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Australian Renewable Energy Agency

ARENA

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Stand-alone Power Systems Review Issues Paper- ARENA submission

This submission provides background information on projects funded by the Australian Renewable Energy Agency (ARENA) as relevant to the Commission's review of the regulatory arrangements for stand-alone power systems (SAPS).

About ARENA

ARENA was established to make renewable energy solutions more affordable and to increase the supply of renewable energy in Australia.

ARENA provides financial assistance to support innovation and the commercialisation of renewable energy and enabling technologies by helping to overcome technical and commercial barriers. A key part of ARENA's role is to collect, store and disseminate knowledge gained from the projects and activities it supports for use by the wider industry and Australia's energy market institutions.

Summary

Australia's electricity sector is in transition, driven by technical and commercial innovation and changing consumer preferences. At the centre of this change is the emergence of low cost grid-scale and distributed renewable energy technologies that shape and enhance the opportunity for the future development of Australia's power systems.

Prior to 2017, ARENA directed funding at remote area power supplies, fringe-of-grid and network-constrained areas. Projects in this space tended to focus on the deployment of solar and/or wind near fringe-of-grid load centres to reduce the need for network augmentation or, in off-grid

applications to reduce diesel fuel costs. ARENA is currently witnessing strong interest from network service providers (NSPs) looking to trial renewable energy-based SAPS for the purposes of fringe-of-grid defection, however current ring-fencing rules, combined with weak incentives for Network Service Providers (NSPs) under the current price regulation framework to fund non-capex solutions, appear to create a material barrier to implementation.

This submission makes the following key points:

- ARENA's experience is that high penetration renewable energy-based SAPS can achieve reliable power supplies for regional and remote area customers. A wide range of technology approaches exist and these are rapidly evolving, and
- The Commission should consider regulatory frameworks that provide for an independent assessment of SAPS and other approaches, and an independent trigger mechanism for that assessment process, rather than leaving decisions solely in the hands of the local NSP.

To assist AEMC with its review, ARENA has provided a list of related projects at Attachment A.

ARENA's Regional Australia's Renewables (RAR) Initiative

In 2013, ARENA launched the RAR Initiative, which was comprised of the Community and Regional Renewable Energy (CARRE) program and the Regional Australia's Renewables - Industry (I-RAR) program. The objectives of the RAR initiative were to:

- Demonstrate a portfolio of renewable energy solutions, including hybrid and integrated systems, in Australian off-grid and fringe-of-grid areas,
- Ensure knowledge is produced and disseminated regarding the deployment of renewable energy solutions in remote areas catalysing further renewable energy uptake, and
- Remove roadblocks, leading to greater deployment of renewable energy solutions in off-grid and fringe-of-grid areas.

Under RAR, 14 active projects had a total value of $323 million[1] adding 78.32 MW to off-grid renewable capacity. The locations of these projects are provided in Figure 1 (below). Figure 1 includes the multiple locations of the $59 million Solar Energy Transformation (SETuP) project in the Northern Territory.

The RAR initiative addressed real and perceived risks associated with early stage, pre-commercial renewable energy development and provides a foundation of SAPS demonstration projects to enable the development of a competitive renewable energy-based SAPS sector. An evaluation of ARENA's RAR projects, focussing on technology and commercial lessons learned, has recently been published[2] and may be of interest to the Committee.

[1] Including contributions from all parties

[2] Herteleer et al (2018), *Identifying risks, costs, and lessons from ARENA-funded off-grid renewable energy projects in regional Australia*: https://onlinelibrary.wiley.com/doi/full/10.1002/pip.3004

Key lessons from the RAR initiative include:

- Demonstration projects contribute to industry experience and develop the knowledge required to integrate renewable energy resources into existing fossil fuelled SAPS in remote areas,
- SAPS projects can range from low to high percentage of renewable energy penetration up to the multi-megawatt scale and encompass a variety of sectors (mining, tourism, and remote communities),
- All projects use solar PV as a key technology, often supplemented by additional technologies such as batteries,
- Land acquisition, technical integration, stakeholder engagement, and access to finance are among the main reasons for project delivery challenges,
- Comprehensive community engagement is critical to success in remote SAPS projects,
- Project developer's capability and local knowledge is critical to ensure effective and proactive communication and stakeholder management in project development and lifecycle support,
- Remote area power systems face a significant 'remoteness cost premium', and
- The risks and benefits of a proposed SAPS need to be clearly articulated early in the project development process.

More information on the RAR program is also available on the ARENA website (www.arena.gov.au) as well as case studies and reports associated with each project.

Figure 1: Map of ARENA RAR and SETup projects

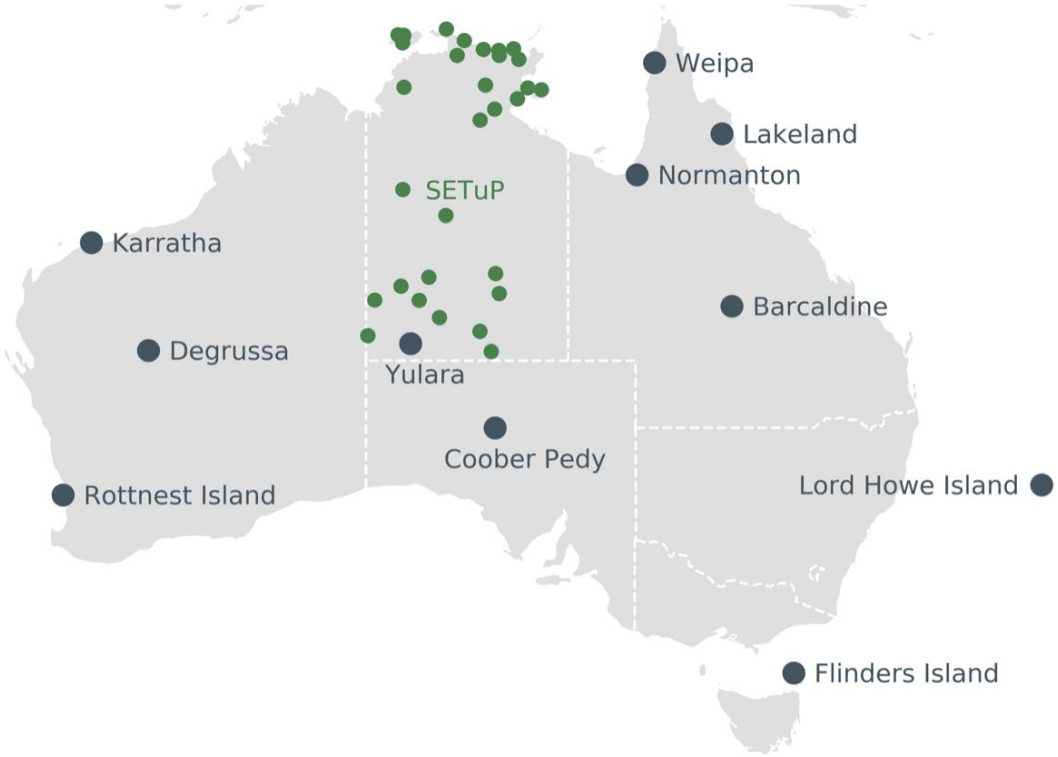
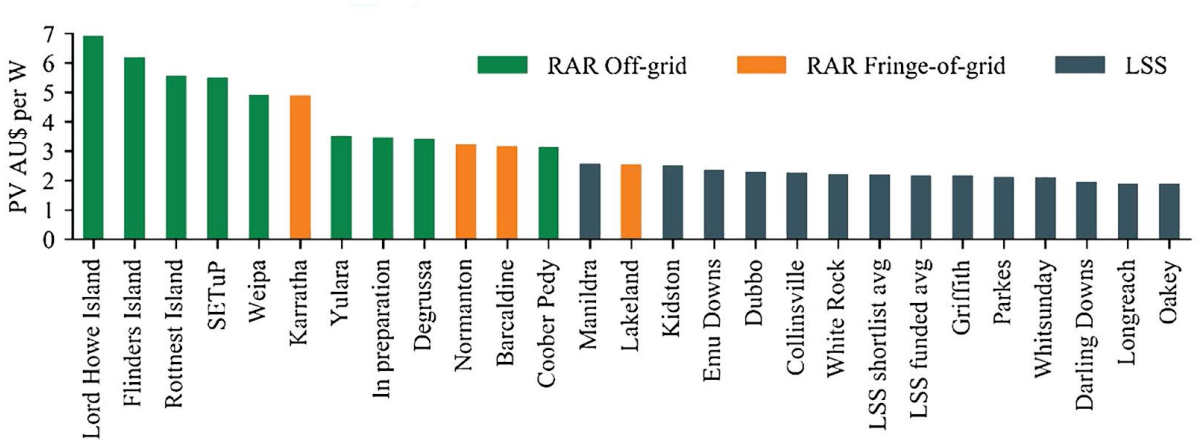


Figure 2 - PV $/Watt for ARENA off-grid, fringe-of-grid and on-grid (Large Scale Solar) projects[3]



Huntlee Energy Utility: Case Study

ARENA supported the *Delivering higher renewable penetration in new land and housing developments through edge-of-grid microgrids* report – produced by Flow Systems.[4] This report, which focussed on fringe-of-grid residential developments and concluded that, if implemented correctly, microgrids have many benefits for developers of land and housing developments in terms of reduced costs and product differentiation, consistent with the national energy objectives.

Flow Systems identified the regulatory environment as the key barrier to microgrid development, including the lack of community ownership models and a lack of common technical standards. Key recommendations for regulators included establishing clear rules of engagement for microgrids in relation to retail, generation and network operation and ownership.

Responses to the issues raised by the Commission

ARENA supports the Commission's assessment that the falling costs of renewable generation and batteries are leading to significant decreases in the costs of providing off-grid electricity supply through SAPS. A number of NSPs are in discussions with ARENA regarding the potential for demonstration projects in this area, however these are yet to progress with the NSPs invariably citing regulatory and commercial barriers to implementation. The resolution of these matters, through changes to the rules, will provide a basis for ARENA to work with industry to support the scale-up of innovative solutions that could reduce supply costs at the fringe-of-grid.

[3] Reproduced from: Herteleer et al (2018), *Identifying risks, costs, and lessons from ARENA-funded off-grid renewable energy projects in regional Australia*: https://onlinelibrary.wiley.com/doi/full/10.1002/pip.3004

[4] https://arena.gov.au/assets/2015/04/Delivering-higher-renewable-penetration-new-land-housing-developments-microgrids.pdf

Comparing technology approaches

ARENA is also working with industry on solutions to ease network constraints or to avoid network augmentation expenditure by deploying distributed energy solutions. These projects (examples provided below) demonstrate that distributed energy provides a range of approaches for NSPs that exist on a continuum rather than as binary options. In some cases NSPs may be comparing options that involve, variously, avoiding augmentation costs, reducing reliance on a connection or providing a stand-alone solution for a customer or a community. In this case it is important that projects can be compared in relation to the interests of consumers, rather than other distortionary factors such as potential capex/opex preferences of the NSP, regulatory risk or varying consumer protection obligations. ARENA agrees with the proposal that SAPS should be considered alongside other non-network solutions.

Project examples include Virtual Power Plant (VPP)-type solutions like the TasNetworks **CONSORT project** on Bruny Island in Tasmania's south-east. Working in conjunction with rooftop solar generation, batteries will be coordinated to alleviate congestion on Bruny's undersea power supply cable, improve power quality and reduce costly diesel generation.

ARENA is also supporting the **Garden Island Microgrid project** with the ability to produce both power and desalinated water. The Project will involve the construction and integration of 2 MW of solar PV capacity, a 2 MW/0.5 MWh battery storage system and a control system with the option to connect wave energy generation technology. Together this will form a microgrid designed to operate either independently or in conjunction with the Western Australian electricity network, seamlessly switching between the two through a control system. The project is aiming to demonstrate a renewable energy and water solution in an island/off-grid-ready microgrid setting.

Comparing reliability outcomes

Jurisdictions apply reliability standards across the network areas rather than requiring NSPs to achieve a prescribed reliability outcomes at each customer premises. This means that jurisdictional reliability standard may not be at all reflective of the actually outcomes experienced by a fringe-of-grid customer or community. ARENA notes that while differential reliability standards could have the potential to distort the comparison of grid connected versus SAPS solutions, it is important that the reliability of supply for the affected customer is the primary consideration, rather than the simple application of a network-wide reliability standard. Perversely, applying an overly onerous reliability standard to a SAPS investment test could make it un-economic, even when it could result in improved reliability for the affected customer or community.

The **Coober Pedy project** is an example of a high-penetration renewable energy SAPS achieving positive reliability outcomes for customers. The project integrates 1 MW solar, 4 MW wind generation, a 1 MW, 0.5 MWh battery storage and inverter system as well as a range of additional proven technologies with EDL's existing 3.9 MW diesel power station in Coober Pedy. The project aims to achieve an average +70% reduction in diesel consumption over its 20 year life and to date this has been achieved. From the start of July 2017 to the end of February 2018, the project has operated for more than 1300 hours on 100% renewables (all diesel generators off), with the longest uninterrupted supply of 100% renewable energy to the town lasting 42 hours.

Allocation of roles and responsibilities

SAPS present an interesting 'edge case' that means alternative regulatory approaches should be evaluated, even where they might vary from general best practice principles for economic regulation within the NEM. If the grid were to be developed today, it is likely that existing NSP businesses would have a smaller presence in regional and remote areas and that competitively delivered, renewable energy-based SAPS would be more common. The development of SAPS in the current environment however, will occur in the context of NSPs having existing capacity and infrastructure in some regional and remote areas.

ARENA's experience with remote area power supply projects indicates that commercial arrangements for SAPS solutions need to be adaptable to the local community context. Further, open and transparent competitive processes can help ensure innovative solutions can be brought forward and at the local cost. While there are a range of commercial entities in Australia that are able to design, build and maintain SAPS, it is conceivable that the local NSPs may be best placed to deliver these services in some cases. Because of this, a pragmatic, outcomes-based, approach should be considered, incorporating the possibility for a range of service models for SAPS provision.

In some cases, the Commission should consider the merit of NSPs providing a fully-integrated solution, such as in very remote areas, or in 'English as second language' communities where other parties cannot provide effective support. In such cases it may even be appropriate for the NSP, through a ring-fenced business, to own behind-the-meter assets where that is the most efficient option and is agreed by the affected customer(s).

Where multiple parties are able to provide a solution, competitive pricing could be supported by a third party assessment process either conducted, or overseen by, the Australian Energy Regulator. This would help ensure a level playing field for competition in the procurement of SAPS or other services and ensure efficient outcomes for customers. ARENA further considers that the trigger for a third party assessment process could be open to third parties such as affected customers, local councils or jurisdictional governments. A third-party trigger mechanism could help mitigate the risk that NSPs do not pursue a cost-effective SAPS solution due to expenditure biases or other distortions created through network price regulation.

ARENA would like to support the Commission's review by sharing information and insight gained through our project portfolio. Our Advancing Renewables Program is open to proposals for further proof of concept demonstration projects in this area if they help advance the renewable energy sector as a whole. Please contact Jon Sibley (Principal Policy Advisor, jon.sibley@arena.gov.au, 0400 031 596) if we can provide any further information or assistance.

Yours sincerely

Darren Miller

Chief Executive Officer

Appendix A - Examples of relevant ARENA-funded off-grid and fringe-of-grid projects

Lead proponent	Project name	Description	Total project value (all party contributions)
Hydro Electric Corporation	King Island Renewable Energy Integration Project (KIREIP)	This Project demonstrates a world-leading power system that combines several renewable energy technologies, smart tech integrations and energy management technologies. The system will supply over 65% of King Island's annual energy needs using renewable energy, reducing CO2 emissions by more than 95%.	$17,696,282
Indigenous Essential Services Pty Ltd	Northern Territory Solar Energy Transformation Program (SETuP)	The Solar Energy Transformation Program or SETuP aims to transform the delivery of electricity in remote off-grid communities throughout the Northern Territory.	$62,500,000
Hydro Tasmania	Flinders Island Renewable Energy Project (FIREIP)	This Project will further the understanding in the potential for cost reduction, achieved through the modularisation and containerisation of Hydro Tasmania's hybrid off-grid product elements, through reducing the on-site construction and commissioning time and cost, a major component for projects in remote areas.	$13,380,475
Hydro Tasmania	Rottnest Island: Addressing the Energy and Water Nexus	This project will combine innovative use of renewable energy and smart controls to help reduce the amount of diesel fuel needed to generate power and produce clean drinking water at Rottnest Island, a popular tourist destination.	$6,096,391
Lakeland Solar & Storage Pty Limited	Lakeland Solar Storage Project	This project involves the construction of a large-scale solar plant with battery storage in the Lakeland region of North Queensland. The integration of big solar and battery storage has the potential to revolutionise power supply for fringe-of-grid locations.	$42,500,664
Lord Howe Island Board	Lord Howe Island Hybrid Renewable Project	The project will centralised solar PV and a Battery Energy Storage System and integration equipment.	$10,600,000
EDL Group Operations Pty Ltd	Coober Pedy Renewable Diesel Hybrid	This project will install 1MW solar, 4MW wind generation, a 1MW, 0.5MWh battery storage and inverter system as well as a range of additional proven technologies, integrated with Energy Developments Ltd's (EDL) existing 3.9MW diesel power station in Coober Pedy.	$38,860,080
Barcaldine Remote Community Solar Farm Pty Ltd	Barcaldine 25MW Remote Community Solar Project	The Barcaldine Remote Community Solar Farm (BRCSF) will be located in central Queensland within a fringe-of-grid area of super-premium solar irradiation. The project site is approximately 90 hectares and located near the Barcaldine Gas Power Plant.	$70,100,000
Karratha Solar Power No 1 Pty Ltd	Karratha Airport Solar Project	This project involves the design, construction, commissioning and operation of a 1 MW solar photovoltaic (PV) facility with cloud predictive technology (CPT) at Western Australia's second-largest airport Karratha Airport. The City of Karratha, which owns Karratha Airport, will enter into a 21 year power purchase agreement (PPA) with the solar plant.	$6,823,741

Degrussa Solar Project Pty Ltd	DeGrussa 10.56MW Off-Grid Solar PV/Storage Project	The project consists of a 10.6 MW (AC) solar PV power plant with storage at the DeGrussa Copper Mine. Commissioned in June 2016, solar power provides the majority of the mine's daytime electricity requirements, offsetting up to 20% of total diesel consumption annually. The project aims to increase knowledge and confidence in the use of renewable energy to power off-grid mine sites.	$39,477,750
Scouller Energy Pty Ltd	Normanton Solar Farm	As part of the Measure Ergon Retail will investigate the opportunity, technology requirements, business model and the value to customers, Ergon Retail and Ergon Network from the HES product offering. Ergon Retail believes the real value of batteries is to manage solar generation to create additional value for a number of stakeholders, and the HES product concept captures the mechanism (from a business model, customer offer and technology combination perspective) by which this can occur	$13,970,600
Voyages Indigenous Tourism	Yulara 1.8MW Dispersed PV	This project, commissioned in March 2016, integrates 1.8 MW of solar photovoltaics (PV) into the existing power system at the Yulara Resort near the iconic Uluru in the Northern Territory. This system could become a showcase for sustainable eco-tourism, setting a benchmark for other remote tourism operations. Outcomes and learnings from the project will be shared in support of knowledge sharing requirements.	$6,894,550
Weipa Solar Farm Pty Ltd	Weipa Solar PV Project	This project involves the two stage construction and operation of a 6.7MW solar photovoltaic (PV) solar farm at Rio Tinto's remote bauxite operation in Weipa. The first stage of the system is complete and connected to the existing mini-grid at Weipa, delivering electricity under a long term Power Purchase Agreement (PPA).	$23,327,145
Laing O'Rourke Australia Pty Ltd	Redeployable Solar First Deployment	This Project will undertake the manufacture and deployment to the Combabula 350-person accommodation village in Queensland, of the world's first large-scale, portable solar-diesel hybrid power plant, a technology that is highly relevant for Australian off-grid, fringe-of-grid and grid-constrained users whose modus operandi is the diesel-only generator. The Project will undertake associated knowledge sharing activities.	$1,762,537
CSIRO	Novel Concepts for Low Cost Small Heliostats in Remote Installations	The project will develop a heliostat optimised for deployment in regional and remote areas of Australia. A heliostat is a device used for harnessing the sun's energy that includes a mirror which moves with the sun to continuously reflect light toward a fixed target.	$2,158,071
Carnegie Wave Energy Limited	Garden Island Microgrid Project	The Garden Island Microgrid project is being developed the ability to produce both power and desalinated water. The Project will involve the construction and integration of 2MW of photovoltaic solar capacity, a 2MW/0.5MWh battery storage system and a control system with the option to connect wave energy generation technology. Together this will form a microgrid designed to operate either independently or in conjunction with the Western Australian electricity network, seamlessly switching between the two through a control system. The project is aiming to demonstrate a renewable energy and water solution in an island/off-grid-ready microgrid setting.	$7,498,712

ENWAVE Energy Pty Ltd	Delivering higher renewable penetration in new land and housing developments through off-grid microgrids	This project aims to explore the commercial viability and impact of renewable energy for large new housing developments with off-grid microgrids. All Australian suburbs close to existing infrastructure are currently connected to one of the country's main electricity networks. Little is known about the opportunities and barriers to powering new residential developments with renewable energy and enabling technology, rather than connecting to the grid.	$1,106,000
Moreland Energy Foundation Limited (MEFL)	Feasibility and product design for inner city brown fields off-grid solar (called "Here Comes The Sun" HCS)	The Here Comes the Sun project addresses the feasibility of integrated local electricity networks that incorporate battery storage and demand management in existing residential suburbs. It evaluates the proposition that clusters of suburban houses sharing their electricity generated by PV systems and stored in batteries can produce better outcomes than each house operating independently and can result in reduced overall investment in both panels and batteries.	$225,800
The Australian National University	CONSORT: Consumer Energy Systems Providing Cost-Effective Grid Support	CONSORT will deploy consumer-owned PV and battery storage on Bruny Island, Tasmania, and develop control and optimisation software to overcome challenges faced by DNSP TasNetworks during peak load scenarios on the island. To achieve this, CONSORT will extend Reposit Power's platform by developing and demonstrating new algorithms for large-scale distributed coordination of battery storage, and will study consumer response to this technology. These algorithms provide dynamic pricing incentives, and will support the creation of regional electricity markets. In the same way that the NEM exists to match supply and demand NEM-wide, these regional markets will allow networks and consumers to proactively work together to overcome regional, spatio-temporal mismatch between distributed energy generation and consumption, and solve critical reliability issues related to capacity and voltage. The world-leading capabilities developed will provide clear commercialisation and incentivisation pathways for using consumer-owned PV and battery storage to address current and emerging market, DNSP and consumer energy challenges.	$7,991,746
NEV POWER PTY LTD	Narara Ecovillage smart grid	This project aims to balance the energy generation, consumption and storage in a new development, initially of 50 houses. Smart grid technology will be used to monitor loads, determine usage patterns, particularly peak load periods, and forecasting weather events, especially those affecting renewable energy generation. The smart grid technologies will also co-ordinate the connection to the NSW grid for the village.	$2,472,000
Regional Power Corporation	2016/ARP037 - Horizon Power Business Model Pilot Project - Phase 1	The Project will trial a variety of behind-the-meter distributed energy system in Carnarvon, Western Australia to resolve the technical and transitional barriers to adopting a high penetration DER generation model, and lower the overall system cost to supply. 10 PV/Battery combo systems, from varying brands who have demonstrated strong support for Sunspec , will be installed at selected customer premises to test their remote control functionality (via Sunspec) and ability to contribute to network power quality, including an assessment of the functionality available to our customers for participation in reformed tariff environments - Microgrid operation or future trading mechanisms.	$7,087,296

Sea Box International Pty Ltd	Sea Box International - Design, manufacture and test of a factory assembled and relocatable Container Roll Out Warehousing System - Photovoltaic (CROWS-PV)	This Project will is to finalise design of the 40 foot and 20 foot CROWS-PV (Container Roll-Out Warehousing System) units to deliver a 'fit for purpose' rapidly redeployable, robust Solar PV system and test the mobility characteristics of the system. Since executing the Funding Agreement, Sea Box International has changed its name to ECLIPS.	$703,468
LO3 Energy Pty Ltd	Latrobe Valley Microgrid - Feasibility Assessment	LO3 Energy has developed a blockchain-based energy platform called Exergy, running in LO3's first project - the Brooklyn Microgrid. A blockchain is a seamless, secure, self-executing transaction system. Blockchain technology allows devices at grid edge to transact with any other entity, whether it be another user or utility, rather than centralized systems, which require data from millions of IoT devices to go from grid edge to data center back to grid edge. Users can set preferences for how devices should react, or just enroll with a third party who handles it all for them. Once preferences are set, customer devices and local grid systems transact kWh, kW, and kVAR in near real-time and self-executing contracts convert transactions into grid operations. For example, users can choose to purchase locally generated clean energy or only use their devices within certain price ranges. Eventually, devices within a blockchain platform can become self-organizing based on economic efficiency, leading to a more flexible and resilient grid. The Latrobe Valley Microgrid wants to test this with real customers in Australia, in a regional setting, and the detailed feasibility assessment is the first step towards implementation.	$775,000