Over the Edge: The Australian Outlook for Embedded Microgrids to 2027

A Confidential Report for Strategic Research Clients

ENERGEIA

1.0 Overview

Embedded microgrids are set to become a cost effective approach for customers to increase the reliability of their electricity supply above grid levels within the decade. Longer-term, Energeia expect they will offer all customers the ultimate choice of disconnecting from the network, unleashing a new era of electricity industry transformation and regulatory reform.

In this confidential report for our Strategic Research clients, Energeia examines the emerging market for embedded microgrid systems in Australia. The report analyses the market's key drivers, barriers, customer segments, technologies, products and industry players to gain insight into its medium to long-term outlook. Energeia's fifteen year view covers total investment potential, final costs to the end consumer, and total installed capacity, energy trade, and peak supply potential.

Most of the world's microgrids are remote islands of electricity unable to interconnect with larger systems. Embedded microgrids are a relatively new, grid-interactive breed offering end users the ability to achieve greater levels of reliability than the local network at relatively low cost. The key to an embedded microgrid's lower cost is its ability to shape its demand from the grid to minimise energy costs while providing valuable market and network services that help offset system costs.

Energeia's research has found that while few institutional barriers to them exist, Australia lacks a formal policy or regulatory framework to encourage embedded microgrids. The main policy gaps in Australia relative to international best practice are supply side government incentives to build industry capability, demand side incentives to build capacity, and truly cost reflective demand management (DM) incentives. There is also the need to adopt recently agreed international microgrid standards.

Demand for premium reliability, driven by a gap in performance relative to requirements, occurs in rural, suburban and urban systems. Energeia's market analysis has found existing markets for premium levels of reliability to be the most likely adopters of the technology as a means for lowering costs. However, embedded microgrid projects to date have mainly been driven by government programs aimed at increasing the penetration of low carbon energy supplies.

The lack of off-the-shelf solutions, industry immaturity and high costs are the key barriers in the Australian market for embedded microgrids. Few control systems are available here, and there is a major gap in the cost effectiveness and availability of key solution components including fuel cells, energy storage systems and demand management systems. Traditional, combustion based backup generation (other than cogeneration) is not viable due to their high operating costs and emissions.

The key questions facing the microgrid market are when and where it is likely to become cost effective. Energeia's modelling shows solar PV based microgrids are the most likely solutions to become cost effective in the next five to ten years, largely due to pre-existing solar PV resources and the anticipated declines in the cost of the storage and control systems. Falling costs are expected to widen the market for improved reliability, particularly for rural and residential energy users.

By 2027, Energeia's outlook is for over 74,000 customers to have invested $1.3 billion in embedded microgrid solutions to access better than grid levels of reliability. The market's total installed demand response capacity is estimated to be 42 MW with annual energy exports of 60 MWh. Although we expect lower prices to expand the market scope, Energeia sees the business segment representing a relatively small share of the overall market due to relatively fewer sites.

Energeia expects greater policy support for embedded microgrids once policymakers become aware of their potential for equalising the electricity service reliability of rural and remote areas. We also expect they will increasingly be promoted as a check on the monopoly power of electricity networks and the market power of major generators. As the technology matures and costs fall, Energeia expects more customers will begin to go 'over the edge' and completely disconnect from the network.

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The key value proposition of a microgrid is its ability to provide better than grid supplied reliability by operating when the network is down. Customers valuing higher reliability have traditionally relied upon a local source of backup power, such as a petrol fuelled generator or batteries, which typically only meet a portion of the load. In some cases, customers might pay for an additional network connection with an alternative source of upstream supply.

The promise of microgrids to supply backup power at relatively low emissions and/or cost holds the potential to expand the market for higher reliability by making it more affordable. Embedded microgrids can reduce the cost of backup power by subsidising it through off-peak energy purchases and offering demand response services to offset system costs. Key technology breakthroughs, e.g. falling solar prices and new fuel cells based technologies, allow greater utilisation of microgrid energy resources in urban settings normally constrained by emissions and noise restrictions.

2.1. Scope

This report is part of Energeia's strategic research service covering energy technology, which focuses on the emerging energy technologies that will power the Customer of the Future. The report addresses the market for embedded microgrids over the next fifteen years, microgrid solutions and products, and the industry value chain that will develop, manufacture, distribute and service them.

Figure 1 – Report Scope

	In Scope
Segments	
Residential	✔
Commercial	✔
Government	✔
Military	✘
Off-Grid	✘
Technology	
Controllers	✔
Solar PV	✔
Storage	✔
Fuel Cell	✔
Diesel	✔
Wind	✘

Source: Energeia

The report's in-scope market segments and microgrid technology elements are presented in Figure 1. The focus on embedded microgrids excludes the off-grid microgrid market and the military microgrid market is also out of scope due to its relatively unique operating requirements. Onsite wind has been excluded from our analysis in this report due to its relatively immature development state.

2.2. Definitions

The US DOE Microgrid Exchange Group defines an embedded microgrid as a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid dynamically to enable it to operate in both grid-connected or island-mode. Figure 2 illustrates a typical microgrid topology.

8.0 Glossary

This report uses the following abbreviations:

ACT	Australian Capital Territory
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
APVA	Australian PV Association
ARRA	American Recovery and Reinvestment Act
AU	Australia
CEC	California Energy Commission
CER	Certified Emissions Reduction
CERTS	Consortium for Electric Reliability Technology Solutions
CHP	Combined Heat and Power
COAG	Council of Australian Governments
CPRS	Carbon Pollution Reduction Scheme
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CUPC	California Public Utilities Commission
DM	Demand Management
DER	Distributed Energy Resources
DG	Distributed Generation
DOD	Department of Defence
DOE	Department of Energy
DRET	Federal Department of Resource Energy and Tourism
DSES	Demand Side Engagement Strategy
DSP	Demand Side Participation
EA	EnergyAustralia
ERU	Emissions Removal Unit
ESV	Energy Safe Victoria
EU	European Union
FERC	Federal Energy Regulatory Commission
FiT	Feed-in-Tariff
GCSS	Guaranteed Customer Service Standards
HAN	Home Area Network
HEM	Home Energy Management
IEC	International Electrotechnical Commission
IP	Internet Protocol
IT	Information Technology
kW	Kilo Watt
kWh	Kilo Watt Hour
kVA	Kilovolt-Ampere
LAN	Local Area Network
LI-ION	Lithium-ion
LPG	Liquefied Petroleum Gas
LRET	Large-scale Renewable Energy Target
LRMC	Long-Run-Marginal-Cost
LV	Low Voltage
MCE	Ministerial Council on Energy
METI	Ministry of Economy Trade and Industry
MRET	Mandatory Renewable Energy Target
MW	Mega Watt
NEDO	New Energy and Industrial Technology Development Organisation
NEEI	National Energy Efficiency Initiative
NER	National Electricity Rules
NSMP	National Smart Metering Program
NSW	New South Wales
PV	Photovoltaic
QLD	Queensland
R&D	Research and Development
RAPS	Remote Area Power System
REC	Renewable Energy Certificates
RET	Renewable Energy Target
SA	South Australia
SAIDI	System Average Interruption Duration
SAPS	Stand Alone Power System
SCER	Standing Council on Energy and Resources
SCO	Standing Committee of Officials
SGIG	Smart Grid Investment Grant
SNC	Smart Network Committee
STC	Small-scale Technology Certificate
STPIS	Service Target Performance Incentive Scheme
TAS	Tasmania
TOU	Time-of-Use
UPS	Uninterruptible Power Supply
VCR	Value of Customer Reliability
VIC	Victoria
VRLA	Valve Regulated Lead Acid
WA	Western Australia
WACC	Weighted Average Cost of Capital
WAN	Wide Area Network

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