AUSTRALIAN ACADEMY OF TECHNOLOGICAL SCIENCES AND ENGINEERING (ATSE)

ENERGY ACTION STATEMENT

ATSE

INTELLIGENT ELECTRICITY NETWORKS FOR THE FUTURE

OCTOBER 2014

Australia needs intelligent electricity networks and enabling policy frameworks to ensure that future electricity supply systems provide efficient, affordable and low-emission energy to the Australian economy.

AUSTRALIA'S ELECTRICITY SUPPLY

Over the past decades advances in technology and a range of Government policy interventions have resulted in major changes to the nature and role of Australia's electricity supply network. This has seen a transition from a limited number of large power generation sources to a more distributed system comprising a greater number of smaller, more technologically diverse sources of electricity.

The role of the grid has evolved from networks for one-way power distribution to networks for two-way exchange of electricity between various participants. A system with inherent energy storage (i.e. continuously fuelled electricity generation plants that are interconnected) is evolving to one in which storage capacity has to be a specific consideration. 'Consumers' are also changing from passive users of electricity to individuals or groups more actively engaged with the electricity supply system through self-generation and demand management activities.

In this more diverse and interactive environment of energy exchange the electricity network is required to manage more complex interactions between participants and facilities to maintain reliability of electricity supply and minimise energy cost. These include changes in the nature of production/exchange/use interactions as well as changing production and demand characteristics resulting from the expansion of renewable and distributed generation. This inherently means that there will be a need to acquire, store and use large sets of data to model a more complex network and predict its operation increasingly in real time. The developments seen in information and communication technology have provided the basis for the evolution of more intelligent and increasingly self-managing networks.

AUSTRALIA'S NEED

The Australian electricity supply network has significantly different characteristics to those in most other developed countries, being isolated, relatively sparse and extending over great distances. The trend to smaller renewable energy production units has resulted in these facilities being connected in 'fringe of grid' locations, and at lower voltages in the network, rather than connected directly to the main transmission system. In order to maintain an efficient and affordable electricity supply, the inputs and impacts of these diverse and distributed facilities need to be brought together in an intelligent network. Such a network comprises a comprehensive information system and an operational system that is integrated across the whole network from consumer to electricity producer.

This is particularly critical for Australian electricity networks as new investment in facilities to maintain reliability and quality of supply will be impacted by new configurations of network supply and use facilities - thus requiring flexible approaches to provide the capacity needed for reliable supply.

The characteristics of these systems include;

- A range of **consumer interface types** from simple energy metering through a more complex interface to facilitate energy interchange, access to storage, and demand management options. A singular concept of this interface, such as smart metering, will be incapable of efficiently addressing the diverse consumer requirements.
- A more complex **real-time information-based protection system** for the networks to manage the impact of changing power flows though the network resulting from unforseen changes in power production across the diversified network facilities.
- A **network management system** capable of handling less schedulable demand, increased interaction between electricity suppliers and users, and more distributed systems in which production and use are increasingly co-located.
- A more dynamic **systems management structure** to maintain system integrity in the face of uncertainties and increasing disturbances in an electricity supply system which will have a reduced inherent capacity through inertia and capacity of input fuel control to cope with disturbances.
- **Market signals** which provide an appropriate balance between risk, cost impacts and rewards.

SMART TECHNOLOGIES

Technologies underpinning the intelligent network can provide more economic ways of managing and augmenting the network to maintain reliability and quality of supply in an environment of diversification and distribution of energy production (and storage) facilities. These include:

- Improving network capacity through improved monitoring and control
- Extending life of network assets using expanded network condition monitoring
- Limiting the need for network augmentation
- Regulating voltage of the network (particularly at the distribution level) to facilitate electricity exchange between participants, stability and equipment safety
- Allowing effective use of local (e.g. stationary batteries, electric vehicles) and distributed (e.g. large batteries, pumped hydro) energy storage from

A 2013 study estimated that the deployment of smart grid technologies in Australia could deliver a net economic benefit of $28 billion over the next 20 years if delivered in an integrated approach that also combines cost-reflective pricing, consumer behaviour change, and energy market reform.[1]

AUSTRALIA'S CHALLENGE

The transition to intelligent networks of the future will be a long term process. It requires strategic development of technology and underpinning strategic policy development, strategic changes to market structures and significant investment. Given the federated governance agreements upon which the current markets are based, and mixture of market-based and regulatory mechanisms upon which network arrangements are based - Australia faces long-term, strategic challenges to achieve effective transition to intelligent networks. The development of intelligent networks will, if done effectively, play a key role in minimising the investment needed to provide efficient, affordable and low-emission power for the Australian economy.

1. The *Smart Grid/Smart City Project* (2010-2013), delivered by Ausgrid and a consortia of research and industry partners, provides resources and information relating to the adoption of smart grid technologies in Australia, including a national cost benefit assessment https://ich.smartgridsmartcity.com.au/.

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Incorporated in the Australian Capital Territory Limited by Guarantee

THE WAY FORWARD

ATSE provides the following key recommendations to Australian governments and industry to transition to intelligent electricity networks for the future:

RECOMMENDATION 1: Develop a strategic blue-print for the transition to future intelligent networks

Government, working with industry, should develop a strategic blue-print for the evolution of existing electricity networks and operations to intelligent networks, including an assessment on the economic impact on future network developments.

RECOMMENDATION 2: Review market rules and regulatory processes to address barriers to intelligent networks

Governments should establish a review of market rules and regulatory processes to ensure that any barriers to providing appropriate market signals for participants in the construction, operation and use of an electricity supply system based on intelligent networks and the interactions between participants are addressed.

RECOMMENDATION 3: Establish a strategic policy agenda

Industry and governments should jointly establish a strategic policy agenda that supports the evolutionary path to intelligent network configurations, including the development of a policy framework that allows a combination of technologies and tariffs to ensure net benefits are efficiently captured.

ALIGNMENT WITH ATSE's ENERGY POSITION STATEMENT

ATSE's Energy Position Statement, *A Sustainable Energy Future for Australia*, set out four key priorities to transition to low emission energy systems that are affordable, secure and reliable. The following are particularly relevant to progressing *intelligent networks* for Australia:

THEME 1: Improved and new regulatory, market and information measures to double Australia's energy productivity by 2030.

- Intelligent networks will contribute to improved network utilisation including demand management (both opportunities and effectiveness) in the electricity network.

THEME 2: Supply systems and market measures that deliver reliable, competitive, low emissions electricity.

- The development of intelligent energy networks and enabling policy frameworks – as discussed in this action statement - are key to ensuring that future electricity supply systems provide efficient, affordable and low-emission electricity.

THEME 3: Supply systems and market measures that deliver reliable supply of competitively priced, low emissions fuels for transport

- Increased use of electric vehicles can benefit the productivity of the electricity network and increase the amount of stored energy available to the network.