13 April 2018

Ms Jessica Shaw MLA
Chair, Economics and Industry Standing Committee
Parliament House
GPO Box A11
Perth WA 6837

Dear Ms Shaw

Reference: Inquiry into Microgrids and Associated Technologies in WA

Thank you for the opportunity to make this submission to the Western Australian Parliaments' Economics and Industry Standing Committee.

The Energy Made Clean and Lendlease Joint Venture (EMC Lendlease JV) is one of Australia's leading microgrid developers, with a capability across engineering, procurement and construction as well as system integration, remote monitoring, and operations and maintenance for solar and battery renewable energy systems.

Microgrids encompass a range of applications that can provide safer, more reliable and affordable electricity supply to many electricity consumers. With the upcoming investment cycle for Western Power to replace their ageing distribution line assets, microgrids will provide significant savings to the Government. In addition, Western Australia has the potential to gain economic and social advantages through early support for the industries that support microgrid design, delivery, operations and maintenance – a capability that can be exported.

At present, almost all microgrid development options face legislative, regulatory, policy and cultural barriers, rather than technical issues.

To be successful, we advise that the transition from a centralised electricity network to a modular and decentralised network must not be considered by the electricity sector in isolation, but integrated with other infrastructure and land-use planning.

We look forward to participating in any further discussions or clarifications on our response. Feel free to contact Paul Azzalini (0429 529 585; paul.azzalini@lendlease.com) or Tristy Fairfield (0411 220 704; tfairfield@energymadeclean.com) at any time.

Yours sincerely,

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Introduction - What is a microgrid?

The term 'microgrid' encompass a range of applications and is often used interchangeably, leading to confusion and miscommunication.

In general, the term 'microgrid' refers to multiple integrated Distributed Energy Resources (DER), with multiple loads, that act as a single controllable entity through the use of power control systems.

The most widely accepted definitions in relation to microgrids and similar applications are outlined in Table 1 below:

Type of Microgrid	Description	Example (refer to Appendix 1)	Responsible Entity	Drivers
Customer microgrid	Wholly on one site, always disconnected from the main grid.	RAAF Delamere Weapons Range	Site owner	Fuel savings Greenhouse gas emission reduction Security benefits from relying on less diesel being delivered
Utility microgrid – grid connected	Connected to the main grid but can operate in 'islanded mode'[1].	Kalbarri Microgrid, Garden Island Microgrid	Utility	Reliability Reduced fire hazard
Utility microgrid – isolated (Sometimes referred to as a "mini-grid").	Entirely separate grid.	CSIRO Square Kilometre Array	Utility Other government agency (e.g. Housing) Community	Fuel savings Safety Reliability
Metro microgrid	Operates as microgrid within a network – transports DER across segment of network.		Utility	Maximise benefit of DER Reduce customer costs
Nanogrid – also known as a Standalone Power Systems (SPS)	Services only one load in a small area.	Ravensthorpe, Esperance and Hopetoun SPSs	Utility Site Owner	More economic than replacement of network infrastructure Improved reliability Improved safety from reduced fire hazard

Table 1: Types of Microgrids

[1] "Islanded mode" refers to a mode of operation in which a power system is not connected to a main electricity grid.

Appendix 1 shows the charge and discharge cycle of an off-grid PV/ battery hybrid power system supporting a small microgrid.

a) *The potential for Microgrids and associated technologies to contribute to the provision of affordable, secure, reliable and sustainable energy supply, in both metropolitan and regional WA*

The current South West Interconnected System (SWIS) emerged from connecting a number of small electricity networks with local generation to an interconnected system of centralised generation, starting in the 1950s. The Rural Electrification Schemes of the 1970s and 1980s connected approximately 80,000km of network infrastructure to promote economic development and social equality[2]. These network expansion policies were appropriate for the time. However, the underlying premise that the associated tariffs collected would fund future rebuilding of this infrastructure did not materialise.

With vast lengths of this infrastructure now reaching its end of life, it is not only expensive to replace these 'poles and wires', but the most suitable technologies to provide safe, reliable, affordable electricity services to Western Australian communities has changed. Whereas in the mid to late 20th century, centralised generation and network infrastructure was the most economically efficient option, today solar and battery systems, coupled with effective communications and control systems is a better solution.

In the regional areas serviced by Horizon Power or the Department of Communities similar technological and economic shifts are occurring; solar and battery systems provide cheaper power than diesel generation with greatly improved energy security.

While many microgrid applications have positive net economic benefits, a range of legislative, policy, and market instruments (e.g.. subsidies distorting the market), coupled with cultural barriers (e.g. entrenched processes and risk aversion) means that early adoption is time-consuming and complex.

The resolution of legal and other barriers (e.g. legal fees, extensive stakeholder engagement, excessive engineering costs to meet unsuitable requirements) erodes the economic benefit of projects resulting in an inability to capture the full benefits that would be derived from efficient planning and delivery. When considered at scale, this represents a significant opportunity cost to the economy of Western Australia.

The key benefits of microgrids are summarised below:

1) Affordability

- Western Power has recently estimated that 52% of its high voltage overhead conductors service just 3% of its customers[3]

[2] Booth, R.R. and Coulter, T.E. *A Review of Rural Electrification Policies in Western Australia*, Electric Energy Conference, Sydney, 13-17 October 1980.
[3] Western Power, *Reshaping the Network, Off-grid and Stand Alone Power Conference*, March 2018

- In its submission to the Australian Energy Market Commission's *Alternative to Grid Supplied Network Services* Rule Change proposal[4], Western Power estimated a net benefit of $388m over ten years could be realised if it were able to replace end-of-life assets with SPSs.
- Independent modelling undertaken by the EMC Lendlease JV suggests this saving could be significantly greater with improved designs, reduced raw material costs and if work was undertaken at significant scale.

2) Reliability and security

- Because they are less reliant on long electricity network spurs, microgrids are inherently more resilient to extreme weather events. For example, data from the Western Power SPS trial, shows significantly better performance by SPS than the equivalent feeder[5].
- Microgrids rely on sophisticated power control systems which also enable systems to ride through events that may otherwise cause interruptions by dispatching fast response DER.

3) Safety

As a consequence of not relying on the long-distance transport of electricity, fewer poles and wires are required in rural and regional areas. This has key safety consequences of:

- Removing power poles from paddocks, which are a safety hazard for broadacre cropping enterprises
- Reduction in bushfire risk from network assets (e.g. pole top fires)
- The ability to retain electricity supply during bushfires (i.e. for water pumping).

b) Opportunities to maximise economic and employment opportunities associated with the development of Microgrids and associated technologies

As a market leader in the development of microgrids and SPS's, Western Australia is well-placed to leverage its expertise and first-mover advantage by providing clean energy solutions to the South-East Asian market and other developing economies such as Africa, that are looking to rapidly energise to drive economic growth and social development.

i. Development of raw material resources / primary commodities

The demand for lithium is increasing due to a worldwide uptake for lithium batteries in cars, electronics and Battery Energy Storage Systems. However, the volume of microgrids needed for the WA market will have limited impact on local lithium demand.

[4] Western Power, *Rule Change Proposal – Removing Barriers to Efficient Network Investment*, September 2016, https://www.aemc.gov.au/sites/default/files/content/b379bfe2-5ee0-43e5-a36c-6eef9068b05c/Rule-change-request-Western-Power.pdf

[5] Western Power, *Stand-alone Power System Trial – One Year On*, September 2017 https://westernpower.com.au/media/2500/stand-alone-power-systems-stakeholder-report-20170906.pdf

ii. Research and development

Western Australia has the opportunity to be a world leader in developing and delivering microgrids and associated technologies. Western Australian enterprises, such as the Government Trading Enterprises (GTEs) Horizon Power and Western Power, and the private sector, such as the EMC Lendlease JV, have significantly more experience than other States and Territories in developing this industry.

Microgrid technology has been applied across a range of applications (e.g. mine sites, remote and small communities and autonomous installations) for both on and off grid solutions, and with its unique environmental factors Western Australia is well positioned to continue leading this field of development.

Potential research and development (R&D) opportunities exist in electrical engineering, power systems engineering and network planning. But there are also R&D opportunities in related infrastructure and land-use planning and social research (for example, community co-investment opportunities, community experience and acceptance of microgrids).

This experience and knowledge in microgrids has the potential to be exported across Australia and overseas as this technology allows developing countries to leap-frog old centralised power system technology to decentralised systems, particularly in the South-East Asian, African and island regions that rely on diesel fuel.

iii. Design, engineering and construction

During the early stages of microgrid design and deployment, considerable opportunity exists for design and construction work, as these systems are bespoke. Microgrid applications including remote monitoring and communications, need to be standardised to achieve economies of scale.

Battery Energy Storage Systems (“BESS”) designed to Western Power requirements and Australian Standards to suit the Australian environment can be undertaken in local workshops such as EMC’s facility in Belmont. These systems undergo Factory Acceptance Testing (FAT) in the workshop prior to shipment to site. EMC is one of very few workshops in Australia that have the knowledge and experience in undertaking the FAT while many other battery providers still undertake the FAT overseas. This is an area for potential local growth in capacity and capability.

As demand grows within Australia and globally for these technologies, Western Australia is well placed to leverage its first mover advantage in these areas.

iv. Advanced Manufacturing

No comment

v. Information and Communications Technology (ICT)

Microgrid design and deployment has a heavy reliance on ICT and Western Australia has an opportunity to emerge as a leader in this field. Aspects of microgrids that have advanced ICT requirement include:

- system design (using global component supply chain)
- system integration (into existing generation or networks)
- system operation
- remote monitoring

- remote maintenance dispatch
- customer-facing user interfaces
- integration of Internet-of-Things applications
- leveraging big data for fleet management and improvements
- market design and settlement.

vi. Ongoing asset operations

The ability to remotely monitor and control the new technology options currently being deployed by the EMC Lendlease JV and other emerging technology providers, is a critical distinguishing feature from the "pre-networks" regime during which remote and regional users were responsible for their own power supply. Responsibility to manage these systems can still be retained by the utility, so there need be no change to the status quo for regional users.

Ongoing operations and maintenance provides new employment opportunities, for example:

- remote monitoring, maintenance, scheduling and trouble-shooting
- local electrical and site maintenance requirements (e.g. vegetation maintenance, parts replacement, scheduled and unscheduled maintenance, emergency response)
- predictive maintenance regimes based on advanced analytics
- critical spares management planning.

c) Key enablers, barriers and other factors affecting Microgrid development and electricity network operations

i. Regulatory barriers

There are a number of regulatory barriers to the deployment of microgrids on the SWIS due to idiosyncrasies of the legislative framework that established the GTEs. These include:

- The statutory functions of the GTEs
- The definition of the SWIS and its inclusion in subsidiary legislation, and associated instruments.

Numerous market issues will need to be resolved to enable a competitive and innovative market for microgrid services, including retail and wholesale market operation, and network and microgrid control services.

Importantly, other infrastructure and land-use planning policies and processes must be considered in anticipating the transition from a centralised electricity network to a modular and decentralised network, including microgrids. For example, planning policies must recognize that microgrids and associated technologies are capable of delivering the same power services as grid-connection, and grid connection must not be a pre-requisite for development. Similarly, land should be set aside in new developments for battery energy storage and community/ utility-scale DER that will enable microgrid development.

ii. Technical Factors

The technology around microgrids and SPSs has been proven and currently used by both Western Power and Horizon Power in Western Australia.

iii. Workforce planning and development

Existing skill sets in electrical power systems engineering, electrical and civil trades etc. can be utilised to meet future demands of microgrid deployment at scale, however, increasing numbers of skilled practitioners will be required.

In particular, additional demand for skills within the distributed energy integration and associated power systems control will be needed for the following:

- Industrial Networking & Security
- SCADA - Supervisory control and data acquisition (SCADA) systems – SCADA refers to the system of software and hardware that enables microgrid operators to control processes locally or remotely, monitor, gather, and process real-time data, interact with loads and generators, and record events.
- SysOps – “SysOps” refers to system operations. Power system equipment, particularly in renewable energy, is experiencing a trend towards increasing remote interconnection capabilities. Data feeds are richer and more information dense requiring on-site information pre-processing and cloud based aggregation. A SysOps engineer designs, implements and maintains the server infrastructure required to facilitate this and glean timely insight during the operations and maintenance lifecycle.
- Front/Back-End Development - Sitting on a conceptual layer above system operations, front end development centres on the design and delivery of client facing data dashboards. Engineers working in this space place key consideration on graphical layout, interactivity and user experience. Conversely, back end development is concerned with all behind-the-scenes work require to support the front end. These developers receive workflow support from system development (“DevOps”) personnel and work closely with SysOps engineers to add functionality to the servers they maintain.
- Control System Engineers - Renewable energy plant involves multi-layered interactions between various power systems components not limited to solar PV, battery energy storage, wind turbines, standby diesel generators and protection equipment. Control system engineers are concerned with the real-time dynamics of each of these elements and seek to coordinate each part into a well-considered system.
- Electricians– sufficient numbers of electricians with suitable experience in renewable energy / CEC accreditation will be required to install and deliver on-site support.
- Electrical Engineers – increasing numbers of protection, power and renewable energy engineers are likely to be required.

Additionally, skill sets associated with regulation and policy development will play an increasingly important role as new markets and commercial structures emerge and adapt to microgrid technology and capability.

iv. Social factors

To successfully transition to a decentralised energy system, community acceptance is critical.

Effective community engagement is needed to ensure a smooth and successful transition. In addition to digital interfaces with electricity retailers and service providers, consumer acceptance will be based on understanding the drivers, challenges and ultimate benefits (cost effectiveness, safety and reliability).

As with other transitions, the greater level of community collaboration and empowerment, the greater likelihood of long-term success. The level of engagement is a factor of the complexity and size of any project, and the experience of other individuals and communities.

Customer engagement in Western Power's SPS trials in Ravensthorpe has demonstrated the effectiveness and value of a thorough and genuine community engagement, and the important role that early adopters can play as ambassadors of new technology and processes.

v. Electric Vehicles

No comment

d) Initiatives in other jurisdictions to facilitate the development, and maximise the value of, microgrids and associated technologies

Our experience in other jurisdictions is that Western Australia is an industry leader in the application of microgrids and has a unique opportunity to be seen as a worldwide centre of excellence.

Appendix 1 – Charge and discharge cycle of an off-grid PV/battery/ diesel system supporting a small microgrid