Mr Andrew Broad MP
Chair, Standing Committee on Environment and Energy
Parliament of Australia
Email: environment.reps@aph.gov.au

27 April 2017

Dear Mr Broad

Please find attached Deakin University's submission to the Inquiry into modernising Australia's electricity grid.

Deakin University believes this Inquiry, in examining the challenges and opportunities in the modernisation of the grid, is addressing a fundamental issue for future safeguarding the security and reliability of the Australian electricity system.

In recognising the importance of this area, Deakin has drawn together its recognised capabilities in battery materials and technology, electrical engineering, intelligent energy system development and policy under 'Deakin Energy' to facilitate accelerated development and generate stronger support for industry and domestic consumers.

I commend this submission to the Inquiry and the insight and advice contained within our responses to the key elements.

Best wishes

Professor Jane den Hollander AO
Vice-Chancellor

Deakin University

Submission

Inquiry into modernising Australia's electricity grid
Standing Committee on Environment and Energy

April 2017

PREAMBLE

Deakin University is pleased to contribute to the Inquiry into modernising Australia's electricity grid. Deakin strongly supports the Australian Government's Inquiry to generate a stronger understanding of the challenges and opportunities in relation to modernising our electricity grid (the networks and markets that support electricity transmission and distribution networks) as an important part of broader endeavours to provide guidance and support for future energy provision. In a rapidly developing new world of energy, where there is significant market disruption and uncertainty, the need for leadership and direction is paramount.

Significant advancements in wind and solar energy generation technologies, control systems and the substantial reduction in the cost of those technologies, combined with enhancements to battery capability have triggered a new paradigm for energy generation.

Furthermore, developments in smart technology and user integration has the potential to provide significant energy efficiency to the current grid. Like many countries, most of the infrastructure in Australia has been built without due consideration for energy efficiency. The retrofitting of existing infrastructure can yield significant energy savings and enhance the capability to underpin energy system development in the future.

Through Deakin Energy, the University has drawn together its expertise and facilities in a cross disciplinary approach to the integration of traditional power systems with renewable energy and microgrids as well as the development of new technologies and system modelling, analysis and management. Deakin is collaborating with industry to support and guide development in this field and is discussing a range of significant pilot and demonstration projects to provide program direction as well as to stimulate innovation in the field.

Deakin welcomes further discussion with the Australian Government in relation to modernising the grid and provides the following responses to the Inquiry.

DEAKIN UNIVERSITY'S RESPONSES TO KEY QUESTIONS

1 The means by which a modern electricity transmission and distribution network can be expected to ensure a secure and sustainable supply of electricity at the lowest possible cost.

1.1 How are the objectives of security, reliability, sustainability, and affordability interrelated?

The current centralised structure of the electricity system has a strong correlation between the security, reliability and affordability objectives. The loss any of the centralised sources of energy or major part of the transmission network puts the rest of the grid under pressure to deliver the required flow of energy to customers. This leads to a high level of risk in the grid system. Energy security in this context has significant cost implications creating a strong relationship between sustainability and affordability.

With the current trends towards low emission generation technology, sustainable energy production is associated with less affordable energy. However, there are studies and models on optimising low emission energy production with more affordable energy. A careful balance should be established between all of these objectives in order to maintain energy supply to customers.

1.2 What should be the highest priority objectives of a modern grid in Australia?

Security and reliability should be the highest priority objectives for a modern grid in Australia. The Australian economy relies on a secure and reliable supply of energy to support continued growth. The development of a modern grid should focus on ensuring that there is sufficient energy supply to industry and that it is delivered when it is required. Ensuring energy supply security and reliability is particularly important when generation includes renewable energy sources, which are inherently intermittent in nature. Conversely, expansion of distributed energy generation systems or microgrids utilising renewable technologies has the potential to spread the risk of generation failure and add to system security and reliability as part of an overall approach.

Energy storage is also fundamental to the future reliability and security of Australia's energy system. Advancements in batteries and other storage technologies will become increasingly important in supporting the grid system in addition to microgids. Deakin is collaborating with CSIRO to develop and test new battery technologies as well as their integration capabilities with the grid.

1.3 What are appropriate standards for the security and reliability of the electricity system?

The Australia Energy Market Commission (AEMC) is currently responsible for setting reliability and security standards of the electrical system in Australia. The current level of reliability standard is 0.002 per cent unserved energy (USE), which would seem an appropriate standard. In delivering security the AEMC guidelines argue that load be shed in an equitable manner, ensuring maximum security for each region in proportion to the aggregated demand for that region. When there is a shortfall in generation this would seem an appropriate standard.

The Institute of Electrical and Electronics Engineers (IEEE) also has a number of standards on reliability and security of electrical power systems.

Cyber-security and the maintenance of system integrity is increasingly an area of concern. Further development of robust systems and standards in this area will also be critical.

2 The current technological, economic, community, and regulatory impediments and opportunities to achieving a modern electricity transmission and distribution network across all of Australia, and how these might be addressed and explored.

2.1 What are the costs associated with an 'outdated' grid?

Outdated infrastructure is more vulnerable to failures and outages that can result in increased asset management costs. The centralised nature of our outdated grid also makes it less flexible for accommodating emerging loads, such as localised demand from electric vehicles. Replacing a section or sections of the grid or building new capacities is costly though and thorough cost benefit analysis is needed before future action occurs.

2.2 What might be the role of new technologies in improving system security, reliability, sustainability, and affordability? What is the potential for new technologies to alter the inter-relationships between these objectives?

New technologies have the potential to improve the efficiency of the grid system by optimising electricity usage and increasing the overall capacity of electricity generation, which will in turn improve the security of the system.

The introduction of smart grids and advanced telecommunication and information technologies, including smart meters, will facilitate better management of energy generation and distribution and will result in improvements in the reliability of the system.

Advancements in wind and solar technology have the potential to expand the role of renewable energy sources and, with advanced control systems, will improve the sustainability of energy generation. Energy efficiency should also be considered in conjunction with renewable energy generation. Significant energy can be saved through energy efficiency measures, including the adoption of various energy efficiency appliances and operating devices in industry and individual households and through progressive policy and design. Like many countries, most of the infrastructure in Australia has been built without due consideration for energy efficiency. The retrofitting of existing infrastructure can yield significant energy savings.

The implementation of distributed generation technology will provide individual customers the capacity to select the generation technologies of their choice and transact with grids in a manner that will improve the affordability of the energy.

The decentralisation of energy generation and supply has additional benefits in relation to the security and consistency of supply for the nation although continued maintenance and security for transmission and distribution networks is still required as well as consideration for localised security measures.

2.3 How can the grid better accommodate the rapid pace of technological change, including an increasing level of variable electricity generation?

The adoption of innovative grid models such as smart grids and distributed generation structures will offer a decentralised, yet more connected, structure for the power grid. This will enable a grid-wide coordinated monitoring of energy generation and distribution.

The deployment of distributed energy storage systems to manage the consumption of energy during on and off peaks will also be critical.

The installation of renewable energy technologies in individual households continues to grow and the development of shared wind and solar plants and community microgrid systems is now

emerging. In the main, these systems articulate with the traditional energy grid, however there is also growing experimentation with off-grid and self-sufficient systems, particularly for communities in remote locations. In recognition of this growth, a number of traditional energy providers are developing or trialling renewable programs for localised energy generation to endeavour to maintain positioning in a rapidly changing market.

2.4 What possibilities are there for alternative pricing models (for example, cost-reflective pricing) to better reflect the true cost of services provided by a modern grid?

Modernising the grid with a diverse mix of electricity generation and the associated large investment requirements will have significant implications for current pricing models. As such, there have been several studies on alternative and more accurate pricing systems. These alternative models considered:

- that the market should be predominantly customer driven (not market driven)
- that regulatory frameworks should promote innovation and competition
- that the way customers use energy will continue to change as pricing mechanisms change
- incentives and/or disincentives models.

Energy policy and the associated regulatory framework must be able to adapt the above factors to allow for a dynamic market response.

2.5 What opportunities are there to improve governance and regulation in the grid?

The integration of new technologies into grids can offer a number of improvements to governance and regulation including:

- flexibility to deploy new technologies by new or existing market players
- more incentive models for energy efficiency.

2.6 What opportunities are there for consumers to benefit from the modernisation of the grid? How can we ensure that these benefits are able to be shared equitably by all consumers?

Modernisation of the grid will result in consumers being able to access a clean, sustainable and affordable energy system. The implementation of new controls for variable sources of energy generation will improve the overall quality of the energy system.

To ensure that these benefits are shared equitably, a well-designed tariff system and appropriate support mechanisms are required. This will ensure that consumers are paying equitable prices for their demand on the grid, regardless of what generation technology they choose.

2.7 What sort of community attitudes or concerns will need to be addressed in order to successfully modernise the electricity grid?

Adoption of some of the new technologies will require changes in community attitudes and acceptance, such as in the case of the usage of smart meters and demand side management technology.

Solar and wind options currently have the strongest uptake and potential for growth, with ready availability of these resources a key factor. Improving technology, reducing costs and optimising storage capacities will continue to drive the implementation of these options.

As further work is undertaken on intelligent management systems to underpin the usage of these technologies, it is expected that greater benefits will be generated. The development of noiseless and less intrusive wind technology will also assist in uptake within more developed communities.

Through its Deakin Energy program, the University has been working with a number of energy users, providers and communities to consider priority needs and opportunities for the development of new pilot and demonstration projects. The development and implementation of collaborative, well managed and researched demonstration projects is considered by all parties, including Deakin, as a critical strategy for guiding and encouraging the uptake of variable generation energy projects and new technologies.

2.8 What options are there for addressing geographical barriers to achieving a truly national grid?

Australia has a number of geographical barriers; long distances and highly variable terrain between customer centres combined with large areas with very low population density requiring affordable and reliable energy supplies. This presents significant challenges to a national grid.

Therefore, transmission infrastructure will remain an essential part of new network structure. Careful consideration is needed as to whether additional automated and intelligent interconnectors are needed as one cost-effective way to strengthen the network.

3 International experiences and examples of electricity grid modernisation in comparable jurisdictions.

3.1 What are the key similarities and differences between the electricity system in Australia and those of other countries?

One of the differences between Australia and most of the rest of the world is that Australia is an island country and has no close neighbours to share the issues of energy generation and supply. Although there are wide options for energy resources, the cost of generating electric energy from these resources is higher in Australia than for the rest of the world.

3.2 How does Australia compare with other countries in the rate of adoption of variable electricity generation and other new technologies?

The issues of aging grids and the emerging challenges of adopting new technologies into the existing grid are global concerns in developed countries, Australia is no different.

3.3 How does Australia compare with other countries in progress towards electricity grid modernisation?

Australia is lagging behind other advanced countries in progress towards electricity grid modernisation. There has been significant investment in updating the current grid, particularly in the area of communication technologies, leading towards smart grid development. The adoption and integration of distributed new energy will be limited without proper smart grid capabilities.

3.4 What are examples of best-practice governance and regulation in other countries?

One of the advanced best-practice examples is in the United States. The Federal Energy Regulatory Commission proposed rule changes associated with more effective integration of energy storage systems into wholesale markets to enhance competition. The rule changes would require market operators to revise their electricity tariffs in order to better accommodate the participation of battery storage systems and allow distributed energy resource aggregators to participate in the market.

CONCLUSION AND RECOMMENDATIONS

In a rapidly developing new world of energy, where there is significant market disruption and uncertainty, the need for leadership and direction is paramount.

Like many countries, most of the infrastructure in Australia has been built without due consideration for energy efficiency, expansion and the accommodation of new generation models. The retrofitting of existing infrastructure can yield significant energy savings but needs to be considered carefully as does the articulation of the grid system with distributed generation programs and storage systems.

There are a number of key operational challenges to address, including but certainly not limited to:

- the need to be open and flexible in our approach to embracing rapid technological development and to use this to optimal advantage
- the need to acknowledge and understand the complexities and opportunities around system and technology integration and the development of efficient and effective management platforms
- the opportunities for research and development collaboration and building productive and progressive engagement between government, industry and university sectors.

This Inquiry into modernisation of the grid provides an opportunity to enhance the collective understanding of the issues and opportunities in this field and to generate a platform for future progression.