company* ***1892*** *Local municipal authorities authorised to install or arrange electricity supply.* ***1894*** *Perth Gas Co authorised and begins generation for Perth city* ***1898*** *Gold mining towns of Coolgardie and Kalgoorlie lit* ***1899*** *Electric trams in Perth run by Perth Electric Tramway Co*	***1900*** *Claremont Elec Light Co PS i/s (inner suburb of Perth)* ***1901/2*** *Northam & Bunbury supplied by Splatt &Wall (local DC stations)* ***1905*** *Fremantle Municipal Tramways PS i/s 50 Hz* ***1912*** *Perth City Council acquires Perth Gas Co including DC electric system and power stns* ***1912*** *State govt acquires assets of Perth Electric Tramways Co* ***1913*** *Govt decides to build East Perth PS to supply trams and sell in bulk - selects 40 Hz frequency* ***1916*** *East Perth PS i/s 4 MW*	***1922*** *Geraldton PS i/s (DC)* ***1923*** *Conversion of street lighting in Perth from gas to electricity completed* ***1927*** *East Perth PS extended - 12.5 MW* ***1931*** *Government proposes privatisation of electricity industry - without result* ***1937*** *Electricity Advisory Committee set up* ***1938*** *East Perth "B" PS i/s -1 25 MW unit ~ 33% of total capacity* ***1938*** *Royal Commission established to investigate electrification of South West of State*
SNOWY MOUNTAINS HYDRO-ELECTRIC SCHEME *3,200 km²* *in NSW*	***1884*** *Surveyor General Adams of NSW proposes diversion of the easterly flowing Snowy River into the western hinterland for irrigation purposes - nothing resulted*		***1937*** *Rendell Palmer and Tritton (UK consultants) propose 250 MW hydroelectric project on Snowy River without any irrigation diversion*
AUSTRALIAN CAPITAL TERRITORY	*2,400 km²*	***1908*** *Site of the National Capital of Australia chosen* ***1913*** *National Capital named "Canberra".* ***1915*** *Canberra PS i/s 150 kW*	***1927*** *Federal Parliament transferred to Canberra* ***1929*** *Supply at 66kV from Burrinjuck hydro-electric PS in NSW. Canberra steam PS closed*
NORTHERN TERRITORY *1,346,000 km²*			***1923*** *Felix Holmes authorised to generate and supply power in Darwin - 66 kW 240v DC* ***1934*** *Darwin Town Council takes over electricity supply* ***1937*** *Alice Springs PS i/s 20 kW* ***1939*** *Northern Territory Administration takes over electricity supply in Darwin*

	1940 - 1960	1960 - 1980	1980 -2000
SA	**1941** First major 66kV trans line i/s Osborne to Morgan 200 km **1946** Electricity Trust of South Australia formed to develop rural supply and lignite-fuelled generation. Assets of AES Co compulsorily acquired **1947** Osborne "B" PS i/s **1954** Playford A PS i/s 3 x 30 MW using lignite hauled 250 km from Leigh Creek **1954** 132 kV transmission i/s Port Augusta to Adelaide - 310 km	**1960** 275 kV transmission i/s Port Augusta to Adelaide **1960-64** Playford B PS i/s- 240 MW **1965** Osborne "B"PS completed - 240 MW **1967** Torrens Island PS i/s **1969** Natural gas piped 780 km Cooper Basin to Adelaide. Torrens Island gas fired - first in Australia **1973/74** Dry Creek GT PS i/s 156 MW **1975** Torrens Island "B" PS i/s **1979** Snuggery oil fired GT PS i/s 75 MW	**1981** Torrens Island "B" PS completed - 800 MW **1984** Mintaro gas fired GT PS i/s 90 MW **1985** Interconnection Agreement with NSW and Victoria **1985/86** Northern PS i/s 500 MW fuelled by lignite from Leigh Creek **1990** 275 kv interconnection to NSW/Victorian system. **1995** Electricity Trust corporatised **1996** Generation function separated from ETSA Corporation in preparation for National Electricity Market
WA	**1943** Conversion of 40 to 50Hz decided **1946** State Electricity Commission created. **1947-49** Power shortages due to plant failures **1948** SEC takes over Perth City Gas and Electricity undertaking **1951** South Fremantle PS i/s **1952-58** Conversion of 40 to 50 Hz completed in customer premises **1955** East Perth PS converted from coal to oil **1957** Bunbury PS i/s - 132 kV line i/s Bunbury to Perth - 180 km	**1960** Rural assistance scheme **1964** Muja PS i/s and 132 kV lines Muja to Bunbury and Perth **1970-73** Kwinana oil-fired PS i/s 4x120 MW **1973** Geraldton 20 MW GT i/s and 132 kV line to Perth - 480 km **1973** Country Towns Assistance Scheme begins **1975** State Energy Commission replaces State Electricity Commission 1975 ***First 330kV line i/s*** **1977** Memorandum signed for North West Shelf Natural Gas **1978** Conversion of Kwinana PS to coal following "oil-shock"	**1980** Take-or-pay agreement signed for North West Shelf Gas Muja "C" PS i/s 200MW unit **1984** Muja to Eastern goldfields 220 kV line i/s 655 km **1984** First natural gas to Perth from North West Shelf - 1500 km Conversion of Kwinana PS units to natural gas **1990-93** Mungarra and Pinjar GT PSs i/s - total of 608 MW **1993** Australia's first commercial wind farm i/s 9 x 225 kW **1994** Government separates electricity and gas utilities - Western Power inaugurated
Snowy Scheme	**1946** Commonwealth Dept of Works & Housing and Post War Reconstruction investigates power potential of Snowy River **1947** Commonwealth-States Snowy River Committee formed **1949** Committee recommends irrigation /power project for Snowy with electrical output of 2,500 MW **1949** Commonwealth creates Snowy Mountains Hydro-electric Authority to build Scheme. Chief Engineers was Sir William Hudson. **1955** First output from Snowy - 80 MW Guthega run-of-river PS **1957** Snowy Mountains Council (joint States and Commonwealth) created to control and direct operations. **1959** Tumut1 PS i/s - ultimate capacity 4 x 80 MW **1959** 330kV interconnections to NSW and Victoria	**1961** Tumut 2 PS i/s - ultimate capacity 4 x 70 MW **1966** Murray 1 PS i/s - ultimate capacity 10 x 95 MW **1968** Murray 2 PS i/s - ultimate capacity 4 x 138 MW **1971** Blowering PS i/s - 80 MW **1972** Tumut 3 PS i/s - ultimate capacity 6 x 250 MW This completed construction of the Snowy Mountains Hydro-electric Scheme Total installed capacity 3,756 MW	**1995** Agreement reached between Commonwealth Government and State Governments of NSW and Victoria to "corporatise" the Snowy Mountains Hydroelectric Authority and Council in preparation for trading on the National Electricity Market from 1st July 1997 **1997** Snowy Corporatisation Bill withdrawn from NSW Parliament after debate on the timing of a review of water management. Plagued with the National Engineering Landmark (NEL), Information Plaque (IP) International Historic Civil Engineering Landmark (IHCEL) at the Tumut 3 Power Station.
ACT	**1955** Agreement with NSW to provide supplementary bulk supply in excess of ACT entitlement under Snowy Scheme	**1967** 330 kV interconnection with NSW and Snowy Scheme	**1988** ACT Electricity Authority incorporated within ACT Electricity and Water Authority
NT	**1945** Tennant Creek PS i/s 40 kW diesel **1945** Katherine PS i/s	**1962** Stokes Hill PS i/s at Darwin 15 MW oil fired **1978** Northern Territory granted self-government by Federal Government **1987** Northern Territory Electricity Commission (NTEC) formed to supply major towns in Territory	**1983** Natural gas piped from Amadeus Basin to Alice Springs **1983-89** Gas Turbine Power Stations commissioned at Alice Springs, Tennant Creek, Katherine, Pine Creek and Darwin **1987** Power and Water Authority formed -takes over functions of NTEC **1987** Channel Island Power Station, Darwin i/s. Natural gas fired 100MW open cycle, 96 MW combined cycle - Australia's first CCGT Power Station **1987** Transmission line i/s Darwin - Katherine 320km at 132 kV

	2000-		
SA			
WA			
Snowy Scheme	*2006 The state governments of Victoria and NSW propose a privatisation of this asset which was subsequently abandoned.*		
ACT			
NT			

ENDNOTES

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[1] *A History of the Electricity Supply Industry in Queensland*	Malcolm I Thomis, , 1987, Boolarong Publications for Queensland Electricity Commission.
[2] *Power for the People*	Louise Boylen and John Mc Ilwraith, Editor David Gladwell for State Electricity Commission WA
[3] *A History of Australia*	Manning Clark v4.
[4] *City of Light*	Ian R Lobsey for Peel - Cunningham County Council 1988.
[5] *100 Light Years*	David Joss for the Young Historical Society.
[6] *Proc Elec Engrs Assoc of NSW*	Presidential address by ACF Webber 9th April 1906.
[7] *Electricity Australia 1996*	Published by Electricity Supply Association of Australia.
[8] *Power development in Australia*	A J Gibson - a Report to the Commonwealth Government – 1927.
[9] *Electricity Australia 1996*	Electricity Supply Association of Australia.
[10] *Ibid*	
[11] *Electricity Supply in NSW - the First Century and Beyond*	Frank Brady to Institution of Engineers Aust., Sydney Division Heritage Committee, 16th October 1994
[12] *Analytical Techniques for the Application of Static VAR Compensators to Improve the Capability of Long Distance Transmission Systems to Remote Areas of Australia*	W Grainger et al, CIGRE 1986 Session Paper 38-04.
[12]*Personal communication to C J Joyce 12th Oct 1996*	NR White former Chairman of State Electricity Commission of Victoria and third Chairman of Australian National Committee of CIGRE.

In addition to the specific end-noted items, the text depends substantially on the contributions of the following individual contributors from each State and Territory.

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NEW SOUTH WALES	Frank Brady AM, former Chief Executive, Electricity Commission of New South Wales and General Editor for the text. The General Editor accepts responsibility for interpretive comment wherever appearing.

This document was prepared by Frank Brady for the Australian National Committee of CIGRE for what was supposed to have been an International dictionary. This dictionary never eventuated. Reproduced here with permission.