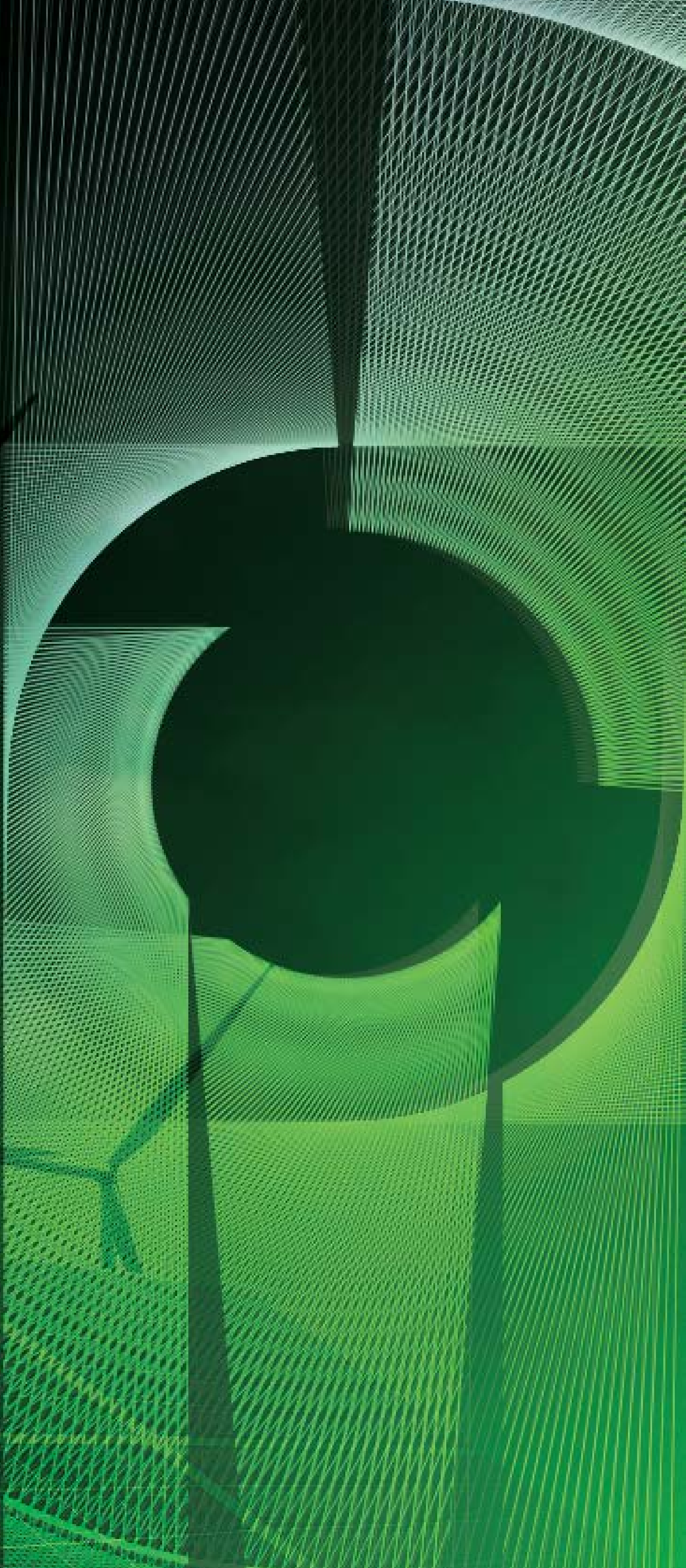
MONASH University

MICROGRID ELECTRICITY
MARKET OPERATORS

VICTORIAN MARKET ASSESSMENT
WHITE PAPER FACT SHEET
MAY 2019

monash.edu/net-zero-initiative



INCREASING THE DEPLOYMENT OF MICROGRIDS COULD HAVE SUBSTANTIAL BENEFITS FOR VICTORIA, WITH AN **ESTIMATED POTENTIAL $22 TO $36 MILLION MARKET** IN GROSS ECONOMIC VALUE PER YEAR, IMPROVED GRID STABILITY, LOWER ENERGY BILLS FOR CUSTOMERS, AND GREATER PENETRATION OF DISTRIBUTED RENEWABLE GENERATION.

Monash University acknowledges the support of the Victorian Government.

ENABLING MICROGRIDS OFFERS SIGNIFICANT PRIVATE, PUBLIC AND MARKET BENEFITS

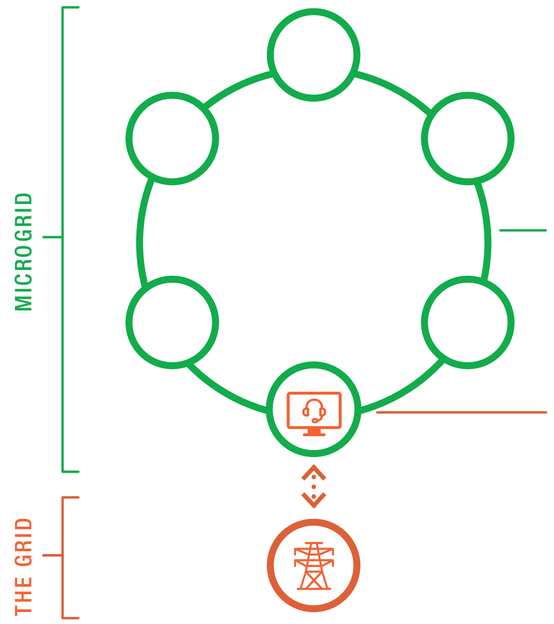
THE ENERGY MARKET IS TRANSFORMING

It is moving away from centralised generation, as more and more renewables and storage (e.g. solar panels on residential and commercial rooftops and batteries) are connected behind the meter.

And both customers and the broader network stand to benefit in many ways – but only if the right market design, policies and rules are in place.

EFFICIENTLY USING ENERGY RESOURCES WITHIN MICROGRIDS WOULD:

- Lower energy costs by shifting demand to low price periods
- Manage batteries and behind-the-meter generation to respond to changes in energy generation, demand and price
- Allow prosumers to share/trade renewably generated energy with each other



MICROGRIDS

A microgrid is a small electricity network, composed of multiple co-located customers with their own electricity consumption needs and power generation. Through co-ordinating connected renewable **generation and batteries, microgrids can benefit** their own customers and the broader market.

MICROGRID OPERATORS

A microgrid operator provides the point of coordination for the batteries and renewables connected to the microgrid. The microgrid operator also provides an interface with the wholesale electricity market and the ancillary services market to manage system frequency and voltage.

INTERACTING WITH THE BROADER ELECTRICITY NETWORK AND MARKET, MICROGRID OPERATORS COULD:

- Reduce pressure on network during high and peak demand
- Sell renewable generation in wholesale market the broader electricity network
- Provide frequency and voltage control services to the grid through the ancillary services market
- Help the grid to respond to emergencies

With the right market design, policies and regulations in place, microgrids could provide **$22 to $36 million in gross economic value for Victoria.** Microgrids could also improve grid stability, lower energy bills for customers, and enable greater penetration of behind-the-meter renewable generation.

Microgrids could represent an attractive financial proposition for residential, commercial and industrial customers and prospective microgrid operators. Through coordination of customers' distributed energy resources by a dedicated microgrid operator, microgrids can improve the efficiency of energy use within the microgrid, provide valuable services to the broader electricity market and contribute to system reliability and security. The Victorian Market Assessment White Paper identifies an initial set of policy, market design, and regulatory enhancements which could be implemented to improve microgrid customers' and operators' capacity to access the economic value of controlling their distributed energy resources. This could enable greater uptake of microgrids and unlock the potential value for Victoria.

ELECTRICITY MARKETS ARE RAPIDLY CHANGING

Distributed energy resources (DER) and decentralised power systems are fast becoming significant challenges to the traditional paradigm of Australia's electricity markets. In Victoria, and elsewhere in the Australian National Energy Market (NEM), DER are increasingly being deployed "behind the meter" at the customers' premises. An increasing number of prosumers are seeking to mitigate rising electricity prices and reduce their greenhouse gas emissions through deploying their own on-site renewable generation and storage.

CHANGE ALSO BRINGS MANY OPPORTUNITIES

The rise of DER presents both challenges and opportunities for the grid. Without a level of control and system integration, these decentralised solutions can create challenges for grid power quality and resilience. Conversely, coordinated and controlled use of customers' DER could provide substantial benefits for the stability of the network. However, the energy system is complex and customers are not currently able to access the value from their assets and investment.

A growing number of decentralised business models – including virtual power plants (VPPs), smart embedded networks and microgrids - are seeking to capture and provide new value streams to customers and other stakeholders. These new business models for managing two-way power flows also create new opportunities. In addition to securing higher penetration of renewables, the better coordinated deployment of DER can provide economic value to the market as a whole, and commercial value to consumers, market customers and distribution networks across the electricity sector. New business models could also help place consumer protection and interests at the core of their philosophy and commercial offering.

Microgrids provide one avenue for sharing and monetising value from the increasing volume of DER.

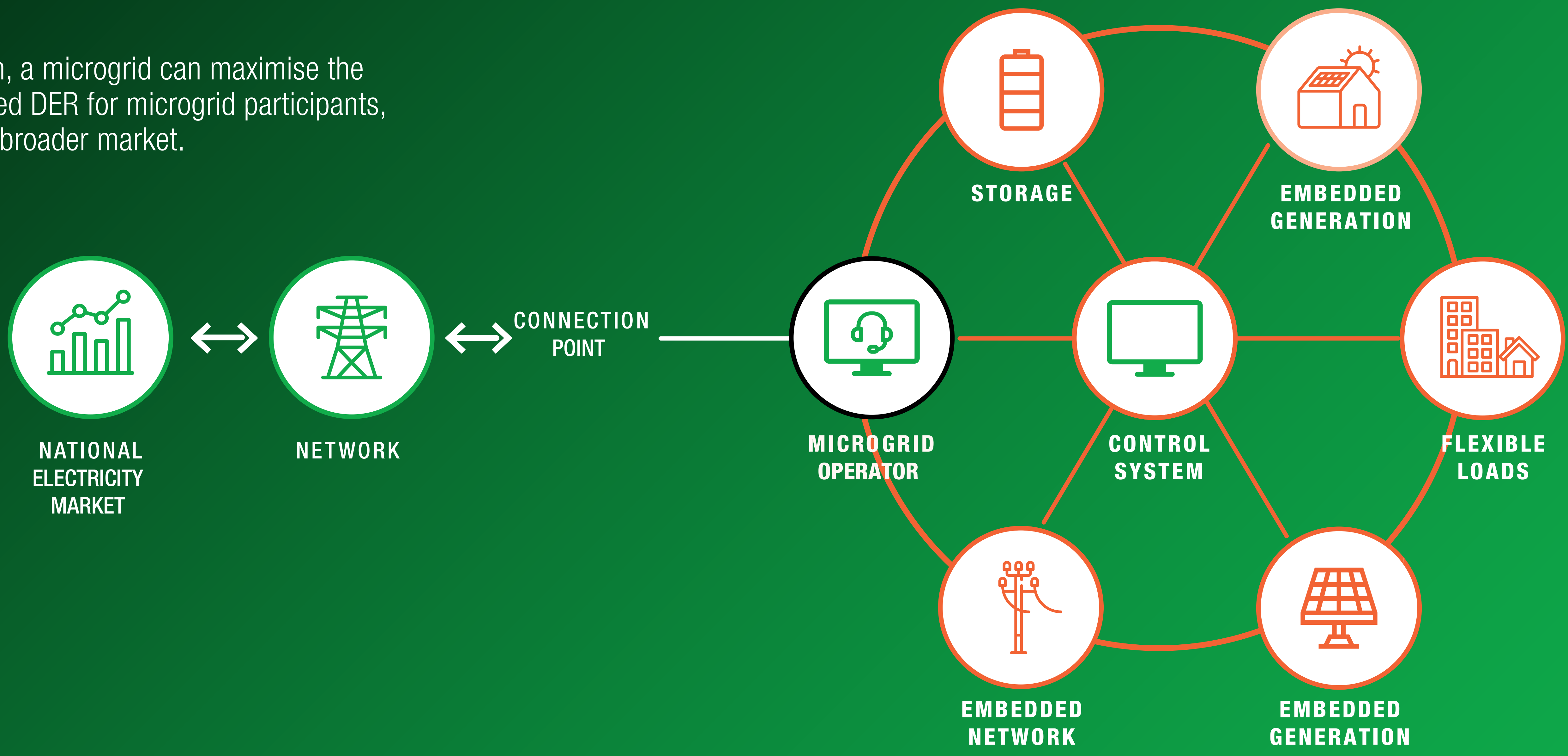
1. Distributed energy resources are small-scale load and generation facilities connected to the distribution system that could be controlled to the benefit of their owners. For example, rooftop solar, batteries and demand response.

CORE ELEMENTS OF A MICROGRID

A microgrid is a small electricity network, composed of multiple co-located customers with their own electricity consumption needs and power generation.

A microgrid has a single point of connection with the broader electricity market and a monitoring and control platform is used to coordinate the supply and demand of customers connected to the microgrid, and maintain grid stability.

Through coordination, a microgrid can maximise the value of the connected DER for microgrid participants, the network and the broader market.



MICROGRIDS INCLUDE A NUMBER OF PARTICIPANTS.

While some of these participants have well-established roles in the electricity market, others may represent new entities, which are evolving to provide services required in an increasingly distributed electricity system:

MICROGRID END USERS are connected to the microgrid and may or may not own distributed energy resources. Microgrid end users rely on the microgrid to supply their electricity needs and optimise the use of these resources.

The **MICROGRID NETWORK** owner owns the infrastructure that makes up the internal microgrid electricity network.

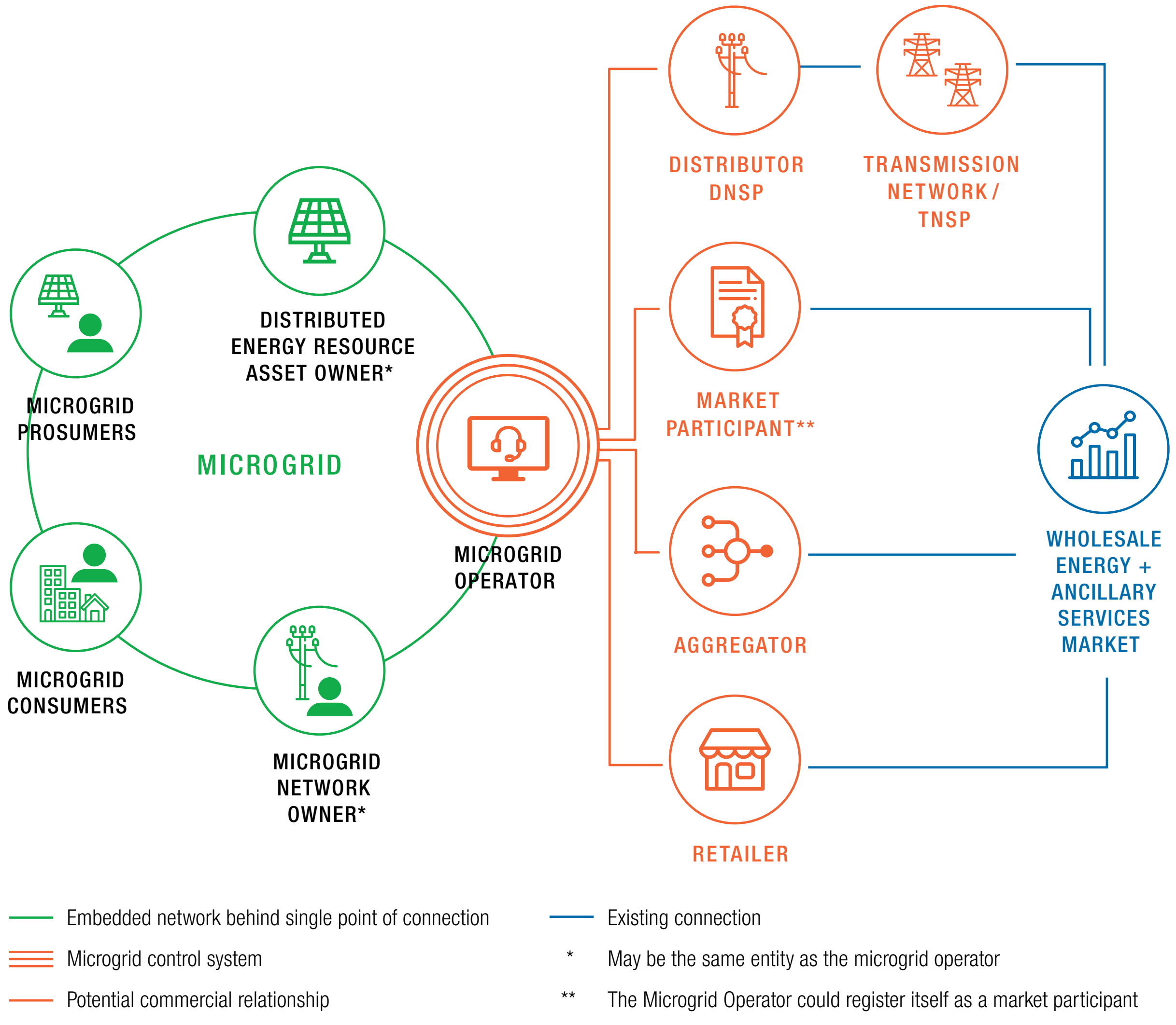
The **MICROGRID OPERATOR** provides the hardware and software to monitor and operate the microgrid facilities and services.

The **MICROGRID NETWORK OWNER** and the microgrid operator may be the same entity.

WHO DOES THE MICROGRID OPERATOR INTERACT WITH?

A microgrid operator provides the point of coordination for DER as well as the interface with the wholesale electricity market and the ancillary services market to manage system power quality (frequency and voltage control).

Microgrid end users and the microgrid network owner benefit from the services of the microgrid operator, as the operator enables better coordination of DER within the microgrid, and the sale of energy services on the broader grid. In return for providing this service, a microgrid operator could charge a fee to participating end users or share the profits from managing electricity transactions with the broader electricity market. These sources of revenue would enable the microgrid operator to maintain its business operations and provide the services promised to its end users. A microgrid operator could represent a new class of participant in the electricity market, or the interface role could potentially be taken up by a wholesale market customer, retailer, a service aggregator or network service provider. This will depend on the business case for such an entity to operate independently or in partnership with existing actors.



BENEFITS OF HAVING A MICROGRID OPERATOR

A microgrid operator would provide expertise and a range of services to help end users make and save money. Savings are made by coordinating DER so that they are used efficiently within the microgrid. This could include shifting demand away from peak times, when energy is expensive, to off-peak times when energy is cheaper. It could also include managing storage on the microgrid to better respond to changes in customers' energy generation and energy demand, sharing renewable generation between DER owners, and, depending on regulatory changes, trading renewable generation and use of storage between end users.

Through interfacing with the broader electricity market, the microgrid operator could also help customers gain financial benefits for the services that their DER provide to the broader grid. Customers' energy resources could be coordinated to reduce demand on the network in response to high price and peak demand times. If this reduction in peak demand can delay the need for upgrades of the distribution or transmission network or improve reliability of supply, these network support services could represent a potential revenue stream for the microgrid operator and customers. In addition, customers' energy resources could also be coordinated to provide additional electricity supply into the wholesale market during peak demand times. Customers may also be aggregated to provide system control services for the ancillary services market.

The deployment of microgrids may also have broader benefits for grid stability and greenhouse gas emissions. In comparison to the current scenario where distributed renewable generation is connected to the network on a case-by-case basis with individual controls, microgrids enable better management of local voltage. This should increase the grid's capacity to host renewables and help reduce greenhouse gas emissions from the electricity sector. Microgrids may also be able to assist in maintaining grid stability through providing distributed frequency control under extreme system conditions, and through providing emergency generation under extreme conditions, including sudden outage of generation and transmission assets.

ACTIONS ARE REQUIRED FOR THESE OPPORTUNITIES TO BE REALISED

For microgrids to become an attractive investment opportunity for electricity market participants, and for microgrid end-users, a range of policy, market design and regulatory issues need to be addressed.

Microgrids bring together a range of functions, such as supply of electricity to end-users, purchase and sale of electricity on the wholesale market and provision of ancillary services. With each of these functions regulated individually, microgrid regulation is currently a composite of the regulations that apply to each function. As a result, these regulations present a barrier to microgrids in three ways:

- Complexity;
- Uncertainty of interpretation - particularly the interaction of functions; and
- Prevention of access to value streams.

Some of these regulatory issues are not unique to microgrids. Because similar issues affect other distributed energy technologies a comprehensive review and reform of the regulatory framework may ultimately be required. However, in the meantime microgrids can be used as a test case for how regulatory frameworks should evolve to accommodate more sophisticated local electricity supply and services.

Using microgrids as a regulatory test case will also create an important feedback mechanism, and provide important lessons for the wider transformation of the sector.

The Victorian Market Assessment White Paper makes five initial recommendations which could begin to address these issues and improve microgrid operators' and participants' capacity to access the value of their DER.

RECOMMENDATIONS

01

Definition of a Microgrid:

Develop a non-exhaustive, non-prescriptive definition of a microgrid as a system that integrates local supply[2], network supply and electricity exported to the grid.

There is no definition of a microgrid in either the Victorian regulatory regime or the National Electricity Rules. Existing definitions of 'embedded network' and 'embedded generation' provide an inadequate basis for authorising and regulating microgrids.

A regulatory definition is needed to:

- clearly distinguish microgrids from embedded networks;
- enable microgrid activities and services to be authorised under the Victorian Electricity Industry Act (2000) and National Electricity Rules; and
- facilitate best practice consumer protection.

The development of a regulatory definition would complement the development of a model constitution for microgrid operators by the industry, which could provide an effective form of co-regulation ensuring that microgrid end users are afforded the same protections as other Victorian energy consumers.

02

Guidelines for Microgrids:

Given the growth in decentralised energy systems, it is recommended that the Essential Services Commission be asked to develop guidelines on the application of:

- the statutory licence/exemptions regime to microgrid activities and services;
- the Energy Retail Code to microgrid operators and end users;
- the Electricity Distribution Code to Distribution Network Service Providers (DNSPs) in their dealings with microgrid operators.

03

Undertake Feasibility Study into Establishment of Independent Distribution System Operator (DSO)[3]:

At present, there is limited transparency and independence in assessing the value of services that defer investment in the distribution network. These services are a potentially important and growing source of revenue for microgrids. Currently, the benefit of providing these services is calculated by the distributor, and service providers must engage in expensive contract negotiations with the distributor to access this revenue stream. The ad hoc nature of current arrangements for network support services also limits competition for the provision of these services. Establishing an independent DSO could help to overcome these issues. The role of the DSO could include the development of a transparent market for the provision of a defined network support service.

04

Protect Local Supply in any New Regulatory Changes:

Victoria should ensure that any changes to the National Electricity Rules, especially as they relate to embedded networks and consumer protection, do not create new technical or financial barriers that will in practice prevent local supply in microgrids. Ensuring microgrid value streams can be accessed requires local supply to be enabled.

05

Investigate Market Design to Enable Access to Value from Reduced Loss Factors:

It is recommended that potential market design changes be investigated to enable microgrid participants to access a share of the value of reduced loss factors from shifting load from high load to low load periods. While a substantial regional benefit could arise from such activity, the economic benefit would be spread across all consumers and so microgrid operators and their customers could not be rewarded for providing this value. If microgrid operators and their customers could be rewarded, it would provide additional incentive for load shifting, battery storage and microgrid control.

2. Local supply means electricity generated or stored within a microgrid and supplied to customers connected to the embedded network.
3. The feasibility study should take into account the findings of the Open Energy Networks process being delivered by the Energy Networks Association and Australian Energy Market Operator. In comparison to this process, the feasibility study should include a broader remit regarding the role of the Distribution System Operator.

VICTORIA STANDS TO BENEFIT GREATLY

If these policy, market design, and regulatory issues are addressed, they could help enable deployment of microgrids which could create substantial economic value for Victoria. There may however, be further regulatory amendments required to enable the full potential of microgrids to be realised. This project will continue to investigate these and make further recommendations in its final report. It is estimated that $22 million per year levelised over the period from 2018-19 to 2022-23 in value could be created, assuming sufficient load could be aggregated by appropriately placed microgrids.

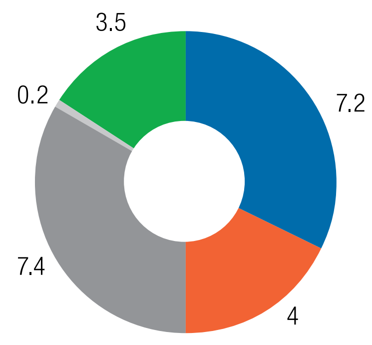
This value in part arises from reduced loss factors on the distribution and transmission networks from load shifting from peak to off-peak periods ($3.5 million) as the microgrid flattens and shifts its external electricity consumption. Value also arises from earnings that accrue to the microgrid operator and customers from a number of sources, including participation in the ancillary services ($7.4 million), the energy market value of load shift to off-peak periods to provide network support services ($7.2 million), load reduction for network support to reduce expected unserved energy ($4.0 million) and distributed voltage control ($0.2 million). We calculate a potential upper estimate of value at $51 million per year, depending on the potential for microgrids to enable the deferral of network upgrades on a planned basis, and the level of contribution of microgrids to voltage and frequency control. These values are expected to increase beyond 2023 in real terms as the penetration of renewable energy increases in the electricity market and the value offered by distributed resources grows.

To enable greater deployment of microgrids, the Victorian Market Assessment White Paper strongly recommends that further work is carried out to identify opportunities to develop microgrid pilot sites where strong benefits are apparent, and address the policy, market design and regulatory issues identified in this paper. In the longer term, greater uptake of microgrids could unlock substantial economic value, improve grid stability, and reward customers for their investments in distributed renewable generation and storage.

POTENTIAL VALUE OF MICROGRIDS TO VICTORIA

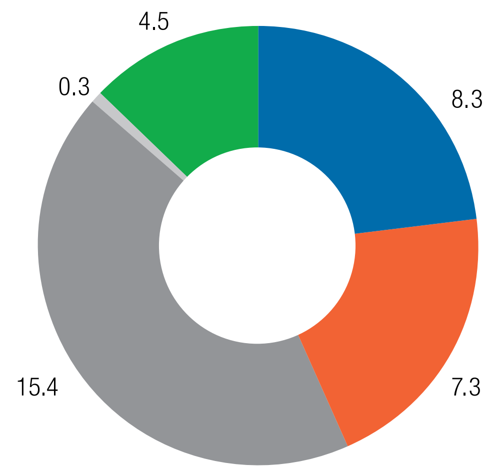
LEVELISED COST PER YEAR ($)

CONSERVATIVE



$22.3 MIL

MAXIMUM POTENTIAL



$35.8 MIL

PRIVATE BENEFIT

- Energy market value for load shift to off -peak periods

MARKET PARTICIPATION

- Load reduction for network support services
- Participation in the ancillary services market
- Distributed voltage control

MIX OF PRIVATE AND PUBLIC BENEFIT

- Reduced loss factors on the distribution and transmission networks from load shifting from peak to off-peak periods

NOTE: These values represent levelised value per year from 2018/19 to 2022/23 in $million per year. There is also a possible reduction in these values due to the conflict between network support and ancillary services. This could be $1.3mil conservative or $3.8mil maximum potential.

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FOR MORE INFO, PLEASE VISIT OUR WEBSITE:
monash.edu/net-zero-initiative

VICTORIA State Government | Environment, Land, Water and Planning

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