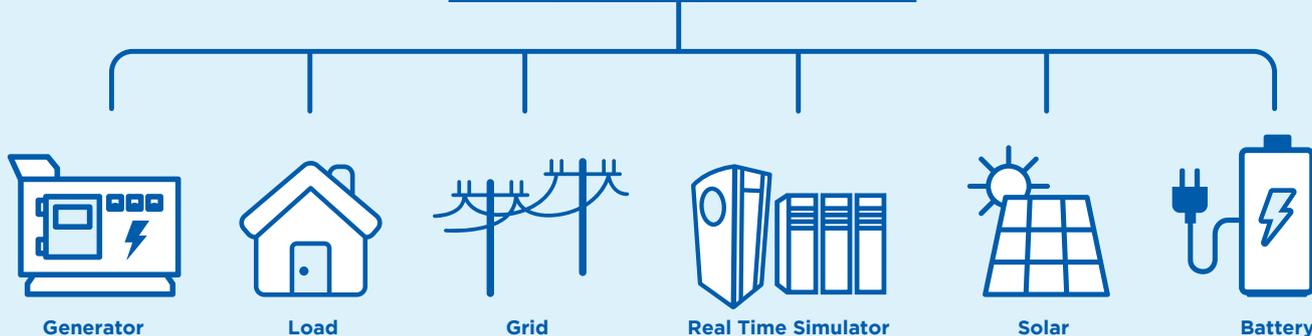


# MIST Facility Capabilities and Roadmap



Part of Energy Queensland



## Overview

The Microgrid and Isolated Systems Test (MIST) Facility is an advanced test and research facility located in tropical Far North Queensland. The facility builds on the success of Ergon Energy Network’s Innovation Lab which was the centre for early testing of residential inverter and battery systems and proved an invaluable asset for the network business. The MIST Facility is part of Ergon Energy Network’s Isolated Systems and is designed to advance the development and uptake of new technologies for power generation and electricity distribution supply, by leveraging state of the art equipment and testing capability.

## Access and Usage

Since its opening in 2021 the MIST Facility has delivered services that support the safe and reliable supply of the Isolated Network through testing control systems, energy storage and renewable generation integration scenarios.

On 8 April 2024 the Australian Energy Regulator approved Ergon Energy Network’s waiver application permitting Ergon Energy Network to lease the MIST Facility and its services to other entities until 30 June 2030.

The facility is not accredited through the National Association of Testing Authorities (NATA).



## Location and Context

MIST is strategically located in the northern most part of the National Electricity Market, and the gateway to the Torres Strait and other remote First Nations communities. The facility is one of the only advanced labs in Australia, designed to support the regional energy transition, to reduce the reliance on diesel fuel in our isolated networks. The strategic location enables:

- Testing new technology in the weakest parts of the electricity network, under harsh tropical conditions
- Driving the energy transition in our remote and regional areas
- Building local and regional skillsets in new technology.



## Existing Capabilities

- Flexible electrical LV device testing (up to 1MVA for each device with a total of 9 independent connection points)
- Full export connection, for synchronous generator and inverter-based connection up to 1MVA.
- Integrated high-speed monitoring system, for fast and configurable data capture and analysis
- On-site distributed energy resources available for different configurations
- Advanced testing using Hardware in the Loop (HIL) or Power Hardware in the Loop (PHIL)
- Hands on training facility linked to the test laboratory

## Expertise

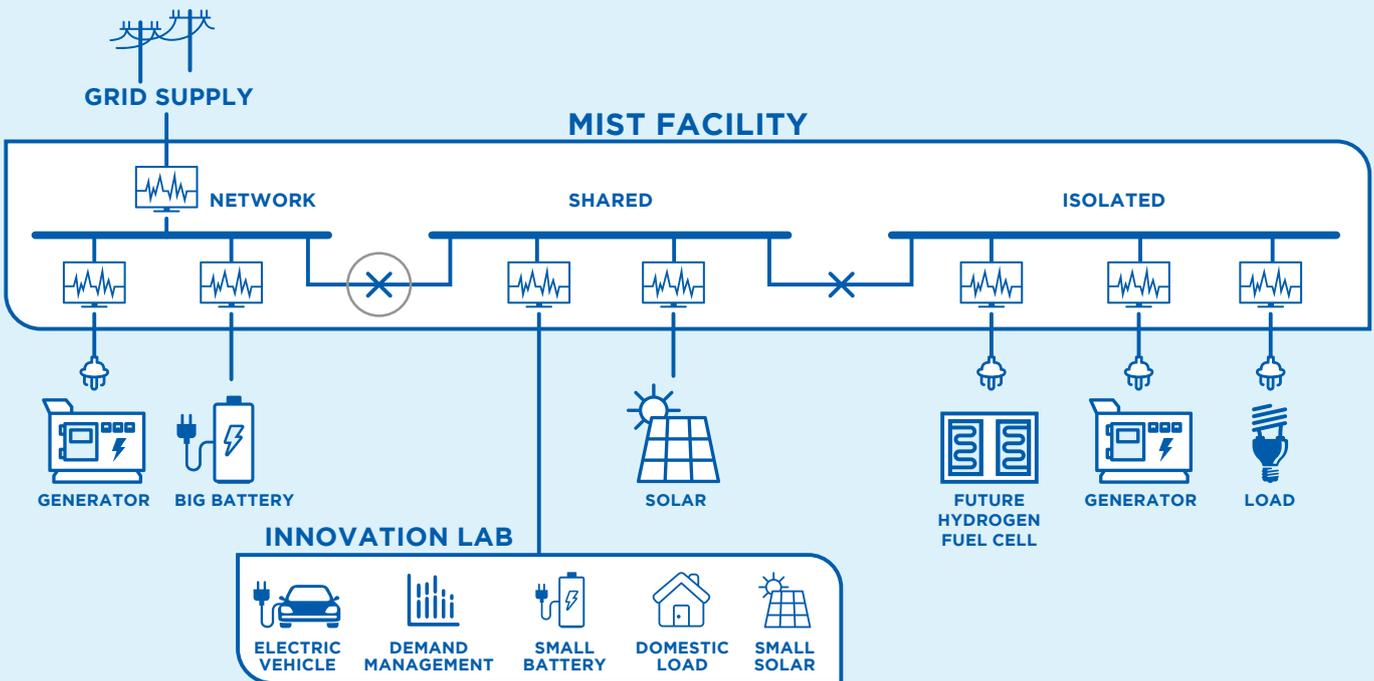
The team has been testing new technologies for over 15 years. Our highly capable engineering and electrical services professionals are experienced in:

- Product testing and deployment of new technologies in remote and fringe of grid areas.
- Functional test and inspection of small and medium scale inverter battery systems
- Operating diesel generation and power station control
- Connection of DER into the network (small and large-scale)
- Implementing standalone power systems (SAPS) across the project lifecycle
- Power system and control systems simulations
- Concept scoping, detailed design and project management,

Our team is linked to the Ergon Energy Network Innovation Lab, testing small-scale inverter and battery systems. Many of the learnings have directly fed into Australian Standards and connection policies.

# Technical details

Capability	Details
1MVA full export grid connection	<ul style="list-style-type: none"> <li>• Export connection for synchronous or inverter-based generation</li> <li>• Dedicated 22kV recloser with synchro-phasor technology</li> </ul>
Dedicated high-power LV switchboard for testing	<ul style="list-style-type: none"> <li>• Compliant to AS 61439</li> <li>• Flexible three-bus arrangement</li> <li>• 3000A rated bus</li> <li>• 1400A rated device</li> <li>• Powerlock connections for ease of device connection</li> </ul>
Fully integrated high-speed monitoring	<ul style="list-style-type: none"> <li>• 25kHz sampling, GPS clock synchronised</li> <li>• AS 61000 power quality</li> <li>• Analog, digital signals</li> <li>• Support of industry protocols</li> </ul>
On-site distributed energy resources	<ul style="list-style-type: none"> <li>• 50kW solar array with station control</li> <li>• Multiple small-scale solar arrays</li> <li>• Various diesel generators available</li> <li>• 83kVA/200kWh battery energy storage system</li> </ul>
Solar Simulator	<ul style="list-style-type: none"> <li>• 3 x 12kVA bi-directional solar simulator</li> </ul>
Real-time digital simulator (RTDS)	<ul style="list-style-type: none"> <li>• 1 x NovaCor chassis – 5 cores licensed</li> <li>• 2 x GTNet card – Modbus, DNP, GSE, SV</li> <li>• 24 Ch high precision analogue outputs</li> <li>• 48 Ch high precision analogue inputs</li> <li>• 64 Ch digital inputs</li> <li>• 64 Ch digital outputs</li> </ul>
Power amplifier	<ul style="list-style-type: none"> <li>• 30kVA single-phase or three-phase</li> <li>• Linear 4-quadrant voltage or current amplifier</li> <li>• Run standalone or fibre linked to Real Time Digital Simulator (RTDS) for Power Hardware in the Loop (PHIL) testing</li> <li>• Extremely low harmonic distortion (0.6% max at 270V DC to 450Hz)</li> </ul>



# Expertise

Services which can be offered fall into the following broad categories:



## Live Power Testing of Third-party Devices

Electrical testing of multiple low-voltage electrical devices up to 1MVA each. Testing of multiple devices connected together to observe interaction (i.e. testing solar, batteries and diesel together). Stress test devices and prove functionality in a safe and controlled environment before deploying into the field.



## Feasibility Studies, Concept Design and Rapid Prototyping

The RTDS is a powerful computing tool which enables complex modelling and simulations in a safe environment. This can be used to efficiently take a project from feasibility, concept design through to rapid prototyping, by coupling this service with digital twins and Hardware in the Loop Testing.



## Creation of Digital Twins

A digital twin is a virtual representation of a complex system, which can be a large power system, inverter, battery or diesel generator. Digital twins are considered a vital part of grid modernisation and the energy transition, to improve testing capability and efficiency, and allow rapid prototyping of new technology.



## Power Hardware-In-the-Loop (PHIL) Testing

A 30kVA linear power amplifier interfaces with the RTDS via fibre optic connection. The power amplifier utilises four quadrant voltage and current amplification to convert the voltage and current reference signals from the RTDS simulated model into power signals for the device under test. This process facilitates the closed-loop feedback of the system and effectively brings the physical device under test into the simulation.



## Training

Our training room within the MIST facility enables classroom-style teaching, which can be combined with hands-on experience and exposure to a wide range of technologies.



## Standards Development Test Support

The capability of the MIST Facility's test equipment to facilitate complex testing and perform accurate data capture can be used to support the development of standards. Specifically, the facility can be used to examine the challenges arising from new compliance testing or procedures being drafted into standards while they are in the development phase to better inform standards committees as they formulate new requirements. We have already contributed to AS/NZS 4777 and AS/NZS 5139.



## Control Hardware-In-the-Loop (CHIL) Testing

This is an advanced testing capability that allows stress-testing of third-party controllers under real-world scenarios. CHIL allows a controller to be tested without requiring the physical devices, which is achieved by creating a digital twin. Not only is this more economical, but it also allows the behaviour of the controller to be tested in response to complex system conditions that may be difficult to replicate on physical devices, but simple to replicate on a simulated system. For example, the control algorithms of a microgrid controller may be rigorously tested without requiring physical batteries, solar inverters, diesel generators which may present cost, safety, and practicality limitations.



## Type Testing

The energy transition is driving innovation in equipment and products. This presents a risk to the energy supply as products are rapidly changing in both hardware and software. In the MIST Facility, we can provide type testing services to ensure a consistent standard can be applied to new products.

## Roadmap

The capabilities of the MIST Facility are recognised as a key part of supporting the transition to renewables. However, technology is moving at a rapid pace and as such, a facility roadmap is crucial to chart the path to maintain relevant capability and consider future gaps and skillsets.

### Current Opportunities

**Testing Microgrid and Hybrid Systems** - Testing and integration of new technology to support the energy transition in remote communities and microgrids for regional communities.

**Digital Twins and Cybersecurity** - With growing complexity and risk in the low-carbon energy future, digital twins are recognised as an important tool to simulate real-world conditions and enhance test capability. Using the RTDS, digital models of critical systems can be developed and tested and advanced cybersecurity testing can be undertaken.

**Skills Training** - The energy transition relies on technically skilled workers to design, install and operate renewable energy systems. The MIST Facility has the potential to become Queensland's premier training facility for hands-on experience with integrating renewable generation, batteries, inverters and control systems extending across grid-connected, microgrid and off-grid applications. The MIST Facility supports the Ergon Energy Network workforce and local industry with a longer-term goal to provide training services Australia-wide.

**Research Partnerships** - Continue to expand our partnerships with regional universities in critical research areas.

**EV Charging and V2X** - EV adoption is still in its infancy but like rooftop solar it is expected to rapidly increase in the coming years, as will consumer interest in Vehicle-to-Grid and Vehicle-to-House capability. The MIST Facility and Innovation Lab present an opportunity to test the functionality of residential and small-scale commercial electric vehicle supply equipment, particularly where EVs will form a significant part of virtual power plants and demand flexibility programs.



## Future Opportunities

**High Voltage Testing** - Batteries and the power conversion equipment required to connect them to the grid are not mature and integration is proving a challenge. With the size and scale of batteries increasing there is an opportunity to upgrade the site to accommodate a high-voltage connection to test larger systems. Providing a means of high voltage and high power testing would enable the facility to better support a broader range of battery integration as their application scales across our distribution and sub-transmission networks.

**Processing Power for Digital Twins** - As we progress through the energy transition, we need to build more complex and more accurate digital models of the power system. These models will allow engineers and system operators to undertake scenario testing and simulations to identify weaknesses in the system response triggered by a significant asset failure and minimise the risk of a widespread blackout. Increased computing power through an expansion of the RTDS capacity would be required.

**EV Charging Infrastructure** - The MIST facility can be used to test charging systems and inform Australian Standards, and utility connection guidelines to enable the charging infrastructure that will be required to support mass electric vehicle adoption in Queensland.

**Testing of Alternative Battery Technologies** - As Australia develops the critical minerals and battery manufacturing industry, we will see third-party development in alternative technologies such as flow batteries and hydrogen. MIST will build off previous experience in flow and hydrogen projects and expand the MIST Facility to safely accommodate these technologies.



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