



A COMPLETE ENERGY STORAGE SOLUTION
FOR **STABLE** AND **SMARTER** GRIDS



Aytemiz | **POWER**
MAKELSAN | **FOR LIFE**
Uninterruptible Power Supplies/Generator

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Energy Storage for a Sustainable World



Fundamentally, countries worldwide are actively making steps towards creating more energy efficient and yet cleaner cities. As the energy industry moves away from carbon-heavy production, renewable energy and storage is being critical for delivering on the demand while securing the future of world energy and playing a prominent role in a grid that is migrating

to a higher penetration of renewable energy, smarter grids, and flexible grids. However, high penetration creates power transmission instability challenges, thus Grid Operators require stringent dynamic and static grid support features for Power Conversion Systems.

For the challenge of energy stability, Makelsan has solutions from kW to MW

For a stable transmission and distribution, the power grid operators need a real-time match between electricity supply and consumption.

Challenges that Makelsan DRM can address:

- Output variability,
- The temporal (time-related) mismatch between generation and demand,
- Uncertainty regarding weather forecasts, and
- Undesirable electrical effects on the electrical grid caused by some RE generation.






Makelsan DRM solution offers proven hardware to meet storage and grid support challenges.

DRM - An innovative energy storage system for the smart management of electrical grids

DRM is a fully integrated turnkey energy storage solution that are ready for connection to medium-or high-voltage grids and cover a power range of hundreds of megawatts. With over 40 years experience in power electronic, Makelsan has developed DRM Energy Storage System for on grid and off grid application with typical loads between 400 kW and 1 MW.

The DRM system is fully compliant with grid systems to import and export power inline with the voltage and frequency regulations, FFR and DFFR schemes required by utilities to support the grid. The DRM can be used to support the stabilisation of the grid to manage the consumption and the production of renewable energy.

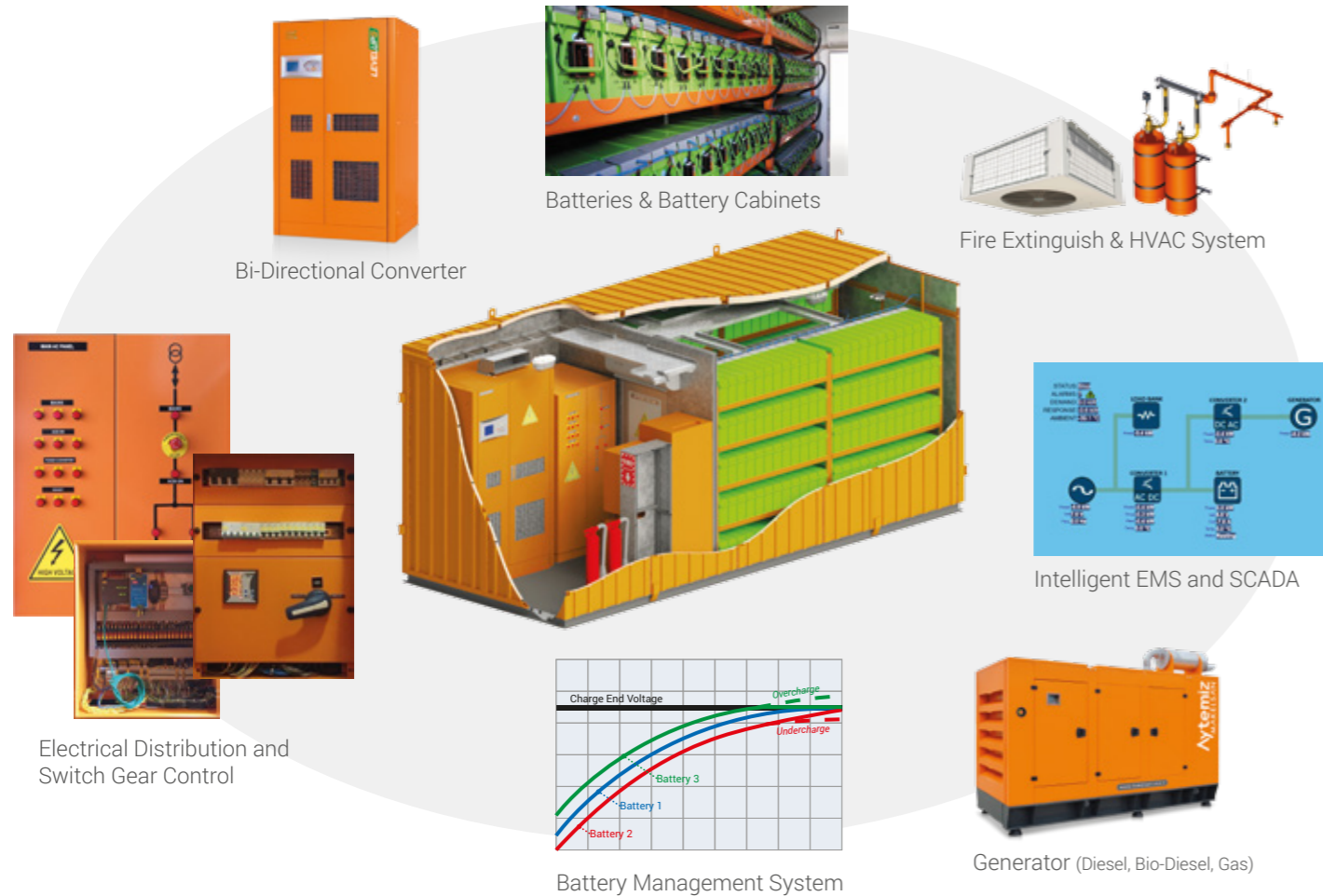
Makelsan DRM can help:

-  **Reduce Fuel Use** and carbon dioxide emissions with a greater use of clean electricity powered by wind and solar.
-  **Increase Resiliency** manage the intermittence of renewable energy production and improve overall resiliency when the wind does not blow and when the sun doesn't shine.
-  **Improve Power Quality** and reliability during against outages or disturbances in the grid, affecting their operation.
-  **Save Money** reduce utility bills and generate revenue, avoid costly system upgrades, reduce operating expenses.
-  **Generate Income** balancing electricity supply and demand, frequency response, capacity market, increased asset utilization.

Complete Solution From Single Source

The containerised DRM system is available with 400kW, 500kW, 600kW, 1000kW capacities by using 20GP or 40HQ containers. Fully bunded ISO Container is designed with personnel and maintenance access doors and has air conditioned separate converter and battery compartments.

System Configuration



Features

- Modular, flexible and scalable up to hundreds of MW
- Plug-and-play containerised design saving time and cost with minimum deployment time
- Fully integrated turn key solution for smart energy management
- Compatible with different battery technologies

Specifications

	20ft Container	40ft Container	Containers in paralel
Maximum Capacity	362 KWh/ 456 KWh	1 MWh/ 1.16 MWh	
System Contents	<ul style="list-style-type: none"> • Power Converter/Freq. Converter etc. • Genset • Main AC In/Out Electrical Panel • Internal AC Distribution Electrical Panel • Battery Breaker Panel • AC Aircon • Battery • Environment Control system • Fire detection and protection • Digital Power and Switchgear Controls 		

Bi-Directional Power Converter

With Aytemiz-Makelsan BPC Bi-directional Power Converter, DRM has dual-function storage capability which enables the energy available during the day to be stored in cyclic batteries, then converted and fed back into the network as usable AC current that is injected into the grid.

Aytemiz-Makelsan Bi-directional Power Converter is capable to manage energy supply to meet demand and

can be programmed to operate according to a charging and discharging schedule settled in advance by the national utility provider.

Aytemiz-Makelsan BPC provides an outstanding conversion efficiency factor for both charging and discharging phases. Thanks to its wide DC input range, it can be used with all battery technologies.

- High Efficiency: 98%
- Wide Battery DC Voltage Range
- High Power Density in Outdoor Application
- Quick Power Transfer/System Response Time (<40ms)
- Integrated AC and DC Switches for Easy Installation and Maintenance
- Black Start and Off-Grid Options for Power Back Up and Microgrid Applications

Multi Grid Support Functions:

- Demand Charge Management (Peak Shaving)
- Load Shifting (Time-Of-Use Optimization)
- Grid Ancillary Service (Frequency Regulation and Voltage Support)
- Power Backup for Grid Power Outage Situation



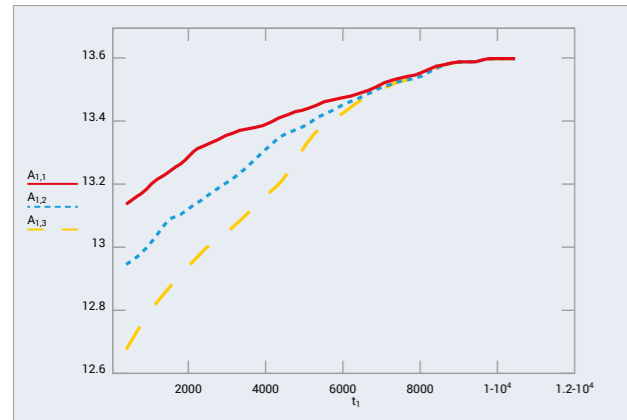
POWER	400kW	500kW	600kW	1000kW
INPUT (DC)				
DC Voltage Range	540 ~ 850 VDC			
Rated Discharge Power	400kW	500kW	800kW	1000kW
Rated Charge Power	400kW	500kW	800kW	1000kW
Max. Discharge DC Current	600A	750A	1200A	1500A
Max. Charge DC Current	600A	750A	1200A	1500A
Battery Compatibility	Lithium-Ion / Lead Acid / Flow			
INPUT (AC)				
Rated Voltage	380V/400V/440V			
Rated Frequency	50Hz/60Hz			
THDi	<3%			
EFFICIENCY				
Efficiency at Nominal Capacity	98%			
ENVIRONMENT				
Protection Glass	IP20			
Operating Ambient Temperature	0°C ~ 40°C			
Storage Ambient Temperature	-15°C ~ 45°C			
Relative Humidity	0% - 95% Without Condensation			
Acoustic Level at 1 m	< 64 DB			
Altitude	0 - 1000m Without Derating			
COMMUNICATION				
Energy Management Communication	Modbus RTU, SNMP, Dry Contact			
Battery Management Communication	CAN, Modbus RTU			
PROTECTIONS				
AC	Overload, Overcurrent, Overtemperature, Overvoltage, Undervoltage, Short Circuit			
DC	Overcurrent, Overcharge, Undercharge, Overtemperature			
DIMENSION & WEIGHT				
Dimensions (WxDxH) (mm)	1200 x 845 x 2102	1200 x 845 x 2102	2345 x 485 x 2003	2345 x 485 x 2003
Weight (kg)	850	850	1740	1990
STANDARDS				
Quality	ISO 9001, ISO 14001, ISO 18001, TSE-HYB			
Performance	EN62040-3 (VFI-SS-111, Bureau Veritas Certificated)			
EMC/LVD	EN62040-2, EN62040-1, EN60950, (TÜV SÜD Certificated)			

Battery Management System

Makelsan's self developed Battery Management System is a web-based integrated battery monitoring and management system, that monitors the temperature, internal resistance, and voltage of every single battery in a system. The BMS calibrates the charging voltage of all batteries with the charger's target value, keeping all

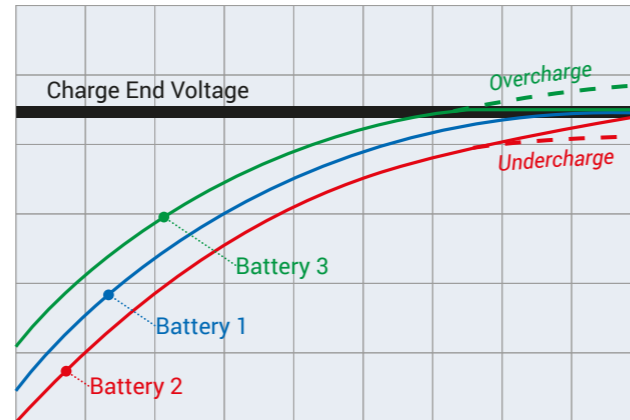
batteries within optimal voltage operating range. This guarantees the availability and capacity of every singly battery at 100%. Makelsan BMS is the perfect system for all battery technologies: Sealed and closed wet cells, Gel and AGM, NiCd, NiMH, Li-Ion.

Benefits: Detect Imminent Battery Issues, Avoid Sulfation, Detect Stratification, Extension of Service Life by >30%, Protect Batteries



Individual Voltage Regulation:

The voltages of the 3 batteries behave differently given the regulating influence of the BMS modules. The ideal harmonic charging curve will be achieved for every battery in the string.



Avoid Undercharging:

The charging of Battery 3 is capped to prevent overcharging and gassing. Supply of charging energy to Battery 2 is continued and boosted until the target charging voltage is obtained. Battery 1 performs ideally and is not regulated.

The BMS Components

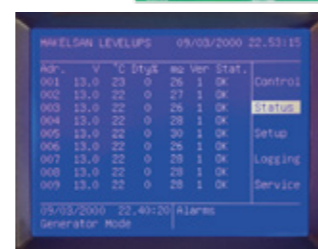
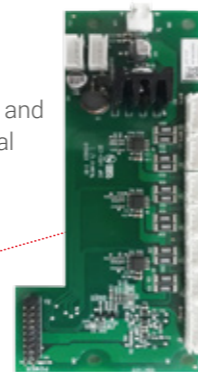
A) BMS Modules

Measurement of voltage, temperature and internal resistance.



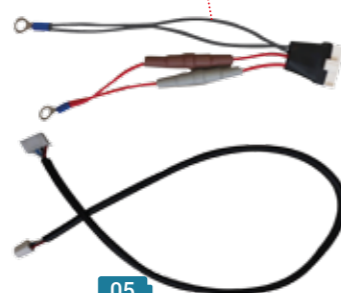
B) BMS Manager

Monitoring of battery groups up to 240. Provides communication between BMS and UPS connection terminals environmental sensors.



C) BMS Measuring and Communication Cables

Measurement and protection cables, data communication cable between modules and module control unit.

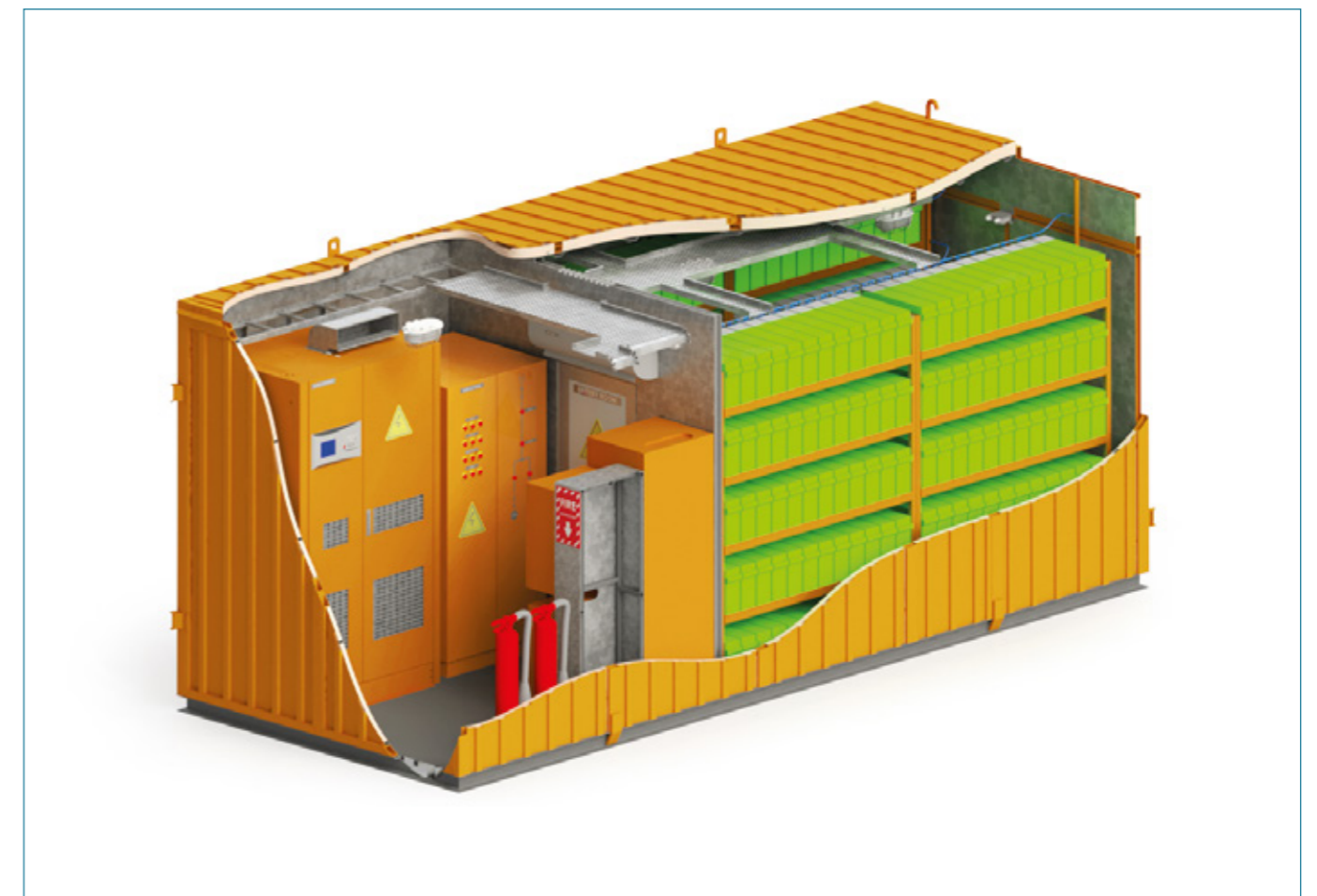


D) External Temperature Sensor



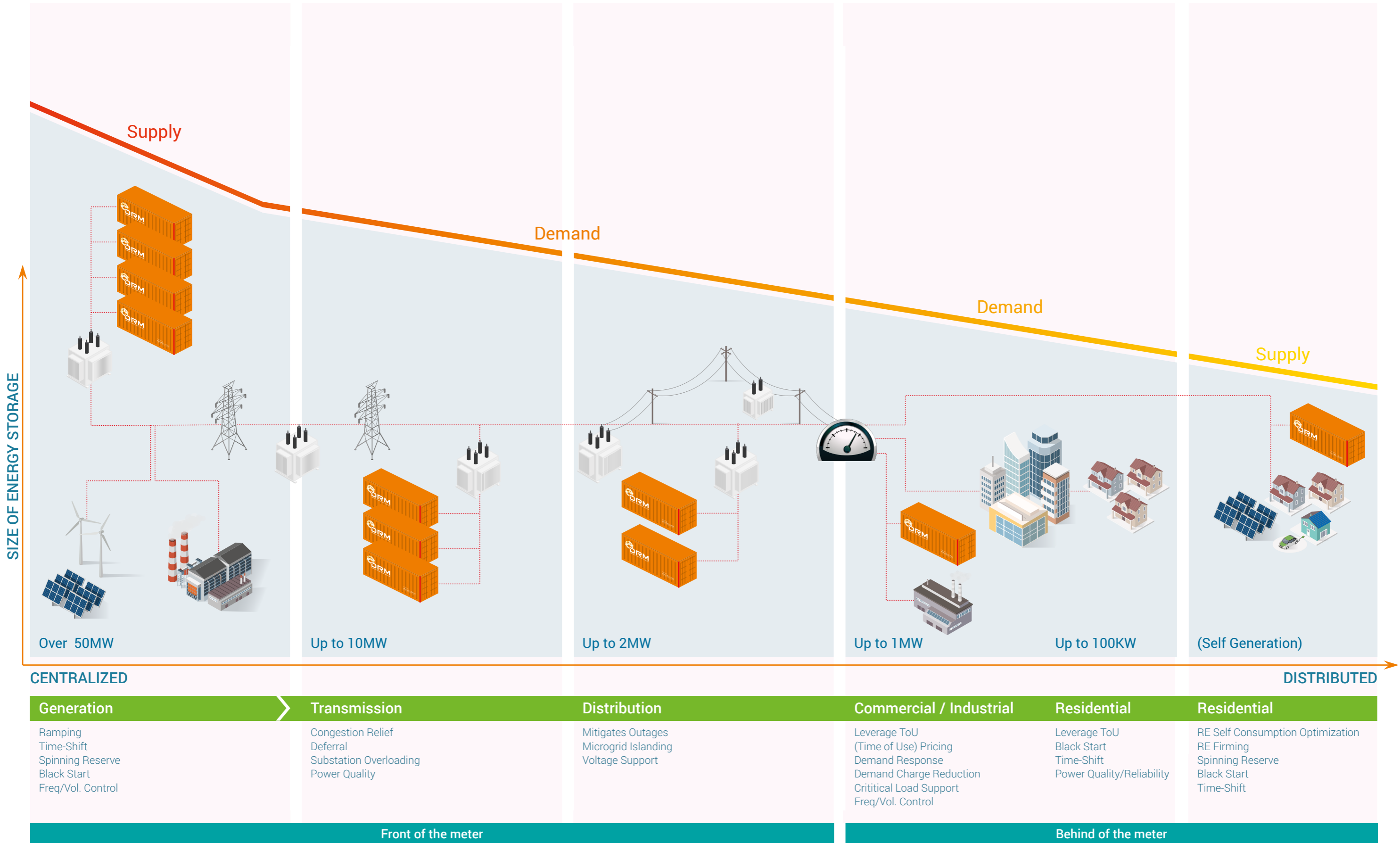
Energy Monitoring System (EMS) and Web-based SCADA

Makelsan offers a future-oriented EMS/SCADA solution and for centralized and decentralized energy management to increase the availability of network, to collect energy data, to respond faster and more effectively to malfunctions, and to reduce the risk of system during disturbances and outages. Thanks to Web-based SCADA system, GRM has real-time monitoring and remote control capabilities.



Overview of DRM Energy Storage System

Use and Possible Locations



Discover Advantages Of DRM

MAXIMUM FLEXIBILITY



SCALABLE SYSTEM FROM KW TO MW
 HIGHEST LEVEL OF POWER IN ONE MODULE
 FULLY INTEGRATED TURN KEY SOLUTION
 BATTERY TECHNOLOGY INDEPENDENCE
 MODULAR ARCHITECTURE TO PROVIDE FUTURE GROWTH
 PARALLEL REDUNDANCY
 READY FOR CONNECTION TO MV OR HV GRIDS
 DELIVERS THE HIGHEST LEVELS OF AVAILABILITY
 PLUG-AND-PLAY DESIGN SAVING TIME AND COST
 WITH MINIMUM DEPLOYMENT TIME
 THE SIZE OF THE SYSTEM IS MATCHED TO THE CUSTOMER-SPECIFIC LOAD PROFILE AND APPLICATION REQUIREMENTS
 AVAILABLE TO RUN ON DIESEL, B100 BIO FUEL (100%), GAS

EASILY FUNDABLE



DELIVERS EXCEPTIONAL RETURNS ON INVESTMENT OUTPERFORMING THE PRE-DETERMINED CRITERIA BY GRID OPERATORS
 PATENTED TECHNOLOGY APPROVED BY NATIONAL GRID
 REPUTABLE, BANKABLE TRUSTED PARTNER DELIVERING OVERALL SYSTEM
 EXTENSIVE EXPERIENCE MANAGING COMPLEX PROJECTS
 2 YEAR ON SITE WARRANTY WITH 10 YEARS EXTENDED WARRANTY WITH O&M CONTRACT AVAILABLE
 LONG TERM SERVICE MANAGEMENT DURING LIFE CYCLE
 LOWEST CARBON FOOTPRINT
 CARBON EXCHANGE COMPLIANT
 ASSET FINANCE AVAILABLE
 INCOME AGAINST COST POSITIVE YEAR IN YEAR OUT
 2-4 HOURS MAINTENANCE RESPONSE

EXCELLENT PERFORMANCE



HIGH EFFICIENCY UP TO 98%
 HIGH PERFORMANCE IN ANY CLIMATE
 MINIMIZED RISK DUE TO PROVEN TECHNOLOGY
 INNOVATIVE DEMAND RESPONSE SOFTWARE

EASY TO INSTALL



FULLY INTEGRATED FRONT ACCESS OPERATIONS
 SUITABLE FOR INSTALLATIONS IN HARSH ENVIRONMENTS AND EXTREME WEATHER CONDITIONS
 QUICK AND EASY MAINTENANCE
 GRAPHIC DISPLAY FOR ERGONOMIC OPERATION AND MONITORING

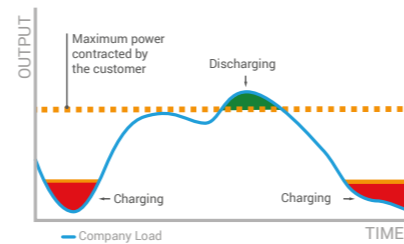


Applications

Peak Shaving



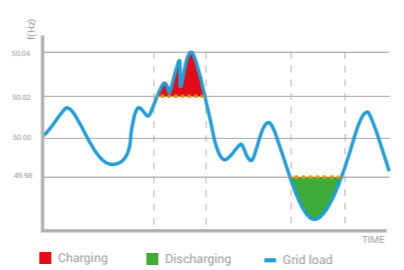
With peak shaving, the energy is stored during periods of low demand (overnight, troughs in the day) and discharged during periods of high demand when the monthly peak consumption could be set. Given the anticipated cycling, duration and power needs of peak shaving, energy storage is very effective. The higher the peak related to the duration of the peak, the better the energy storage economics.



Frequency Regulation



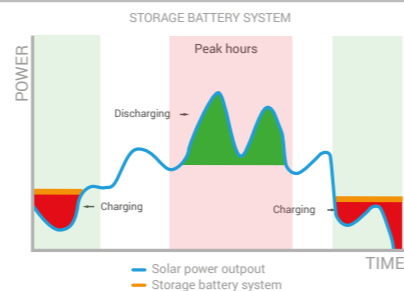
DRM Demand Response Module provides ability to regulate grid frequency in both directions. When there is a grid overfrequency (generation > demand) inverter power output is curtailed and this energy is stored. When there is a grid under-frequency (generation < demand) inverter power output is increased by discharging the batteries and injecting more power to the grid.



Load Levelling



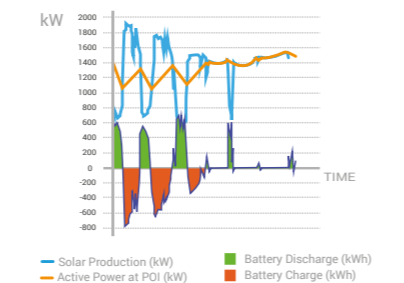
Load levelling is similar to peak shaving but is focused on reducing the kWh costs on a utility bill, and effectively captures the difference between buying energy at low prices and discharging at higher prices. Load levelling typically provides incremental value to a system that is providing other functionality like peak shaving.



Renewables Capacity Firming / Ramping



Capacity firming is the conversion of available uncontrolled random power from renewable sources, into "dispatchable power" with an agreed level and duration which can be committed as part of the utility's generating assets. Aytemiz-Makelsan DRM System attenuates the intermittent nature of renewable energy sources, to provide a smoother power output. DRM controls the ramp rate at which power is injected into the grid, and thus reduces the impact of rapid power fluctuations due to sudden or transient conditions experienced by the PV array.



Power Quality



Facility load power factor can cause power quality issues. Often demand charges are related to facility loads with low power factor, when a higher cost is paid for lower power factor. An energy storage system can improve the facility power factor, improve power quality and save money on utility bills

Case Study

NATIONAL GRID / WHITBIRK PLANT - THE 1ST PILOT PROJECT IN THE UK

Client: Electricity North West

Project Date: 2017

Power: 440kW

Location: Blackburn / UK



The UK electricity grid operates at a frequency of 50 Hz, meaning current flows first one way, and then the other, 50 times per second. National Grid is responsible for managing the frequency, and is required by law to keep it between 49.5 Hz and 50.5 Hz under normal conditions.

If the frequency moves much beyond these limits, or changes rapidly, some generators will automatically disconnect from the grid for safety reasons. The end result can be unexpected power cuts and cause significant inconvenience and economic impacts.



Electricity Northwest Whitbirk Plant, where DRM is installed - National Grid Tests

DRM Demand Response Module installed at ENWL, Whitbirk plant provided ability to regulate grid frequency in both directions. When there is a grid overfrequency (generation > demand) inverter power output is curtailed and this energy is stored. When there is a grid under-frequency (generation < demand) inverter power output is increased by discharging the batteries and injecting more power to the grid.



The hybrid system Demand Response Module comprises a generator set and containerised power module (static power converter + batteries for 30 mins back up + BMS + EMS). The system can deliver up to 440kw and is specifically designed to operate with biodiesel B100 making it the most versatile system of its type on the market.

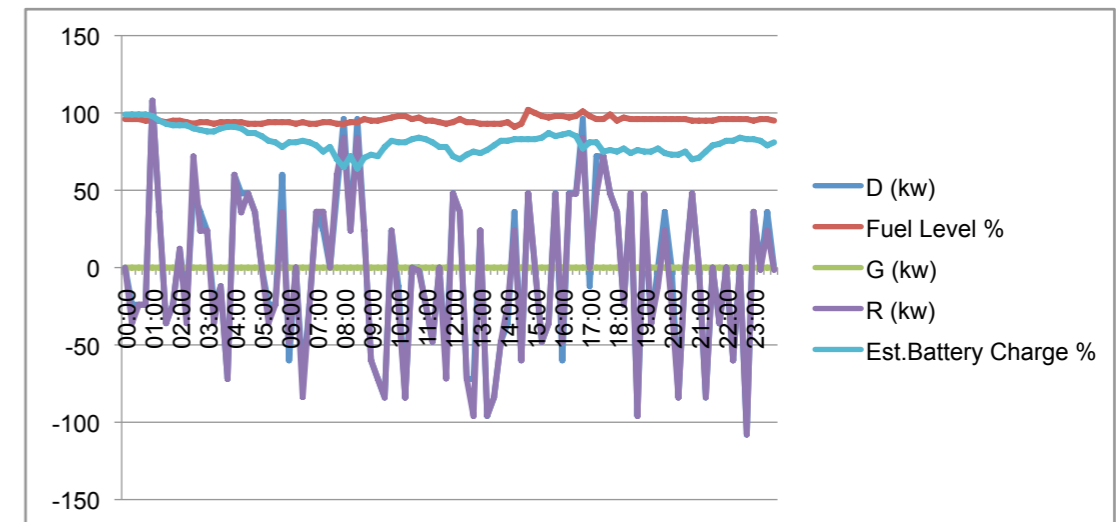
The customer ENWL used the existing connection to the grid to balance the frequency of the grid via importing or exporting electricity. Due to where the grid response module is placed it can also provide benefits to the commercial site through imbedded benefits such as grid resilience, TRIAD and DUoS (Distribution Use of System) avoidance thus making huge energy savings for the site owner.

Application: Frequency Regulation / DFFR service that helps National Grid control system frequency around UK in real time by balancing electricity demand with generation.

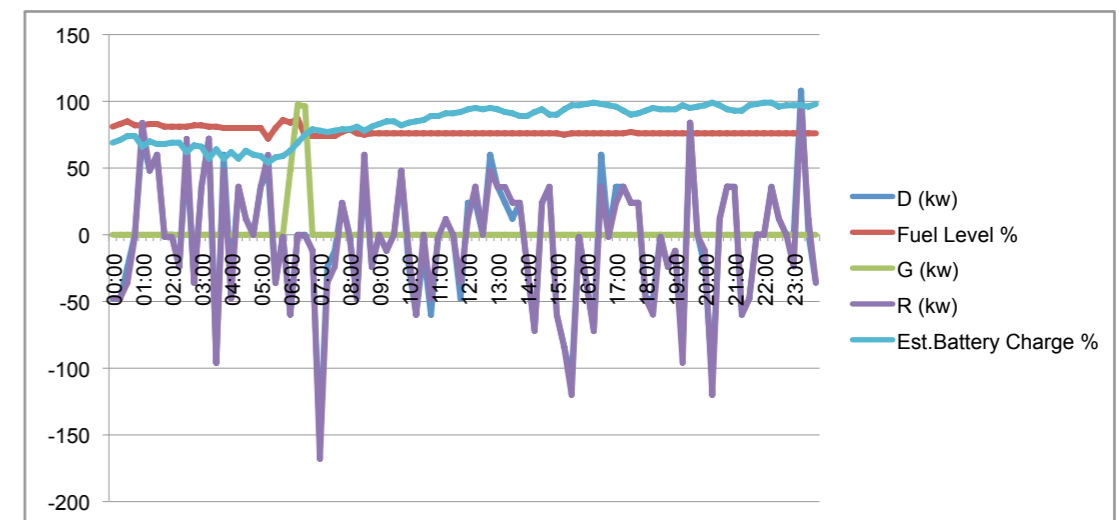
The Results: Following installation, the site used the Makelsan DRM's charging and discharging profile to balance grid import and export.

During tests with National grid Aggregator Makelsan DRM has been approved for the control of energy usage during peak demand and high pricing periods (DUoS), reducing peak demand charges and offering potential revenue to be gained through grid contracts (Demand Side Response).

Some of national grid tests done during installation can be seen in the following charts:



Based on demand (import/export) batteries are discharged or charged. Since the trend is more export, battery charge % is slightly decreasing. As shown in the chart R (response) to D (demand) is very fast.



In case battery voltage come to low level, genset helped to charge them, then stopped.

Why Choose Aytemiz-Makelsan ?



Advanced Manufacturing

- 25.000 m² manufacturing facility.
- 5000 units of 3 phase UPS production per year.
- More than 300 employees, first-class manufacturing facilities equipped with state of art machinery and skilled staff.
- Family owned, sole proprietor company allows to have full control of decisions on the processes.



Global Sales & Distribution Network

- Export to more than 80 countries across the 6 continents.
- 4 subsidiaries in Europe.
- More than 100 global distributors.
- Over 300 certified support engineers and technicians from our global service network are available to make sure that you have the help you need for your power requirements.



Innovation & Flexibility

- Committed to develop leading technologies to make sure the customers get innovative and efficient products.
- Continuous investment in R&D (10% of turnover).
- Flexibility of customizing solutions, which makes the product easy to adapt to the customer requirements.



International Standards

All Aytemiz-Makelsan products complies with EU directives concerning performance, safety, radio frequency emissions, electromagnetic compatibility (EMC), voltage peaks, over voltage and static charges. EN 62040-1:2008.



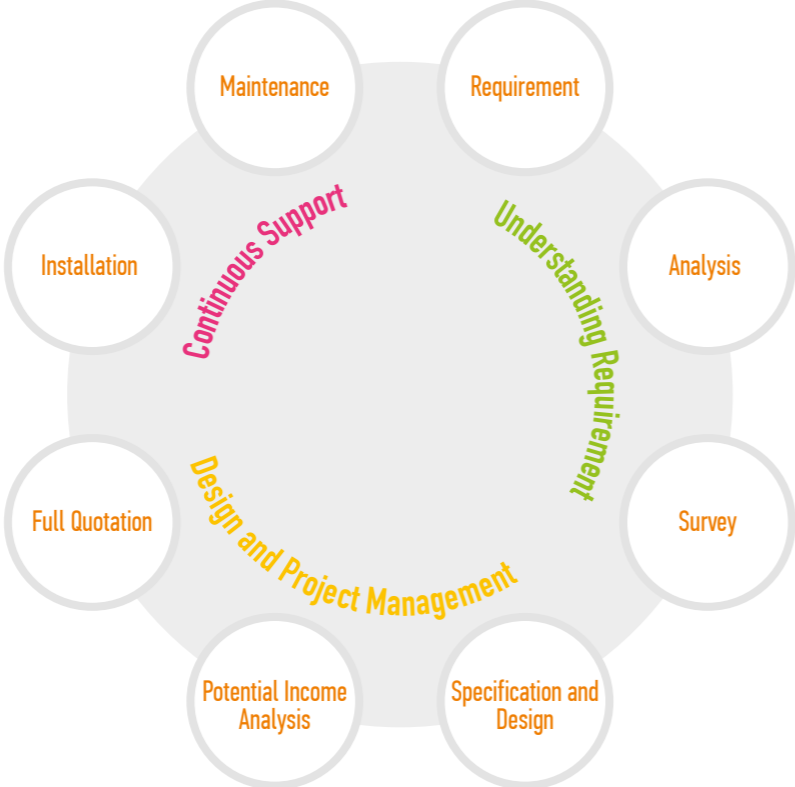
Power Experts

- 42 years experience in power electronic.
- Large Project, Engineering & Contracting team with ability to integrate a full range of custom and rugged AC&DC Power Solutions.

Our Process

Each Energy Storage System project require a carefully planned process.

Our process flowchart shows the steps taken to ensure a fit to purpose Energy Storage Solution is designed, delivered, verified.



We design innovative technologies to help making energy more reliable and sustainable.





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