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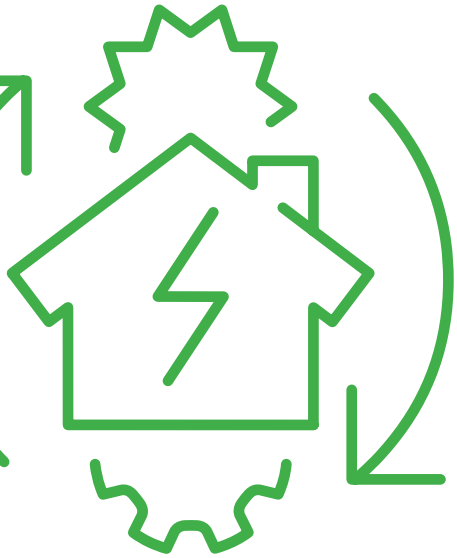


Introduction to Microgrids

Whitepaper

Traditionally, electricity is generated from a central source, which is then distributed via transmission lines to consumers. This electricity is usually fuelled by coal, gas or nuclear sources. However, the traditional power generation model is being put under more and more pressure, and in the interim, consumers are left exposed to power fluctuations, blackouts and more frequent critical infrastructure failures.

Users are looking for alternatives that can provide reliability, stability and lower costs. Users are also looking for solutions that can provide power in a more environmentally sustainable way than other fossil fuel powered plants. Distributed power systems, in the form of microgrids, are the future of power generation, providing independence, resilience, and environmental benefits, as well as providing a cost-effective source of supply.

What is a Microgrid?

The most common definition of a microgrid, (and the definition adopted by the USA's Department of Energy) is:

A group of interconnected loads and distributed energy resources with defined electrical boundaries forming a local electric power system at distribution voltage levels, that acts as a single controllable entity and is able to operate in either grid-connected or island mode. [1]

Put more simply, a microgrid is an independent power source providing power directly to meet local load requirements. A microgrid can be used independently, but it can also be connected to the power distribution network.

A microgrid can be comprised of a generator, a renewable source (such as solar, wind, or hydro power), batteries, mechanical storage (such as a flywheel) or any combination of these.

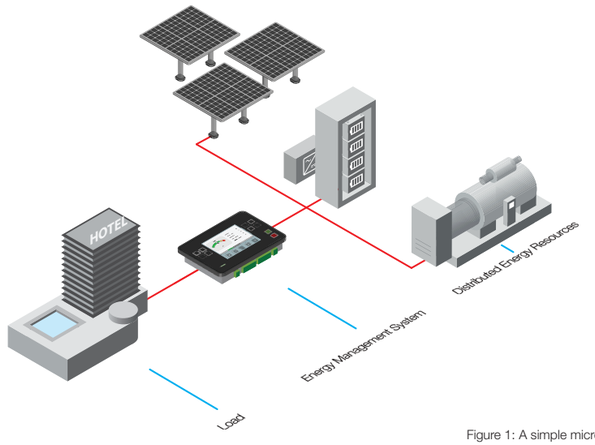


Figure 1: A simple microgrid

The main features of a microgrid include:

- operation in isolated or grid-connected modes
- a single controllable entity distinct from the power distribution network
- combination of interconnected loads and co-located power generation sources
- provision of increased levels of power quality and reliability for end-users
- designed to accommodate total system energy requirements

Distributed power systems, in the form of microgrids are the future of power generation

What are the components of a Microgrid?

Each microgrid needs to be designed and installed specifically for the site it is operating in, since the installation and power generation requirements will be determined by local consumption. However, most microgrids will have three common elements:

1 **Distributed Energy Resources (DERs)**

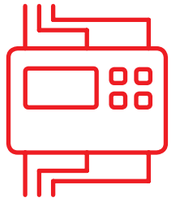
These can include traditional sources of power, such as a diesel or gas generators, as well as renewable systems like solar, wind or hydro power, and even dispatchable loads such as hydrogen electrolysers, EV chargers, and pumped storage.

2 **Energy Storage**

Renewable energy produced typically requires firming support provided energy storage systems. Battery Energy Storage Systems (BESS) are used most commonly for energy storage. Energy storage allows users to discharge stored energy during peak pricing or load times, or to provide coverage when the renewable source is temporarily unavailable due to, for example, lack of solar or wind resources.

3 **Energy Management System**

Due to the diversity of energy sources typically installed in a hybrid microgrid, an Energy Management System (EMS) is essential. The EMS needs to be capable of controlling all the different power generation sources and responding dynamically to any changes in load demands. The control system also needs to be able to prioritise the most efficient and cost-effective sources of supply from the system. It is also beneficial if the system can be monitored, managed and controlled remotely to save on ongoing operational costs.



What are the benefits of a Microgrid?

Microgrids provide many benefits by giving users a tool to personalise their energy generation and focus on what matters most to them. Typical benefits that microgrid installations offer are as follows:

1 **Energy Independence**

A microgrid allows users to be independent from the mains electricity grid for all their power needs. They may want to be independent of the grid because of electricity costs, unreliability of supply, or if the network operator is unable to support the growth of the business, i.e. supply is constrained.

2 **Reduction in Electricity Costs**

A user producing their own electricity can significantly reduce electricity costs, as instead of sourcing supply from an energy retailer at a standard price, users can use lower cost alternatives that they have available on premises e.g. renewables.

In some markets there are also programs that allow for any excess electricity produced to be sold back to the grid - providing further financial incentives.

3 **Environmental Sustainability**

A hybrid microgrid can offer many environmental benefits. Fossil fuels have a clear and recognised impact on our climate. Transitioning away from them, can help organisations meet their corporate social responsibility goals to reduce their environmental footprint. In certain settings it is possible to run a microgrid using only renewables, meaning no fossil fuels are used at all!

4 **Network Resilience**

Users producing power independently of the grid allows for the support of ailing or older infrastructure, rapid increases and decreases in demand and, improved quality of supply locally.

Microgrid operators can also consider leveraging their assets to offer Demand Response and other network balancing services, and in the process, receive additional financial returns from their investment.

Where can Microgrids be of benefit?

Microgrids can be of benefit in locations where the power distribution network is inaccessible, is unstable, or where a user prefers independence from the mains electricity grid.

Microgrids can be of benefit in places such as:

- Islands and remote rural communities and towns
- Mines, agriculture, and other remote operations
- Long-term disaster recovery (such as hurricanes, floods, storms, etc.)
- Datacentres
- Large retail, warehousing and distribution centres
- Military installations
- Edge of grid sites where extending the grid is prohibitively expensive
- Mains transmission and distribution repairs

What is the use case for a Microgrid?

Willinga Park, a popular equestrian facility in New South Wales, Australia, was struggling to cover their electricity needs during public events. The facility was connected to the grid, but it was at the edge of the grid network and upgrading the lines was not possible. The mains electricity supply was able to meet the facility's electricity demands during normal day-to-day operation, but during events the electricity demand increased two to three times, far outside the capacity of the available mains connection.

A hybrid microgrid was installed (behind the meter) comprising of diesel generators, photovoltaic panels and batteries as the solution to supplement the mains capacity during events and to operate as a backup power supply, should the mains become unavailable.

The microgrid at this facility consists of

- 500kW Controlled PV
- 300kW Uncontrolled PV
- 500kW / 2.2MWHr Battery Storage System
- ~4MW of Diesel Generation
    - 1 x 440 kW – 400V, 50Hz
    - 1 x 1.65 MW – 400V, 50Hz
    - 1 x 2MW – 400V, 50Hz

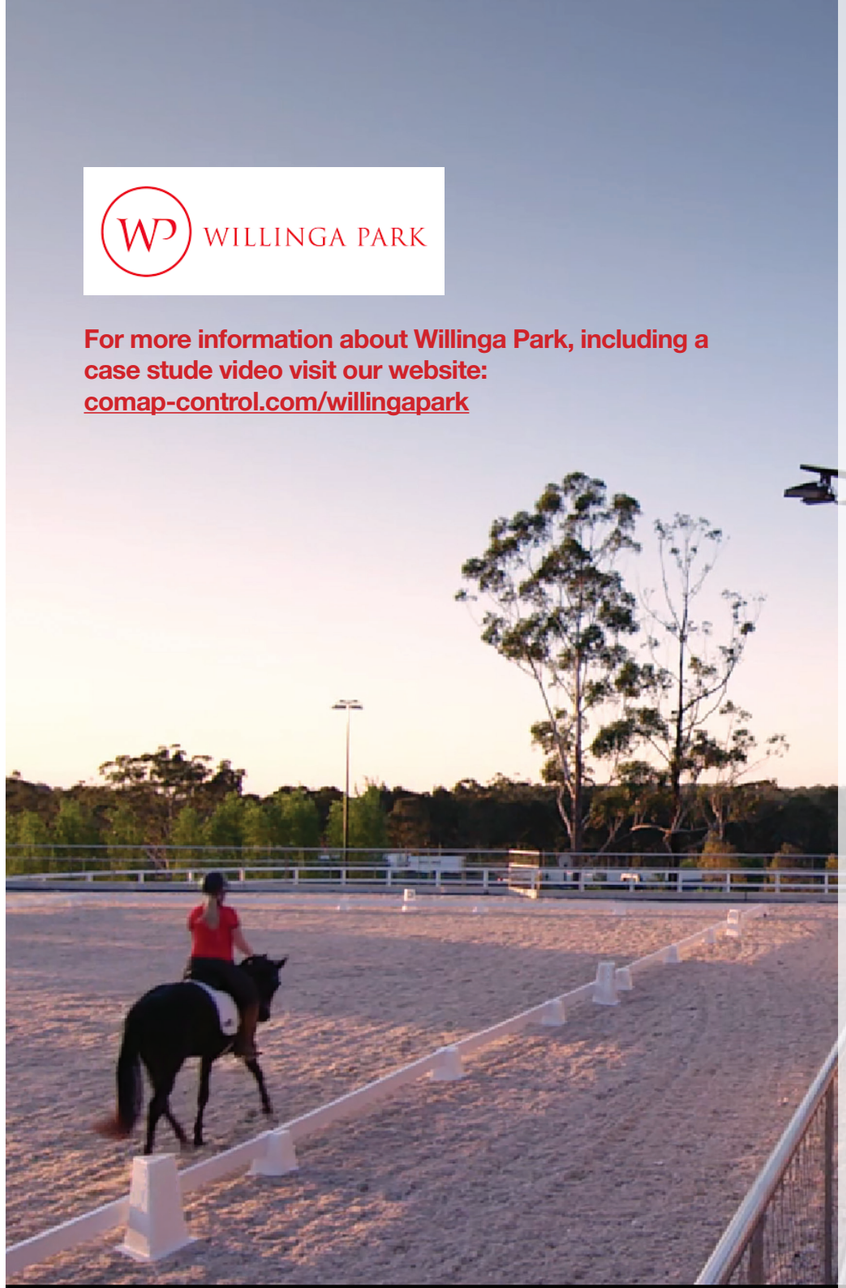
Using ComAp's InteliSys NTC Hybrid controller, the system was able to provide for the increased demands of the events, prioritising the use of renewable power, which saved the parks' owners a considerable amount of money across the multi-hectare site.

The system was designed to limit demand on the network, optimise the use of renewable energy, minimise operating costs and monitor/integrate the diverse balance of plant.

During the 2019-2020 Australian bushfires, Willinga Park's power system continued to operate and it became a hub for both the emergency services workers, and the local community.

WILLINGA PARK

For more information about Willinga Park, including a case stude video visit our website: comap-control.com/willingapark



For more information on how ComAp can help you with your microgrid design, installation and commisioning, please visit our website or email us at the address below.

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References
1: https://www.electropedia.org/iev/iev.nsf/display?open-form&ievref=617-04-22
2: Hayden, Ernie. Introduction to Microgrids. CISSP CEH Executive Consultant