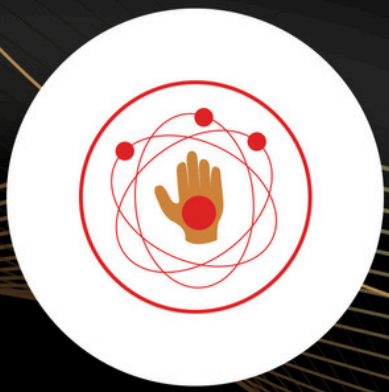
A Century of Power:

Celebrating 100 Years

of the Electric Energy Society of Australia



Empowering engineers through shared knowledge

1924–2024

A Centenary Celebration

Contents

Introduction

On the 22nd April 1924, seven Electrical Engineers met in Sydney to discuss the idea of Mr W R (Bill) Kemp (then at Warringah Shire) to form an Industry Association to further the education and co-operation between engineers working in the Electricity Supply undertakings spread across NSW.

The Electricity Supply Engineers Association of NSW (ESEA) came into being, later to become the Electric Energy Society of Australia (EESA). The other six engineers at that historic meeting were Messrs. A.J. Bradshaw (Manly), A.M. Conway (Orange), H.K. Crisp (Rylstone), R.H Dunstan (Holroyd), F. Newman (Hornsby) and W. Riley (Sydney City Council).

A. M. Conway, 1924-5 (*Orange*)

A. J. Bradshaw, A.M.I.E., 1926-7-8-9 (*Manly*)

W. R. Kemp, A.M.I.E.Aust., 1930-31, 1943-4 (*Warringah*)

R. H. Dunstan, A.M.I.E.Aust., 1931-2 (*Holroyd*)

H. K. Crisp, A.Am.I.E.E., 1934-5 (*Wagga Wagga*)

F. Newman, A.I.E.E., A.M.I.E.Aus. 1936-7 (*Hornsby*)

The first Conference of the association was held during the Easter week of 1925 at the Lecture Hall of the Institution of Engineers Australia, 16 College Street in Sydney. Twenty-three Municipal and Shire Electrical Engineers attended. The first President was A.M. Conway, who unfortunately died before the second Conference in 1926, and was replaced by A.J. Bradshaw.

The Association's first Constitution was adopted at the 1927 meeting, with forty-two 'foundation members' signing the new membership forms.

Early achievements of the Association included the collation and sharing of "Costing and Data Sheets", the Certification of Electrical Engineers under the Local Government Act, the licensing of Electrical Contractors, the formation of the Australian Commonwealth Standards Association, and the "hall-marking" of electrical appliances to ensure their safety in use.

At the time of the Association's formation there were around 130 Electricity undertakings across the State, 103 of which had their own generating equipment, the remainder receiving 'bulk supply'. This number grew to 162 undertakings by 1932, and 183 undertakings by 1940. Of course, increasing numbers received a bulk supply from the Department of Railways as their Transmission network grew.

St George County Council

The first County Council (dedicated to distributing electricity) was the St George County Council constituted on 29th October 1920. Many more followed, taking over the electricity functions of the local councils and private operators, with 46 County Councils reduced to 25 with the amalgamations of 1st January 1980. That number was further reduced to six State Owned Corporations (SOC's) in 1995, four in 2002 and three in 2005.

In 1950 the Electricity Commission of NSW was created, drawing together the elements of generation and transmission across NSW into one Government-owned organisation.

Until the late 1990's, ESEA operated in accordance (more or less) with the originally envisaged model as an association of NSW of Distribution Engineers. However, the original thesis of numerous separate NSW distribution authorities using ESEA to collaborate was very much affected by the amalgamation of County Councils (under a local Council governance model), through various stages, towards the creation of 3 Electricity Distribution State-Owned Corporations as summarised above.

At the same time, the consolidated operating model of transmission and generation in NSW was dismantled, with the creation of a transmission entity and three separate generation entities, each of which also operated as State-owned Corporations.

In 1980 the ESEA Annual Conference was held in conjunction with the Institution of Engineers Australia's "National Committee on Electric Power Engineering" (NCEE - a committee of the Electrical College Board), foreshadowing the eventual 'merging' of the two bodies almost twenty years later to become a National Association and a Technical Society of the Institution of Engineers Australia.

In the late 1990's, at a time of significant change in the electricity industry, it was agreed to consolidate the NCEE and ESEA to form the Electric Energy Society of Australia - EESA. EESA became a national Technical Society under the Electrical College Board. Existing state-based NCEE committees were brought into the Society, and efforts commenced to establish new State committees where they did not already exist.

Leading this effort were Jeff Allen (Chair, ESEA) Dr David Sweeting (AM, Chair, NCEE), Dr Robert Barr (AM), Russell Ellen, and Larry Meng, all of whom have been made EESA Life Members in recognition of their efforts at that time and/or subsequently. Their collective commitment to the sharing of knowledge and a collegiate approach at a time of significant industry reform should be noted and recognised as an historic achievement.

Contemporaneously, Engineers Australia agreed to a model whereby Technical Societies would be created, reporting to a relevant Engineering College Board. Some Technical Societies such as EESA operated with a degree of independence based on separate incorporation, and it was possible to be a member of such a Society without being a member of Engineers Australia.

Thus, in 1998, ESEA became EESA (the Electric Energy Society of Australia) – a separately incorporated technical society of Engineers Australia. In 1999, the first National Conference of ESEA was held at Old Parliament House Canberra. This was the 75th Annual Conference of ESEA/EESA. The conference title "Electricity 2000" was used from 2000. Terry Miller was EESA President at that time.

The name EECON was first used by the National Committee on Electric Energy (a committee of Engineers Australia's Electrical College Board) with the earliest event being a 1992 conference held in Brisbane. (At the end of 2010, it was decided by EESA that the EECON brand name should be used for all national conferences. The first EECON of the EESA era was the 2011 event held in Hobart.)

The following summary of ESEA/EESA conference papers and presentations, as well as keynote speeches by key

industry decision-makers over the 1929-2023 period should be considered in the context of a century of societal change and industry reform. As a general observation – ESEA/EESA continued to be (as always) a highly successful forum for the exchange of information.

Almost from the inception of ESEA links were forged with our sister organisation in New Zealand, (the Electricity Engineers' Association), with mutual transfers of knowledge, collaboration on industry guidelines and panels and more recently the sharing of best speakers at our yearly national conferences.

Also, in the last two decades ESEA/EESA has been an Associate Member of CIRED (the international Conference on electricity distribution). This has allowed a window into international distribution activities whilst providing an avenue for Australian papers at International CIRED Conferences/Workshops to showcase Australian technology and practices in the areas of electricity distribution. ESEA/EESA was the first Associate Member of CIRED to be appointed outside Europe.

It is my great pleasure to present the following information in summary form to commemorate the significant contribution ESEA/ESAA has made not only to engineering practice within the electricity industry, but also to the safe and beneficial use of electric energy in Australian society in general over this period.

In 2024 and into the foreseeable future, Australia is engaged in a hugely ambitious program for the de-carbonisation of energy on a sustainable basis. EESA is totally committed to ensuring that the engineering view is factored into energy policy considerations, and also that the necessary engineering skills are identified and developed as the crucial enabling mechanism for delivery of the vision of a clean energy future.

Men working together at the original St George County Council. Photo by Reub Deacon

BY TERRY LAMPARD
FIEAust CPEng NER APEC Engineer IntPE(Aus)
National President
Electric Energy Society of Australia

Some Reflections by Gordon McGeorge

I was very pleased to hear from Chris Dahlitz and to learn that the successor to the Electric Supply Engineers Association was still in existence and kept active by a few loyal members of the industry. I related in previous writings how this organisation was one of the most positive influences in my career as an engineer in the electricity supply industry. Therefore, I am very honoured to be able to write a few words to support the recognition of 100 years of service that it has provided.

Today the industry is very different to what it was during my working life. Today one sometimes wonders what is really going on in the industry, where the voice of engineers appears to be little heard, and politics and community interest groups appear to be the main planning discipline in operation.

As I look back, and as an ordinary consumer, I must say that the reliability of the electricity supply system has improved significantly. In rural areas, and in my hometown, small pole mounted circuit breakers are now available and affordable and have apparently added very much to this.

Back row L to R: C. K. Hackney, C. F. Cooper, G. E. Dryza, J. L. Bonsor, M. L. Benson, W. Roodenburg.
Front row L to R: R. J. Harper, G. D. McGeorge, D. C. Wheeler R. M. Stratton

One of my pet criticisms is to the so called non-technical community experts who pronounce that the system is being “Gold Plated”, i.e. that too much money is being spent on upgrades. For example, they do not realise that older outdated failing equipment must be replaced as a planned project. In addition, they do not understand for example that electrical losses due to undersize conductors can become an increasingly significant cost factor. They also do not recognise that in deciding to upgrade to heavier conductors requires the selection of a standard size that is available. This can mean that the new conductors may be oversize initially.

The increasing use of concrete and recently tubular steel poles has reduced the high maintenance costs associated with wood pole construction. There can be traps, however. I remember introducing concrete poles in my County Council area. I was impressed by the practices of ETSA (Electricity Trust of South Australia). However, with the use of steel “pitchforks” to replace timber crossarms I overlooked the need to increase the voltage rating of the insulators When introduced into an existing wood pole line lightning strikes would punch a neat hole through the porcelain between the conductor and insulator pin. These faults were very difficult to find. Sometimes the fault would disappear after rain only to reappear when it rained again.

One could question whether the present structure of the electricity supply industry in Eastern Australia is the best arrangement administratively. Under the old County Council system supply engineers were closely in touch with consumer needs. The alternative of one large authority such as the SECV and our present system is that distribution can get “swamped” by the significant needs of generation and large transmission. Today this is also being aggravated by the needs to accommodate intermittent renewable generation, and local voltage regulation.

I am very satisfied that I became an electricity Supply Engineer with a small rural authority. Satisfaction in that one’s job was serving one’s community. I miss our Annual Conferences.

I commend the planning group in recognising 100 years that the Electricity Supply Engineers Society has provided to so many communities in NSW and Australia.

With best wishes,

GORDON MCGEORGE

P Eng MIE Aust

Gordon McGeorge served as President of ESEA in 1984, the “Diamond Jubilee.

1924 – 1939
The Early Years

Rural Councils and other electricity undertakings were encouraged to develop rural electrification schemes through a State Government subsidy scheme.

While municipal electricity supply was a common model across all countries, an important distinction applies to Australia where the involvement of municipal authorities almost always began through the provision of public street lighting. In the USA, municipal authority involvement was more common as simply authorising the construction of poles and wires through streets.

Originally in NSW, Tramways and Railways sold bulk power to municipal undertakings and industry, while public lighting utilities marketed early household appliances, as well as selling electric motors to factories.

Butlin[1] provides a very useful description of the early development of the Electricity Supply Industry in Australia including its use for both traction and lighting. This also provides a brief insight into the development of demand, and the means used by utilities to both realise economies of scale and levelise demand.

Darroch[2] records that this was initially by renting electric motors to replace combustion engines which drove the extensive series of belts that linked multiple machines in factories before the real benefit of electricity individual motors developed.

By the time ESEA was initiated in 1924, electrification of NSW was in transition between Stages 2 and 3 of the following model:

Thomas Parke Hughes socio-technical model of the electrification process[3].

[1] Butlin, N, Barnard, A & Pincus, J 1982, Government and Capitalism: Public and Private Choice in Twentieth Century Australia, Allen and Unwin, Sydney. (pp. 251-8)
[2] Darroch, S 2015, Power for the people : an (uncensored) story of electricity in Australia 1770-2015, ETT Imprint & The Svengali Press.
[3] Thomas Parke Hughes, Networks of Power - Electrification in Western Society, 1880-1930: (Baltimore: Johns Hopkins University Press, 1983). 14-17

In the 1920's much attention focused on the repatriation of those who served in World War 1, and the need to accommodate a rapidly growing population and provide them with goods and services. An excellent summary of development is provided by Colin Forster in his Doctoral Thesis of 1959[4], with dominant themes of:

- Mass markets for consumer durables: the impact of motor vehicles
- Structural changes in building materials: the growth of the cement industry
- Import replacement: the textile industries
- Innovations in Power: Electrical Manufacturers:
  - Domestic electrical appliances
  - Radios
  - Telephone and telegraph apparatus
  - Electric light globes
  - Meters
  - Industrial equipment
  - Copper manufacturers
- The growth of heavy industry
  - Demand for steel
·- Labour shortages
  - Immigration
  - Movement of labour from Primary Industry
  - Training
- Finance

"Over the decade, the Australian electricity Industry required capital of about £57M, of which about 80% was found by government undertakings. The demands of this industry are appreciated when it is realised that this investment was roughly three-tenths of that in general manufacturing[5]."

During the 1930's, the electricity network in New South Wales continued to be modernised and expanded to meet increasing electricity sales despite the great economic hardship and widespread unemployment experienced by many during the Great Depression. The benefits of electricity had been marketed to potential customers on its convenience and ease of use. New, larger power stations were being planned in turn requiring an increase in the electricity distribution supply networks. The electricity to customers mostly continued to be served by local municipal councils as the local Supply authority.

Rural Councils and other electricity undertakings were encouraged to develop rural electrification schemes through a State Government subsidy scheme, however, it is noted that as of 1939 *"Only 10 percent. of the farms within 300 miles of the coastal area are so far supplied with electricity, and this is natural, as the easiest propositions have been tackled first. As time passes, you will get on to the more difficult problems of servicing the less accessible farms[6]"*.

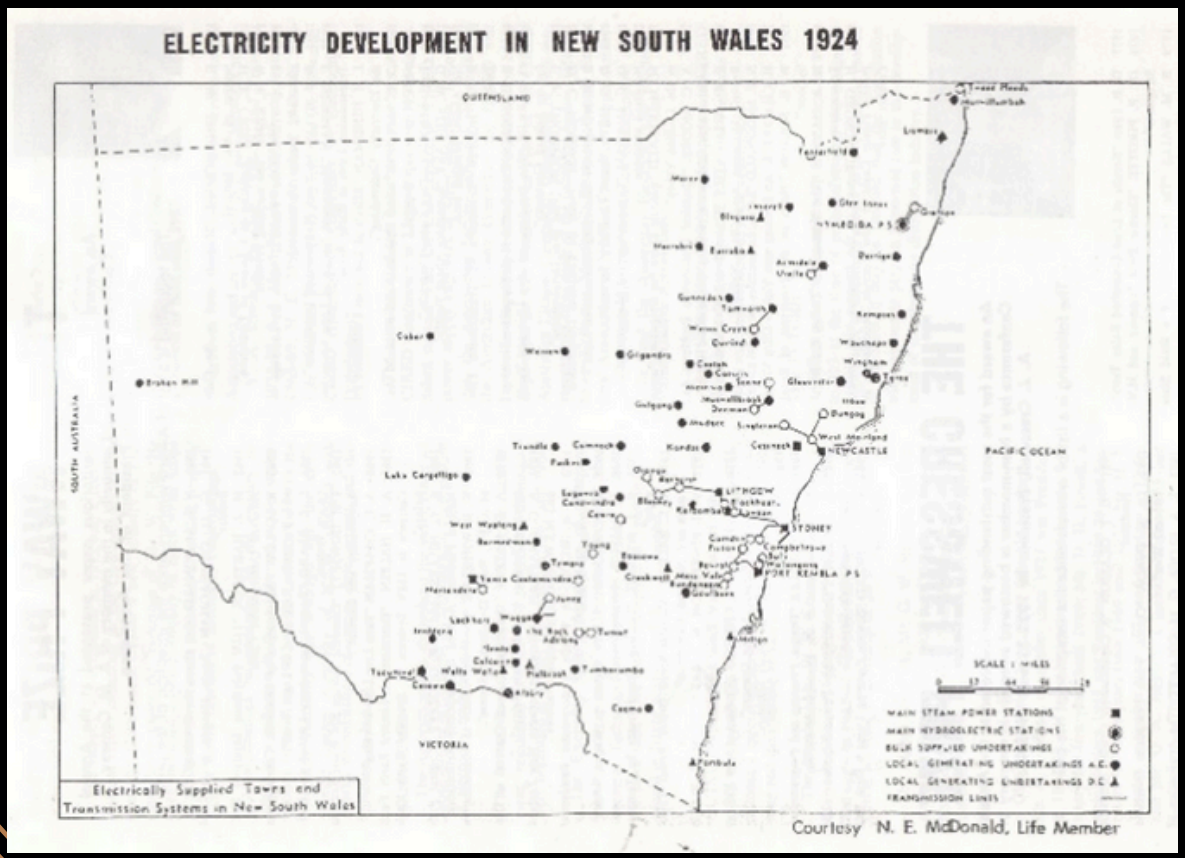
The regulatory framework for electricity in NSW was still under consideration, although an Advisory Committee had been established in 1935[7]: *"…doubtless the present year 1939 will show, and there will be some form of legislation provided to take case of the changes necessary to strengthen, not only the individual administrative authorities, but any proposed central authority, in whatever manner itmay be, to provide a complete linking up and the overall supervision of electricity. Whatever form the legislation may take will, I am sure, be of great interest to you in the work that you are doing now. [8]"*

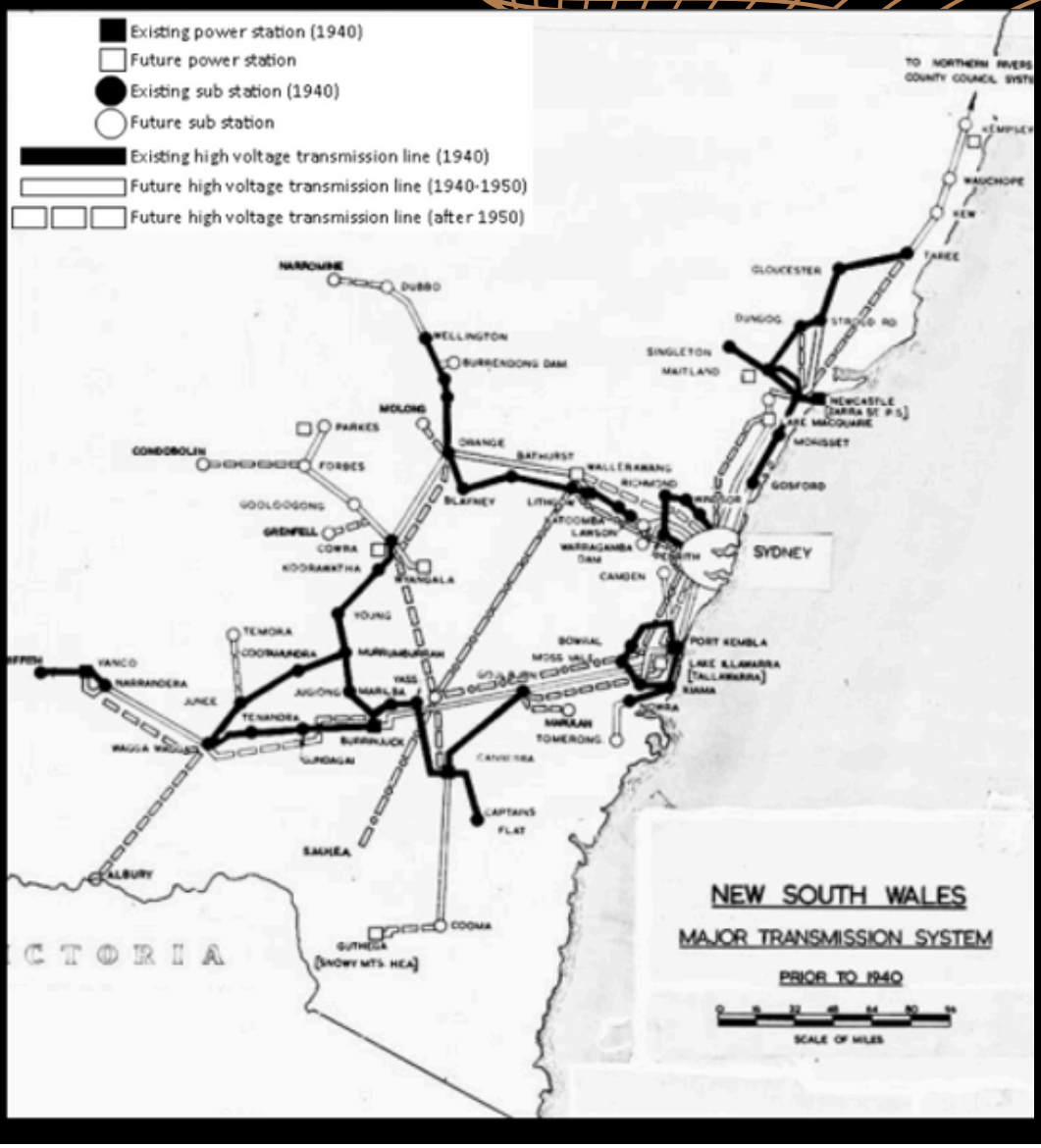
[4] Industrial Development in Australia 1920-1930, Forster, August 1959
[5] Ibid
[6] Address by E S Spooner MLA, Minister for Works and Local Government, ESA Conference Proceedings, 1939
[7] NSW Gas and Electricity Act, 1935
[8] Address by E S Spooner MLA, Minister for Works and Local Government, ESA Conference Proceedings, 1939

Throughout this period, ESEA served a critical role in developing a shared understanding of electrical technology by engineers in NSW, both in terms of distribution networks and consumer technologies. Not only were the Annual Conferences seen as the best way to share knowledge and stimulate discussion, but Standing Committees under the Advisory Committee were also formed dealing with issues such as:

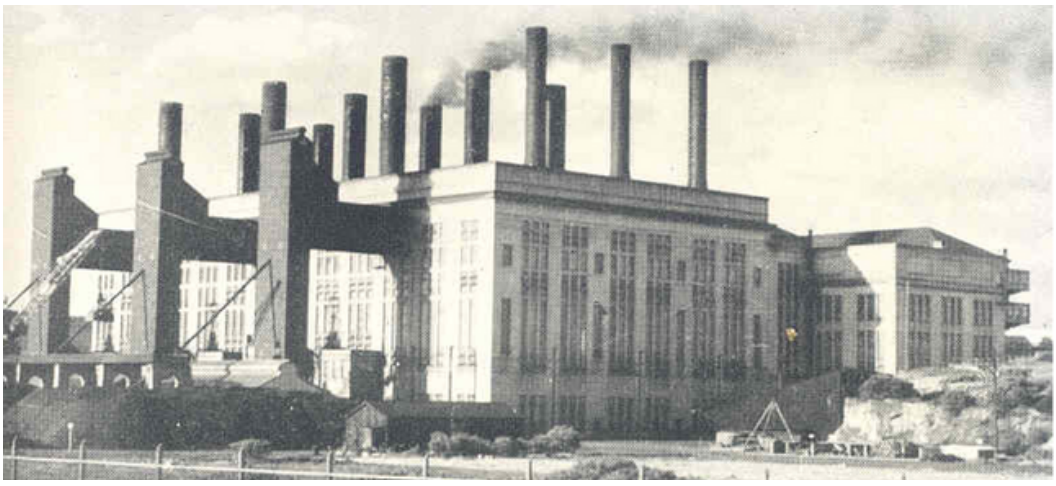
- Electrical Safety Education
- Periodic reinspection of installations
- Safety of electrical appliances
- Overhead line specification

The growth of electricity networks in NSW over the period 1924-1940 is perhaps best demonstrated by comparison of the following maps:





At the same time, state-of-the-art power stations were built. The first 50MW unit at Bunnerong was the largest 3,000rpm generator in the world.



Bunnerong Power Station 1929
(decommissioned 1975, removal of equipment largely complete by 1981)

1939 – 1945
World War 2

Labour controls affected individual liberties more than any other government operation during the war.

World events moved rapidly overseas, culminating with Australia joining Great Britain by declaring war with Germany in September 1939 over the German invasion of Poland. In September 1940, Japan signed an alliance with Germany and Italy. In December 1941, Japan attacked Pearl Harbour at the same time declaring war on the British Empire and the United States and the United States entered the war.

As a result, Australia was on its own and needed to defend itself with what was here. We moved to a wartime economy producing Lee Enfield rifles, Bren guns and Vickers machine guns in large numbers at the small arms factory at Lithgow in New South Wales. Fuel shortages became severe. Rationing was introduced for tea, clothing, butter, sugar, meat, and cigarettes.

Labour controls were introduced to meet a crisis in manpower and to administrate between the needs of the armed services and industry. Manpower regulations affected the individual liberties and touched the day-to-day activities of Australians perhaps more than any other executive operations of government throughout this period.

The first significant regulation introduced during the first two years of the war was to reserve occupations from military service. Occupations reserved were those which were essential for the production of equipment and supplies for the war effort. In 1940, the Minister for State of Defence Coordination published a List of reserved occupations (provisional) to ensure maximum manpower for the war effort. The extensive list was devised to prevent the voluntary enlistment of skilled workers from essential services, such as munitions production. The list was not mandatory, and it was open to anyone to seek release from their reserved occupations.

Specifically, for the electrical supply industry, reserved occupations included: Electrical generation and supply - civil engineers, draftsmen, electrical tradesmen, engineers, foremen, managers, meter makers and welders (all ages). Electrical Installation - draftsmen, electrical fitters and mechanics, foremen and managers (all ages). Electrical Articles Manufacture - Electrical fitters and mechanics, foremen and managers (all ages). Electrical Insulating Materials - Bakelite engineers, foremen and managers (all ages). Electro-plating - first class

electroplaters, foremen and managers (all ages). Engineering (foundry, boiler making, etc.) - apprentices and metal trade trainees (except for service as tradesmen in units of Army. Navy and Air Force)[9].

In principle, the intended effect of these reserved occupations was to allow selected industries to continue almost business as usual. However, in early 1942, during the crisis of the Japanese advance in the Pacific, more than 100,000 men were called up for full-time service. The list of reserved occupations wasn't strong enough to administer the demands of the services against the demands of industry resulting in labour shortages.

The end result was a curtailment of the Association's activities as a number of members were on Active Service with other members endeavouring to keep undertakings going with a minimum of manpower. They continued as best they could in maintaining existing assets, augmenting the supply system where possible, continuing with the work and direction of the pre-war years, and planning for a future larger network. At the same time there was the focus to provide electricity for industry as production ramped up as much as possible to meet wartime needs.

A review of the papers presented at each ESEA annual conference during the war years provides an insight into the technical issues and challenges that were faced by electrical supply engineers during the war. It is particularly notable that there was no annual conference in 1942 when the threat of a Japanese invasion of Australia was imminent.

One unique paper in 1941 was "the Production and Use of Air Raid Warning Sirens". An extended shaft motor was used with sound drums on each end which were activated via P.M.G. (Postmaster General) lines to give a "wailing" sound for an "alert" or a continuous sound for "all clear".

Topics that were most prominent at the annual conferences were:

- Illumination and Street Lighting
- System Design
- Tariffs
- Transformers
- Voltage regulation

[9] War Facts: Australian government Anzac Portal Department of Veterans Affairs website

1945 – 1960
The Post-War Years and Rapid Growth

The immediate post war years saw a rapid expansion of electricity needs for industry, commerce and residential purposes which resulted in the Electricity Supply Engineers facing the problem of rapid growth and extreme material shortages.

The Hon. John Joseph Cahill was Minister for Local Government from 1944-1952 and Premier of NSW from 1952 until his death in 1959. His strong focus was on the economic and industrial development of NSW, notably, he delivered the opening address at each ESEA conference from 1945-1952 acknowledging the key contribution that electric engineers were expected to make in the development of NSW.

Cahill was also a strong proponent of the Sydney Opera House starting in 1954 and signed the contract for the first stage of building works on 2nd February 1959 – despite much public controversy and accusations of extravagance (which persisted for the duration of the project and beyond.

By 1945, Cahill was already referred to as "The Dictator" in the press. His opening addresses at the Conferences included topics such as the need for Regulatory Authorities, rural electrification and subsidies, Council mergers, growth of the electricity "County Council" model, worker licensing and the opportunities offered by what he referred to as "the Age of Mechanisation".

The electricity industry in NSW managed to meet the demand of war years and the full impact of reduced maintenance and plant shortage was not felt by the public until 1948-49.

By then, however, demand had completely outstripped supply and early in 1949 load-shedding was reaching virtually ungovernable proportions. A state of emergency was declared under the provisions of the Gas and Electricity Act 1935.

Construction of the Snowy Hydro Scheme was commenced in 1949, which was a massive project of national significance. The project was to take 25 years from commencement to completion.

The Electricity Commission of NSW was established by statute in 1950 to address the need for a rapid expansion of generation and transmission capacity in NSW in support of industry, urban development, and rural electrification.

In the early 1950's the Commonwealth Appliance Approval Scheme was set up. A growing number of training initiatives were under way for different occupational categories and committees were set up to deal with emerging electrical safety issues in the workplace and in public space. Annual fatalities averaged between 30 and 40 per year.

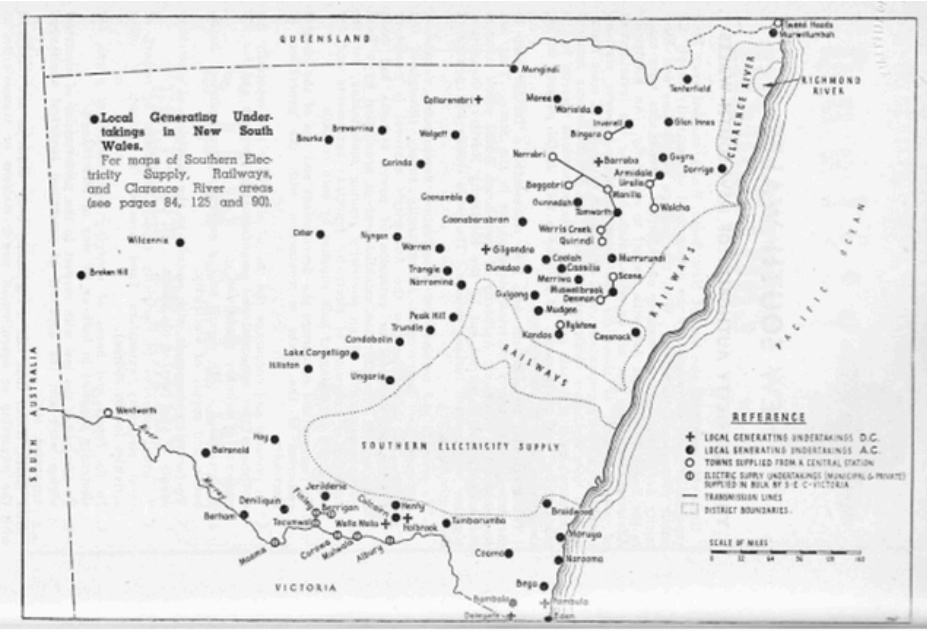
In 1955, use of Aluminium Conductor-Steel Core was promoted as a cheaper alternative to copper conductors. Snowy Hydro Guthega produced power in 1955. New Transmission lines - 132kV Cooma – Yass and 132kV underground Rozelle – Homebush were commissioned, as was the 330kV line Tumut - Sydney, which at

the time was the largest in the world.

By 1958 a 330kV transmission backbone existed from the Snowy to Armidale. The head of the Electricity Commission, Mr H G Conde, observed that nuclear power was 10 years away, and that technology development was being driven in the UK due to shortages of coal.

The decade closed with observations regarding the largest power station yet – Vales Point rated at 1000MW. Topics of interest included the continued and increased use of Single-Wire Earth Return (SWER) rural lines, better line survey methods, and cheaper construction costs. Committees under the Electricity Authority of NSW were:

- Electrical Contractors and Electrical Licensing Committee
- Overhead Line Construction Committee
- Overhead Line Working Regulation Committee.
- Training of Linesmen committee
- Earthing Committee.



Local Government electricity supply authorities and general location of major networks external to Sydney

White Bay Power Station 1958

1960 – 1979
Social Change, the Energy Crisis and Industry Reform

In the early 1960's there was much discussion of the consolidation of electricity supply authorities to a proposed 30 plus two others. This was seen as an existential threat to the ESEA and the Conference by virtue of reduced numbers of Chief Engineers and their deputies – historically forming the basis for conference attendees.

The decade also commenced with conference topics including:

- the economics of rural supply, and financing,
- some early discussion of asset aging
- undergrounding of new construction in shared trenching
- Insulation coordination and testing equipment
- Aluminium conductors and ACSR
- Voltage regulation
- Electricity Authority of NSW now coordinating (through technical committees) standardisation and sound practice for rapid expansion of distribution
- ECNSW accelerating transmission and generation projects, building rural backbone.

We also see the emergence of issues such as:

- Dust precipitation and smog reduction from generators
- SF6 gas blast circuit breakers (first adopted in Australia c. 1979)
- Polythene-insulated HVUG cable trials

The mid-'60's saw the development of the State System Control Centre at Carlingford and Sydney South Bulk Supply Point at Picnic Point, sparking debates about mechanisation, automation, and job losses. Accordingly, Supervisory Control and Data Acquisition (SCADA) systems became topical.

Vales Point Power Station was approaching completion, Munmorah Power Station was under construction, and a decision was made to proceed with Liddell Power Station.

Around the same time, there were widespread natural gas discoveries in rural NSW and elsewhere, which broadened the long-term availability of fossil fuel resources for energy generation and consumption. The Electricity Commission of NSW were investigating the potential use of gas turbines and nuclear.

By 1966, in NSW there were over 700 miles of 330 kV circuits, over 2,500 miles of 132 kV circuits, and over 2,400 miles of 66 kV circuits. There are five 330 kV substations, forty-six 132 kV sub-stations, and fifty-three 66 kV sub-stations. In the following five years it was planned to add four new 330 kV substations, fifteen 132 kV sub-stations, a number of 66 kV sub-stations and to increase the capacity of a large number of existing installations.

Well over 90% of the State's farms were now supplied with electricity (increasing to 98% in 1972), and we saw the first discussions of HDO fuses and fire ignition, and the Initiation of various PPE standards.

In 1968, it was noted that average power consumption per capita had increased by

96% over 10 years, total power consumption increased by 126% and price decreased by 13.4%. Throughout the 1960's and into the 1970's the annual NSW "electrical fatality rate" hovered between 30 and 40 people per annum, with the highest proportion being lineworkers and members of the general public.

In the late 1960's the potential use of "Small Digital Computers" for engineering applications was first discussed. Prior to that, computers were primarily used for the processing of customer accounts.

In 1970 tenders were received by the Commonwealth Government for construction of a proposed nuclear power station at Jervis Bay, and in 1972 the Snowy River Scheme was completed, with several further generators commissioned over the next few years.

The early and mid-1970's saw the emergence of environmental issues, a manual for environmental impact assessments and a new environmental approval framework for projects. The primary environmental impact of electricity distribution was considered to be visual impact and in 1975 underground construction was mandated for new residential areas. Emissions from coal-fired power stations were also under discussion in the context of air quality, nitrous and sulphuric emissions, and particulates. Finite fossil fuels were discussed, and the promise of nuclear and solar at "some distant future stage".

In 1974, ESEA held its "Golden Jubilee conference" – 50 years since the establishment of ESEA. The Premier of NSW (Sir Robert Askin) was invited but was called away at the last minute to an unexpected Premier's conference (a meeting convened by Treasurer Frank Crean to discuss urgent economic problems). At the conference, acknowledgement was made by the Premier's representative of the sole "Lady Member" of ESEA – Robin Faber.

The potential adoption of domestic air conditioning was raised, as well as electric vehicles and the ongoing support for nuclear energy.

On Christmas Day 1974, Cyclone Tracy devastated the City of Darwin. Following this event, there was significant discussion of the need to coordinate emergency response at a national level.

In 1975, CIRED conferred upon ESEA the distinction of being the only Associate Member of that body outside Europe. The first SF6-insulated switchgear was being installed at Beaconsfield Substation and for the first time in history some load decreases were noted in parts of the network.

The late 1970's was a tumultuous period in Australia and internationally, with high local unemployment and inflation, and a global "fuel crisis" caused by issues in the Middle East. Naturally, this stimulated discussion of Australian fuel security and reliance on imports. Oil shortages resulted in further exploration of the viability of electric transport, including cars.

Notable Australian research progress had been made on solar energy (UNSW – photovoltaics, Sydney Uni – solar thermal), however in 1979 a proposal for solar grid support for remote communities was dismissed as a novelty. At the same time, the opportunity for Australia to become a major exporter of coal was identified, substituting for oil which at the time represented about 50% of global energy consumption. 10M tonnes of coal were exported from the Port of Newcastle (cf 157M tonnes in 2021).

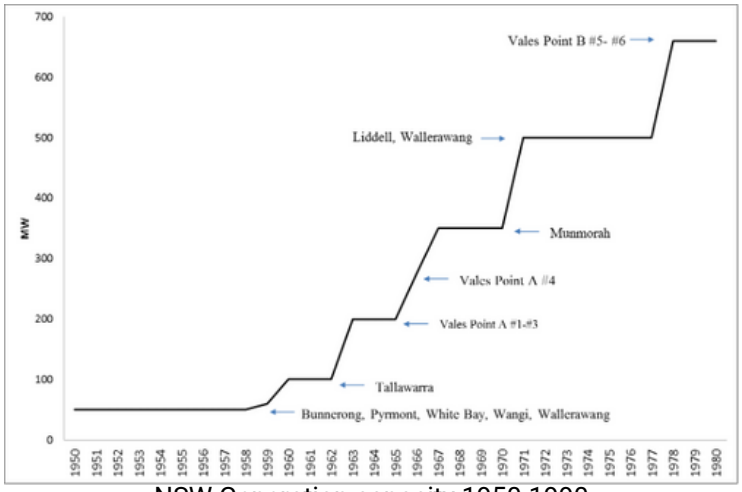
In 1977, a proposal was made to combine Sydney, St George, Mackellar, and Brisbane Water County Councils, as part of the creation of four enlarged coastal County Councils (financial viability and tariff rationalisation given as reasons). All were to remain within Local Government control. This was again identified as an

existential threat to ESEA, however membership and conference attendance actually increased over the period that amalgamations occurred. The growth in“interstate membership was also noted, with the suggestion that ESEA had the potential to become a national body at some time in the future. In 1978, AGL projected consumption of gas 85% industrial, 5% commercial and 10% residential. The first calls began for a National Energy Policy in an environment where energy conservation had now become a priority.

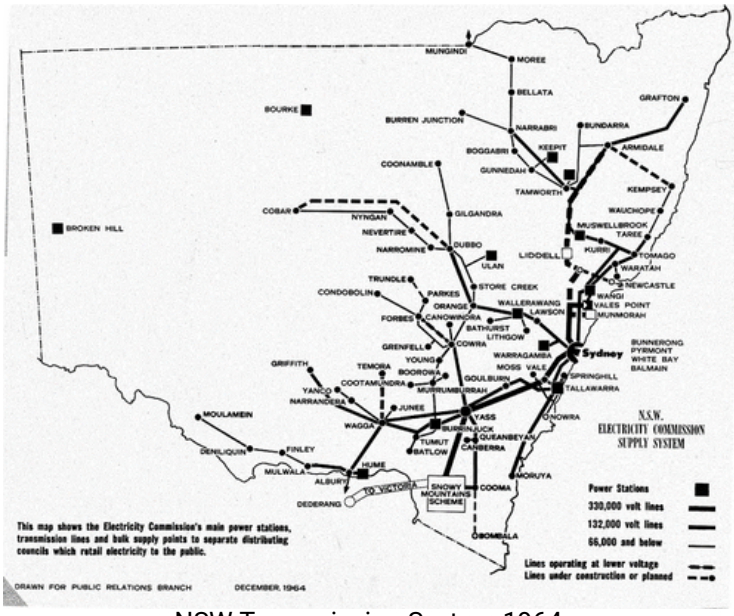
CONFERENCE PAPERS OF NOTE

1966	Paper 1	Live Line Working on HV
1967	Paper 1	Detection of Limited Earth Fault Currents in 11kV Systems of Distribution by Sensitive Earth Fault Relays
1968	Paper 2	Observations of Overseas Electricity Distribution Practices
1968	Paper 3	Observations of Overseas Practices Metering and Protection
1969	Paper 1	Engineering Applications of a Small Digital Computer
1973	Paper 1	The Purchase, Installation and Commissioning of 33,000 Volt Oil Filled Underground Cables
1973	Paper 2	Electrical Shock Hazards in Swimming Pools
1974	Paper 1	Ferroresonance
1974	Paper 4	Solar Electricity for Remote Rural Customers
1975	Paper 4	Planning for National Disasters – The Darwin Experience
1975	Paper 6	Computers in Supervisory Control Applications
1976	Paper 7	Variable Speed Drives, Power Thyristors and Network Harmonics
1976	Paper 9	Partial Discharge Phenomena and Testing
1977	Paper 1	Beaconsfield West 330/132kV Substation
1977	Paper 11	What you always wanted to know about Computers but were always too afraid to ask
1978	Paper 2	Equipment for Underground Distribution Systems

Growth in the NSW Power Station portfolio and accompanying transmission system proceeded apace, as indicated by the following images.



NSW Generation capacity 1950-1990



NSW Transmission System 1964


Early Micro-computer display in Yanco Powerhouse Museum
(Photo courtesy of Chris Dahlitz)

1980 – 1999
More Industry Reform

The 1990s brought significant changes to the Australian energy sector, including the introduction of the National Energy Market and the emergence of grid-connected solar arrays.

ESEA held multi-day Annual Conferences from the year 1980 up to 1999. In addition to these events, there were Regional Conferences held across NSW as well as organised seminars, site visits, and 1-day events for ESEA members. These are not detailed in this document.

Fank Evans was the Secretary and Conference Chairman for the Conferences between 1991-98 inclusive which were initially three (3) days and then reduced to two (2) days as 'austerity' measures across the industry required. Prior to 1991, the Annual Conference was often 4-5 days duration including social events such as Golf and a Harbour Cruise and technical site visits.

The Conference Technical papers were presented in a 'linear' manner, typically sixteen (16), but could be between 12 and 25. The concept of 'parallel streams' did not commence until the new millennia. Similarly, the idea of a unique 'Conference Theme' for the Annual Conference did not commence until the 2000 Conference, although Anniversaries were recognised as detailed below.

The 1980's began with the amalgamation of 34 County Councils and 5 City/Shire Electricity undertakings across NSW down to a total of 26:

- Brisbane Waters, Mackellar and St George were joined with Sydney.
- Hartley, Nepean, and Blue Mountains were joined with Prospect.
- Upper Hunter and Hunter were joined with Shortland.

In late 1981 three of the four 500MW GEC generating units at Liddell Power Station developed problems and were 'off-line' for an extended period. This required some level of power rationing and a wider call for electricity conservation by the NSW Government of the day. By early 1983 repairs had been completed and an independent enquiry made its report.

In early December 1986, an 'advertising stoush' occurred between AGL (promoting gas over electricity) and Sydney/Prospect County Councils promoting electricity over 'unsafe' gas. AGL initiated action in the Federal Court and the Advertising Standards Council. A 'truce' was brokered by the 23rd of December 1986 – that has essentially continued to the present day.

The early 1980's saw the emergence of the personal computer – the Apple 2e, Microbee and TRS 80 were a few.

Electrical Engineers were taught programming, and so were natural 'early adopters' both at home and at work. These personal computers were ideal for streetlighting design, sag tension calculations and load flow analysis to name a few of the applications. (see conference papers of note on pages 23 & 24).

The 1980's was also the decade where XPLE and polymeric cables (and their associated jointing techniques) replaced paper lead underground cables, and insulated overhead cables were also introduced for low voltage and some specialist high voltage applications.

The decade closed with a "shake-up" – the Newcastle earthquake that occurred on the 28th of December 1989.

The 1990's opened with the Federal Government introduced the concept of a National Energy Market - the NEM. This was to comprise five physically connected regions on the east coast of Australia – Queensland, New South Wales (including the ACT), Victoria, Tasmania, and South Australia. A national energy market required the establishment of separate Generation and Retail businesses that competed in the wholesale and retail energy markets to provide customers with electric energy via the regulated monopoly Transmission and Distribution businesses. Separate metering businesses were also set up later in the decade.

A timetable was set – and inevitably delayed – with the 'market' commencing in Victoria in December of 1994 where the industry had been privatised – including the distribution and transmission networks. NSW was to follow Victoria, then the remaining States, with Tasmania requiring the Basslink connection which was built between 2003 and 2005.

The timetable for NSW was as follows:

Very large customers (above 5MW or 40GWh's)	Oct. 1996	(47 sites)
Large customers (above 1MW or 4 GWh's)	Apr. 1997	(660 sites)
Medium business (above 750 MWh's)	July 1998	(3500 sites)
Small business (above 160 MWh's)	July 1999	(10,800 sites)
All remaining customers	Jan. 2002	

In 1991 the Gibbs Inquiry introduced the concept of 'prudent avoidance' when designing overhead power lines to minimise the EMF levels.

In October 1994, the "Paying for Electricity – Interim Report" from the NSW Government Pricing Tribunal foreshadowed the break-up of Pacific Power into three generator groups and amalgamations within the distributors (initially eight – but ultimately six). All of these new organisations would become State Owned Corporations (SOC's) in order to compete in the new NEM. The transfer of the County Councils from Local Government "stewardship" (as it was described by the Treasurer of the day) to the State Government was controversial including some legal challenges.

By mid-1995, the groupings were close to finalised, with Orion (Newcastle/Hunter area) to combine with Sydney and Prospect to join with Illawarra (Wollongong). Some rural customers of these four were to transfer to the three newly formed Northpower, Advance Energy and Great Southern Energy although not all of these ultimately happened (e.g. Lithgow/Kandos/Rylstone area stayed with Prospect.)

On 23 June 1995 the Board of Southern Mitchell was sacked by the Minister for making termination payments totalling M$1.4 to two senior officers who were referred to the ICAC.

In the mid 1990's, the first grid-connected solar array in the Southern Hemisphere was commissioned by UNSW and Sydney Electricity at the SOLARCH research facility in Little Bay, Sydney.

By 29 Aug 1995, new interim Boards and interim CEOs were in place, and in early-mid 1996 permanent CEO roles were being appointed. In 1995 (commencing full operation in 1997), the NSW Government introduced "contestability" for limited work associated with new connections to the network. This was underpinned by a model where a customer proposing to connect paid the full cost of that connection, by contracting with an Accredited Service Provider licensed by the State Government and working to standards specified by the network operators. This was intended to decrease the capital cost borne by network operators for new connections while simultaneously opening these services up to competition.

In February 1998 another Distribution Boundary Review for NSW took place with Terms of Reference to examine 2, 3, 4 & 5 Distributor models for NSW with a view to addressing Retail Trading risks. On 8th July 1995, the NSW Minister for Energy announced 'no change' to the boundaries.

A 'snapshot' of the NSW Industry in mid-1998 is contained in Table 1 below:

Table 1. NSW Consolidated Distribution Organisational Statistics June 1998

Electricity Distributor	Sales $m	Sales GWh	Assets $m	Emp.	Cust. (000s)	Circuit Kms	Area Sq Kms
Advance Energy	192	2,145	341	520	116	46,201	167,272
Australian Inland Energy	32	386	53	103	20	9,415	155,100
Energy Australia	1,889	21,477	3,609	3,379	1,347	47,767	22,275
Great Southern Energy	300	3,380	579	776	220	53,191	176,240
Integral Energy	990	12,570	1,954	2,157	724	29,300	24,602
NorthPower	373	3,552	665	1,160	335	68,200	230,000
Distribution Boundary Review Committee, Final Report, June 1998, Appendix 4, p 98							

As the decade drew towards an end, Privatisation of the NSW Industry became a major election issue for the March 1999 State Election. (Lease transactions of some parts of the NSW industry were finally completed in 2015-17.) The Labor Government that had successfully 'corporatised' the industry in 1995 was concerned about the trading losses being incurred by the retail operations of some distributors and some of the NSW generators that were effectively being underwritten by the State Government. For example, Prospect Electricity entered into some long-term Power Purchase Agreements (PPA's) in 1994-95 for between $45 and $58 per MWh (wholesale) and by 1998-99 were accumulating losses of approximately M$120 in that year.

The Government view was that these market volatility 'risks' were better handled by the private sector.

As previously noted, in the late 1990's it was agreed to consolidate the NCEE and ESEA to form the Electric Energy Society of Australia - EESA. EESA became a national Technical Society under the EngineersAustralia Electrical College Board. Existing state-based NCEE committees were brought into the Society, and efforts commenced to establish new State committees where they did not already exist.

CONFERENCE PAPERS OF NOTE

1981	Paper 6	Electric Vehicles
	Paper 7	Solar Energy Review
1982	Paper 3	Information Systems at CWCC using an IBM34
	Paper 5	Fibre Optics (spelt Fiber by the Japanese presenter)
	Paper 12	Wind Generation
1983	Paper 4	System Planning using a Desk Top computer
	Paper 10	System load collecting, display and management using a $300 computer.
1985	Paper 2	Experience with Insulated Overhead mains in estate reticulation.
1987	Paper 6	Insulated HV lines
	Paper 15	EMF and Public Health

CONFERENCE PAPERS OF NOTE (CONT.)

1988	Paper 7	Power Cables for the 90's.
1990	Paper 12	Newcastle Earthquake
1991	Paper 1	Industry Commission Recommendations for Micro-economic Reform.
	Paper 8	Benefits of DSM for NSW and Paper 9 – DSM in New Zealand
	Paper 10	Gibbs Inquiry (introducing the concept of prudent avoidance).
1992	Paper 3	Lightning tracking.
	Paper 15	HV Insulated OH Distribution.
1993	Paper 2	New Zealand Corporatisation.
1994	Papers 2, 3 & 4	The 230/240 Volt issue.
	Paper 19	Giving Developers the responsibility for designing and constructing URD (This paper by Rod O'Donahue of Prospect foresaw the introduction of contestability for all new customer connection assets under a State Wide accreditation scheme.)
1995	Paper 2	Whither NSW Electricity Distributors (Michael Sinclair – EA of NSW)
	Paper 23	The Nimbin Solar Experiment
1996	Paper 5	The Role of the Electricity Ombudsman (Terry Miller – EA of NSW)
	Paper 9	Green Pricing
1997	Paper 1	Greenhouse Challenge
	Paper 14	Kooragang Island Wind Turbine Project (600kW)
1998	Paper 8	Crookwell Wind Farm (8x600 kW - First multi turbine wind farm)
1999	Paper 7	Non-destructive Evaluation of Poles (Dan Price & Keith Crews)

2000 – 2023
A National Grid and Market – and a National Technical Society

The newly formed National EESA was accompanied by a National Conference, the first three of which were held in Old Parliament House, Canberra.

The following are details of the EESA nationally organised 2-day Conferences from the year 2000. In addition to these events, EESA state chapters organised seminars, site visits, and 1-day events for EESA members. These are not detailed in this document.

The conference "themes" and some of the emerging issues discussed at EESA's national conferences illustrate the issues emerging at the time. As previously mentioned, the Federal Government introduced the National Electricity Market (the NEM) in the late 1990's. This was composed of five physically connected regions on the east coast of Australia – Queensland, New South Wales (including the ACT), Victoria, Tasmania, and South Australia. The concept of a national energy market resulted in the establishment of Generation and Retail businesses that competed in the wholesale and retail energy markets to provide customers with electric energy via the regulated Transmission and Distribution businesses. Metering businesses were also set up.

In 2005 the Australian Energy Market Commission (AEMC) was established, and it assumed responsibility for rule making and market development for the operation of the electricity wholesale market and transmission regulation.

In 2008, AEMC's role was expanded to cover economic regulation of electricity distribution network services.

In 2010, Energy ministers endorsed a new National Energy Customer Framework (NECF) which was a suite of legal instruments that regulate the sale and supply of electricity and gas to retail customers.

In 2012, AEMC assumed responsibility for the National Energy Retail Rules. These governed the sale and supply of energy (electricity and natural gas) from retailers and distributors to customers in New South Wales, Queensland, South Australia, Tasmania, and the Australian Capital Territory.

As a result of the creation of the NEM there was significant restructuring and change across the "electric energy" industry during the 2000 decade. This continued into the 2010 decade with additional issues such as emissions reductions and the roll out of solar panels etc adding to the changes. The EESA annual conferences reflected those changes in the content that was presented and discussed.

The following section sets out the conference themes and the emerging topics over the years in some detail, befitting the relatively recent nature of the issues covered. Of particular note is that EECON continued to be held during travel restrictions imposed during the COVID-19 pandemic by transforming to a partial or full on-line format.

CONFERENCES

ELECTRICITY 2000 **Canberra**	**PERSPECTIVES OF THE CURRENT AND PROJECTED POSITION OF THE ENERGY INDUSTRY** *The electricity market, regulated network businesses, asset management, "2% renewable energy target", fuel cells, 230-volt standard*
ELECTRICITY 2001 **Canberra**	**IMPROVING QUALITY IN A COMPETITIVE ENVIRONMENT** *Full Retail Competition and Metering, Impact of solar energy sources, extreme weather events, Power quality problems*
ELECTRICITY 2002 **Canberra**	**WINNERS AND LOSERS FROM REFORMS AND INNOVATIONS** *Energy and climate change, prospects for large-scale solar energy, Bushfire performance of networks, quality of supply*
ELECTRICITY 2003 **Sydney**	**IS SUPPLY A GIVEN…?** *Demand Management, Distributed generation – challenges and opportunities, Wave power, control of power quality, Impact of wind farms on rural distribution grids*
ELECTRICITY 2004 **Sydney**	**ELECTRICITY 2004...THE NEXT 80 YEARS** *The Control of Voltage Rise from Embedded Generation Sources, Integration of PVs into the Network, System Restart Plan, Electrical Power Engineering Requirements*
ELECTRICITY 2005 **Sydney**	**DEMANDING RELIABILITY** *Implementing embedded generation in a distribution network, Maximising value from distributed generation, Effect of wind farms on system performance*
ELECTRICITY 2006 **Melbourne**	**AT THE FLICK OF A SWITCH** *Advanced Power Automation Technology, Transmission Line Dynamic Rating, Voltage Compensation in Weak Distribution Networks, Latest Control and Protection Innovations*
ELECTRICITY 2007 **Melbourne**	**BRINGING POWER TO THE PEOPLE** *Climate change & impacts on electricity supply, nuclear power as an option, The Intelligent Grid, Sustainable Public Lighting, Strategies to attract young women to study Engineering*
ELECTRICITY 2008 **Brisbane**	**STEPPING UP TO THE CHALLENGE** *Power Quality Strategies, the role of industry in power engineering education, Impact of Grid Connect PV on Network Voltage and Load Profiles, Network Technology Roadmap, The role of industry in power engineering education*
ELECTRICITY 2009 **Gold Coast**	**SMART GRIDS, SMART ENERGY AND SMART PEOPLE** *Modular Buildings, Distribution System Automation, Australian Power Institute - Future Proofing Australia's Power Engineering Capability, Achieving the Maximum Benefit of Distributed Generation*

ENERGY 2010 **Sydney**	**WATT'S UP…DESIGNING FUTURE-PROOF ENERGY NETWORKS** *Smart metering and Time of Use pricing, The impact of climate change on future distribution planning and infrastructure, Energy storage solutions out to 2030*
EECON National 2011 **Hobart**	**FUTURE ENERGY…EMPOWERING SUSTAINABLE SOLUTIONS** *Wind Power, Intelligent Networks, Modelling, Control and Operation Challenges Facing Owners and Operators of Power Systems of the Future, renewables, and bio energy as future generation sources in the current generation mix*
EECON NSW 2011 **Sydney**	**NEW TECHNOLOGIES IN ENERGY NETWORKS – TOPPING UP OR TRIPPING OVER** *Power Quality, Smart Grids, Cyber security, Emerging power quality issues, the need for energy storage*
2012	Plans for EECON 2012 (to be held on 29-31 August 2012 at the Brisbane Convention Centre) were cancelled because of major industry restructuring in Queensland.
EECON 2013 **Sydney**	**NEW ENERGY NETWORKS - FAST, FOCUSED AND FLEXIBLE** *Bushfires and bushfire mitigation, Cyclones and floods, Impact of Solar Storms, integrating large scale renewables into today's grid, everything depends upon energy storage, Power quality management issues*
EECON 2014 **Sydney**	**ENERGY NETWORKS - EVOLUTIONARY TRANSFORMATION OR DEATH SPIRAL?** *Smart Grid, Smart Cities, Use of LiDAR and UAV for line design and vegetation management, Batteries and PVs*
2015	No conference.
EECON 2016 **Perth**	**EVOLUTION IN THE ELECTRICITY INDUSTRY – UNDERSTANDING THE OPPORTUNITIES AND THREATS** *Energy storage and micro-grids to manage edge-of-grid related issues*
EECON 2017 **Melbourne**	**COLLABORATION AND INNOVATION: ADAPTING TODAY'S GRID FOR TOMORROW'S FUTURE** *Overcoming variability of renewables, Trials of a Large Battery Energy Storage System in a Micro Grid, Evolution of the rural network to Standalone Power Systems, Online Condition Monitoring*
EECON 2018 **Brisbane**	**CONNECTED FUTURES: THE POWER OF WORKING TOGETHER** *Renewable energy Zones, Challenges of integrating large scale solar projects into the NEM, Voltage Regulation Distribution Transformers, Grid Scale Energy Storage, Big Data Analytics*

CONFERENCES (CONT.)

EECON 2019 **Sydney**	**ENGINEERING LEADERSHIP PROVIDING SUSTAINABLE, CUSTOMER-CENTRIC ELECTRIC ENERGY SOLUTIONS THROUGH THE INTERACTIVE GRID** *High Penetration Distributed Energy Resources, control of distributed resources, managing loads on a multi-directional grid, Bushfire Mitigation Technology, using voltage regulating distribution transformers*
EECON 2020 **Online**	*Digital Twins and Real-Time Synthetic Networks, deep storage, Community Batteries and retail contestability, bushfire resilience, Stand Alone Power Systems. (This conference was online only due to covid restrictions).*
EECON 2021 **Perth & Online**	**THE NEW ENERGY LANDSCAPE—CHALLENGES AND OPPORTUNITIES** *Shallow and Deep Storage, 2-way flows and voltage management, electrolyzers, hydrogen, ammonia, load management and sophisticated control systems, managing DER in the network.*
EECON 2022 **Brisbane**	**OUR ENERGY FUTURE AND UNLOCKING NET ZERO** *Distributed energy resources: power quality impacts and implications, PV and EV visibility and prediction through HV/LV transformer level monitoring, Delivering a true network "digital twin" for vegetation management and hazard mitigation, Harmonic management in networks with high penetration of renewable energy generators*
EECON 2023 **Melbourne**	**LEADING THE ENERGY TRANSITION THE AUSTRALIAN WAY: POWERING UP WITH RESILIENCE** *The role of grid-forming inverters in distribution systems, operating a 100% Renewables Grid, Renewable Energy Zones, the role of networks in the transition to net zero emission, Future-proofing Networks against changing demands*

It is interesting to look back at the rapidly evolving issues that were being covered by EESA's annual conferences from 2000.

With the introduction of the NEM in the late 1990's (see page 21) there was much discussion on market issues as well as the issues impacting the regulated transmission and network businesses.

There are changes to the key topics over the years as renewable energy and storage grows and businesses faced the challenges of these initiatives.

The increasing deployment of digital technology to support network businesses also becomes markedly evident in recent years.

Rainbow Industry – Capital Windfarm, June 2010. (Photo courtesy of Chris Dahlitz).

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CONFERENCES 2000 TO 2009

- The electricity market - Full Retail Competition and Metering, regulated network businesses, asset management,
- Climate change and extreme weather events, Bushfire performance of networks,
- Distributed generation, Wave power, Impact of wind farms on rural distribution grids Integration of PVs into the Network, nuclear power as an option, embedded generation, fuel cells, Maximising value from distributed generation
- 230-volt standard, Impact of solar energy sources on Power quality, Impact of Grid Connected PV on Network Voltage and Load Profiles, The Control of Voltage Rise from Embedded Generation Sources, Voltage Compensation in Weak Distribution Networks,
- Network Technology Roadmap, The Intelligent Grid, Advanced Power Automation Technology, Transmission Line Dynamic Rating, Latest Control and Protection Innovations, Distribution System Automation, Demand Management, System Restart Plan
- Electrical Power Engineering Requirements, the role of industry in power engineering education, Strategies to attract young women to study Engineering, API - Future Proofing Australia's Power Engineering Capability

CONFERENCES 2010 TO 2019

- Smart metering and Time of Use pricing,
- Intelligent Networks, Modelling, Control, and Operation Challenges facing owners and operators of Power Systems of the Future, Managing loads on a multi-directional grid, Smart Grids, Smart Cities, Use of LiDAR and UAV for line design and vegetation management, Big Data Analytics, Cyber security
- The impact of climate change on future distribution planning and infrastructure, Bushfires and bushfire mitigation, Cyclones and floods, Impact of Solar Storms, Bushfire Mitigation Technology
- Renewable Energy Zones, Challenges of integrating large scale solar projects into the NEM, Grid Scale Energy Storage, control of Distributed Energy Resources, Energy storage solutions, Wind Power, renewables, and bio energy as future generation sources in the current generation mix, Batteries and PVs, Overcoming variability of renewables
- Evolution of the rural network to various Standalone Power Systems using energy storage and micro-grids to manage edge-of-grid related issues
- Power quality management issues, Online Condition Monitoring, using voltage regulating distribution transformers
- Staff retention challenges

CONFERENCES 2020 TO 2023

- Digital Twinsand Real-Time Synthetic Networks, bushfire resilience, load management and sophisticated control systems, PV and EV visibility and prediction through HV/LV transformer level monitoring, Delivering a true network “digital twin” for vegetation management and hazard mitigation, Harmonic management in networks with high penetration of renewable energy generators,
- Shallow and Deep Storage, 2-way flows and voltage management, electrolyzers, hydrogen, ammonia, managing DER in the network, deep storage, Community Batteries, and retail contestability in Stand Alone Power Systems
- Distributed energy resources - power quality impacts and implications, the role of grid-forming inverters in distribution systems, operating a 100% Renewables Grid, Renewable Energy Zones, the role of networks in the transition to net zero emission, Future-proofing Networks against changing demands

Looking to the Future

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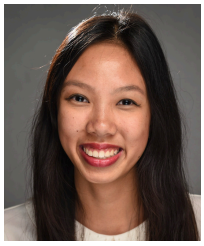

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In a world where almost all significant investment is shaped by economic forecasting and anticipated market behaviour, it is worth reflecting on an observation by the eminent economist JK Galbraith: “The only function of economic forecasting is to make astrology look respectable”.

The modern electrical engineer, supported by a range of other professions (including economics), has the challenging task of predicting demand for electricity – both in location and timing. Increasing use has been made of various powerful tools that are now merging into the general classification of “Artificial Intelligence” to assist in this task, and availability of data is growing at a rapid rate.

But does this mean that future demand forecasts will be more accurate than those of the past? The answer to that question is probably “No” – because the uncertainty of the input parameters to the planning process, market and consumer behaviour, and the range of technology choices which can potentially satisfy demand, is increasing faster than the ability of demand planning tools to cope with them. Added to that, the ability of customers to generate all or part of their energy consumption, to store energy, and to export surplus energy to the grid (regardless of whether there is demand for that energy) increases the complexity of demand forecasting.

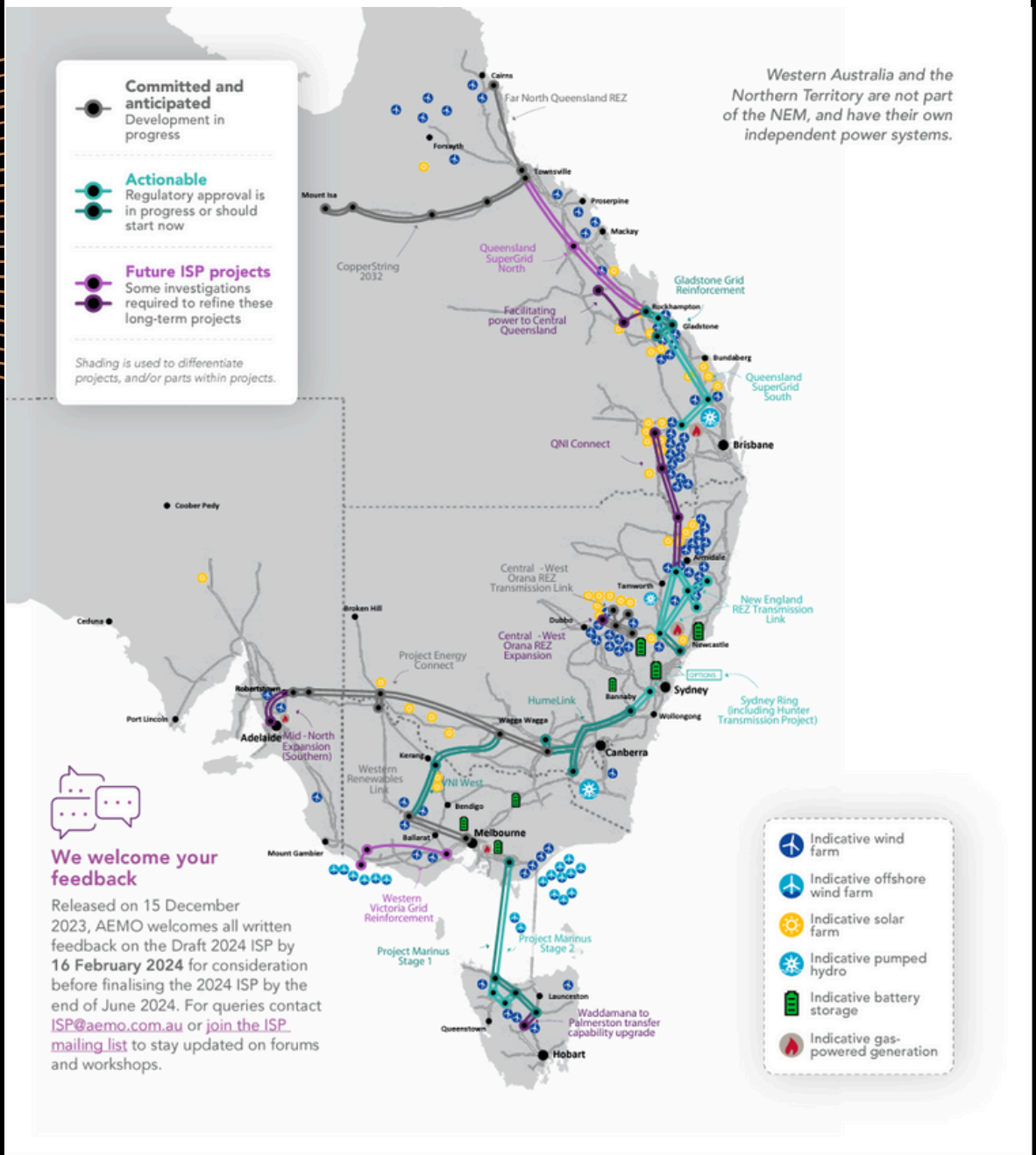
As of 2024, the “Energy Transition” to sustainable, de-carbonised energy is still in a relatively formative stage – although it seems like much progress has been made, the rate of change must accelerate if we are to achieve “Net Zero” by 2050. Electricity generation is expected to carry the bulk of early de-carbonisation efforts with a target of significant growth of the National Grid and a Renewables share of the National Electricity Market of 82% by 2030 – however this is somewhat more than double the share in 2024 because consumption of electricity in other sectors (eg, transport, agriculture) is expected to increase through electrification initiatives.

The challenge of today is to find locations for new or refreshed transmission lines and substations, and to arrive at some certainty about the location and technology choice for low or zero carbon electricity generation. Reflecting on the contents of this booklet, it is fair to say that these are not new challenges for the electricity sector, provided that community concerns are adequately and fairly addressed over the entire life of any new assets regardless of which technology is ultimately deployed.

The Australian Energy Market Operator (AEMO) has the task of planning the National Grid with due consideration of the above factors and many, many more. An Integrated System Plan is now prepared on a biennial basis with a consultative process that receives input from numerous experts and other groups.

The map overleaf, from AEMO’s draft 2024 Integrated System Plan, provides some perspective on expectations for new transmission facilities over the coming years based on current energy policy settings. Provided that AEMO is able to carry out this planning process independently without political interference – with politicians focusing on creating a regulatory environment that supports the national interest – a 2-year refresh of a long term plan should be sufficiently adaptable to absorb the many new options and unknowns that are certain to emerge over time.

Draft 2024 Integrated System Plan – AEMO



Afterword

EESA Conferences over the past 99 years have demonstrably enriched the engineering expertise and capabilities within the sector, as have the many other activities currently carried out by EESA, including webinars, seminars, training programs and participation in EngineersAustralia initiatives.

The subject matter of the conferences contains not only a detailed account of technological progress over that period, but also the changing expectations of electricity consumers. In the 1920's the focus was largely on illumination and industrial applications of electric power. In the modern day, customers expect reliable, inexpensive and safe electric power for everyday domestic, industrial, commercial and agricultural applications. The constant availability of electricity is critical for telecommunications, water and sewerage, transport, healthcare and emergency response, among many other things that are often taken for granted.

As one reflection of how Australian society has changed over the last century, it is useful to compare the above photograph of the National Council to the photograph of the founding members of ESEA/ESAA. The difference is striking.

In 2024, where the drive towards de-carbonisation, electrification and "Net Zero" is gaining momentum, many are questioning whether the goals and aspirations expressed in national energy policy are achievable in a practical sense.

But with the benefit of hindsight, truly remarkable achievements have already been made and there is no reason, short of a lack of ambition or political will, why today's seemingly daunting obstacles cannot be overcome by an innovative, community-focused, and forward-looking engineering community.

For example, a future expansion of the transmission network of some 10,000km, with all the vital community and environmental issues duly considered, sounds (at first pass) an almost impossible target. But in context, this represents a 25% expansion of the existing transmission network over 10 or so years – something that has been done before more than once.

Means of attainment for Net Zero can (and should) be debated, and constantly reviewed to embrace the opportunities offered by emerging technical solutions. However, there is no historical evidence, given an adequate energy policy framework, why there should be any doubt about the Australian engineering community's ability to deliver against ambitious targets for energy in support of the living standards the Australian community has come to expect.

The Electric Energy Society of Australia will continue to serve as an open platform for knowledge sharing, encouraging a collegiate approach to problem solving, and provide a degree of foresight for emerging trends and issues.

Overview

This booklet commemorates the centenary of the Electric Energy Society of Australia, which was initiated as the Electricity Supply Engineers Association of NSW on the 22nd of April 1924. It is largely based on the Proceedings and Technical Papers and Presentations of the annual conferences held over that period, with other conferences as noted. The rich history of the Society described in this booklet highlights the contribution of electrical engineers to the Australian lifestyle and living standards over more than 100 years.

Acknowledgments

Thanks go to Terry Lampard, Jeff Allen, Patrick McMullan, Denis Cooke, Peter Dulhunty, and Chris Dahlitz for their efforts in preparing this booklet.

And of course, the thousands of Australian engineers who have constantly committed to sharing knowledge using the framework of ESEA/EESA are sincerely appreciated and applauded. This booklet serves as a testament to their leadership and the breadth and depth of their expertise and innovation over the preceding century.

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