Future Networks



The challenge for power distribution to meet the future demands of a multi-directional, variable input grid.

BACKGROUND

Over the past 50 or so years, tens of billions of dollars have been invested in building electricity distribution network connections to the vast majority of Australian homes and businesses. Around $40 billion of additional expenditure on the network (transmission as well as distribution) is currently planned to account for growing loads, as well as replacement of aging assets.

Australia has some familiar challenges - for example, large distances and climatic extremes. Despite this, distribution networks perform very well and for the great majority of customers, power cuts and power quality are of minimal or no concern.

Just as widespread electrification occurred in about one generation and changed the face of home and work life, another energy change is now arriving. Specifically this involves a change in electricity demand - some controllable and some not - and a massive increase in generators connecting at distribution voltage, for example Photovoltaics (PVs), combined heat & power generators and fuel cells.

The effect will be that instead of an essentially 'one way' distribution network supplying power along radial lines of progressively smaller capacity, we will need an 'exchange network' that can handle power from multiple small generators and new types of load.

This will create technical and regulatory challenges. For example, there is already congestion on distribution networks that means some PV systems are unable to export power.

KEY ISSUES

Safety – How are sections of the system isolated for maintenance with multiple input points?

Capability – What is the proportion of local generation allowed in a specific circuit?

Congestion – How will the new owners of generation facilities respond to low voltage congestion?

Regulation – What is the appropriate regulatory framework to allow local generation in addition to control of the generation itself?

Reliability – What is the most rational basis for determining reliability which would assist both the industry and the Regulator?

Cost – How does the network owner make a return on investment?

PURPOSE OF THIS PROJECT

To evaluate the likely characteristics of future electricity distribution networks and to identify and articulate the technical challenges and options for transforming today's networks to the future.

TECHNOLOGY AND INFORMATION AVAILABLE

Technology and information are part of both challenge and solution.

For example, challenges being presented to distribution networks are technology-driven:

- Cogen and trigen
- Increasingly peaky load
- Photovoltaics
- Electric vehicles (EVs)
- Fuel cells and other local generation
- Smart meters.

networking innovation

Some of these, such as peaky load, have been increasing in significance for many years. Others such as PVs and EVs are new (last couple of years).

In particular, as the price of newer distributed low-voltage generation technologies fall and network peak pricing increases, there is a high probability that there will be a 'tipping point' soon where completely unsubsidised, high quality low-voltage generation (including for example, PVs) can achieve a simple payback of say 5 years when installed on a suburban rooftop. We may then see several thousand MegaWatt (MW) of generation capacity installed in less than 3 years, all at low voltage.

Once customers have decided to invest in PVs or fuel cell or other technology, they expect to be able to export power at any time. Similarly, owners of EVs will expect to be able to 'quick charge' at any time.

The challenges presented for the distribution network are tremendous, including for example accommodation of such significant low-voltage generation in an exchange-network mode during times of high production (day-time for PVs, windy conditions for wind turbines, etc), reverting to traditional one-way distribution during alternate times, major seasonal variations that impact the relative timing of peak low-voltage generation and energy demand, and variations in the availability of EV network storage.

Network congestion (even with today's very low penetration level of distributed generators and negligible EVs) is already an issue with the potential to prevent low-voltage generators from exporting power through that network.

Technology contributions to solutions include:

- Smart meters
- Remote load control
- In-home displays and controls
- EV storage.

HOW CAN THE OUTCOMES BE APPLIED?

There are multiple ways this project's outcomes could be used. For example:

- In developing public policy through State and Federal governments and their agencies (eg, AER and IPART)
- By regulators, in looking 'over the horizon'
- By network businesses in planning
- By technology companies, in home displays, demand management and other software-driven management tools.

VALUE TO AUSTRALIAN INDUSTRY / NATIONAL INTEREST

As well as providing a pathway to a better use of our electricity networks, the project potentially will result in future energy prices being lower than they otherwise could be.

As just one particular case in point, PVs (one of the main drivers) is going to reach a tipping point in Australia ahead of any other comparably developed country. We can take experience from here in mass-scale PV integration and apply that knowledge elsewhere for the benefit of the nation. There are great opportunities to develop and commercialise new IP, particularly software, through this project.

SPONSORSHIP OPPORTUNITIES

The Warren Centre welcomes all sponsorship inquiries and encourages all industry partners who recognise the importance of a balanced and well constructed examination of the distribution network of the future to take part in the project. The Warren Centre will provide a tailored arrangement to ensure comprehensive recognition of your organisation and contribution. By incorporating a broad spectrum of industry experience, this project can offer guidance for non-partisan policy formulation. Sponsors will benefit from engagement in thought leadership, industry networking, access to the project and final deliverables, and recognition through a range of marketing activities including their logo or name in all project and Warren Centre communications. The project will be communicated to industry, government and all interested stakeholders including the Warren Centre network of over 10,000 members.

To enquire about sponsorship opportunities and to discuss the benefits for sponsor organisations, please contact the Executive Director of The Warren Centre, Dr Nick Cerneaz.

The Warren Centre for Advanced Engineering Limited

The Warren Centre is a not-for-profit organisation with an independent process to find solutions to issues in the current complex environment. It is an industry based think tank based around collaboration which is able to draw on the excellence of its networks from academia, industry and government.

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