

# Electric Energy Storage



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## Features

The Mega-Guard Electric Energy Storage (EES) is an advanced system for electric energy storage for marine environment. Sailing and silent running on stored electric energy becomes a reality with Mega-Guard EES.

The Mega-Guard EES consists of the following main components:

- ▶ GreenBattery
- ▶ GreenBattery BMS
- ▶ Battery Rack

Energy storage systems in between 40kWh and 12MWh can be built with Mega-Guard EES.

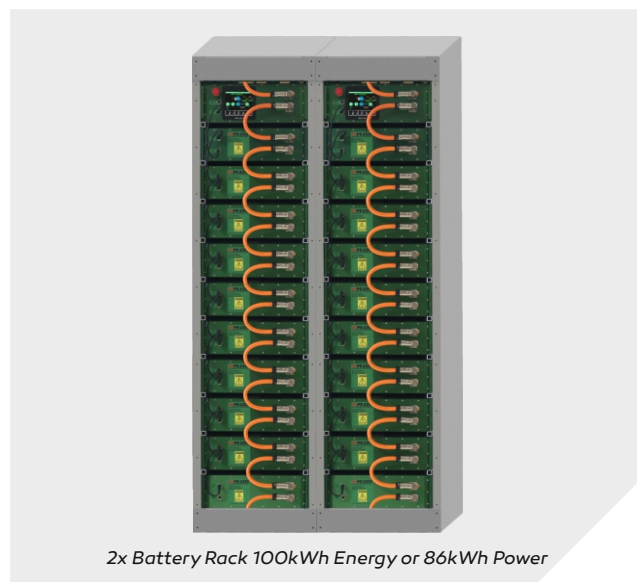
Two versions are available:

- ▶ GreenBattery-Energy ; optimized for low volume and weight
- ▶ GreenBattery-Power ; optimized for fast charging and discharging

## GreenBattery

GreenBattery makes use of the extremely safe LiFePO4 (or LFP) chemistry. Safety can be compared with traditional lead acid batteries and are much safer than Li-ion NMC technology which is used by other marine battery manufacturers. In addition, life time and temperature range of LiFePO4 are much better when compared with Li-ion NMC batteries. GreenBattery has relatively low weight and small volume per stored kWh. In fact, GreenBattery is one of the lightest batteries available for marine energy storage and occupying minimum floor space.

Each GreenBattery has a capacity of 10kWh and a nominal DC bus voltage of 96VDC. GreenBattery can be cooled either by liquid or by forced air (GreenBattery-Energy only). GreenBattery is totally enclosed and includes a built-in slave battery monitoring system which communicates with the GreenBattery BMS. GreenBattery fulfils the latest class requirements and includes a pressure based safety release which should be vented to the outside environment. Up to 10 GreenBatteries can be wired in a string and the GreenBattery BMS monitors and controls the string. Up to 120 strings can be wired in parallel.



2x Battery Rack 100kWh Energy or 86kWh Power

Specification	GreenBattery-Energy	GreenBattery-Power
Stored energy	10kWh	8,6kWh
Recommended SOC window	10% - 90%	10% - 90%
Maximum SOC window	5% - 95%	5% - 95%
Usable energy at recomm. SOC	8kW	6,8kW
Technology	LFP / LiFePO4	LFP / LiFePO4
Nominal voltage	96VDC	96VDC
BMS with cell balancing	✓	✓
Electric connections	+ and - with HVIL BMS in / out	+ and - with HVIL BMS in / out
Max charge rate	1C (=105A) @22°C	3C (=270A) @22°C
Max discharge rate	1C (=105A) @22°C	3C (=270A) @22°C
Max discharge rate 5 minutes	2C @ 10-35°C	
Number of (dis)charge cycles	0,5C	1C
Depth of discharge 90%	>2000 @22°C	>2000 @22°C
Depth of discharge 80%	>5000 @22°C	>6500 @22°C
Depth of discharge 50%	>9000 @22°C	>9000 @22°C
Ambient temp. charging	0 - 45°C	0 - 45°C
Ambient temp. discharging	-20 - 45°C	-20 - 45°C
Storage temperature 1 year	0 - 35°C	0 - 35°C
Heat generation	< 0.22kW	< 0.45kW
Cooling by liquid	Water/glycol mixture Liquid flow: 2l/min (5°C rise @1C) Inlet temp: 35°C max	Water/glycol mixture Liquid flow: 4l/min (5°C rise @3C) Inlet temp: 35°C max
Cooling by air	Forced air with fans	x
Exhaust	✓	✓
Dimensions with forced air cooling	77kg	x
Dimensions with liquid cooling	453x160x685mm	453x140x685mm
Weight with forced air cooling	77kg	x
Weight with liquid cooling	83kg	83kg
Protection	IP66	IP66
Aluminium housing	Green anodised	Green anodised
Thermal runaway propagation	Test 1 passed	Test 1 passed
Accordinging class	LRS, DNV-GL, ABS, CCS	LRS, DNV-GL, ABS, CCS

## GreenBattery BMS

The GreenBattery BMS monitors and controls a string of GreenBatteries. All external connections (DC bus, Ethernet, cooling and venting) of a string are made on the GreenBattery BMS. A 5,7" touchscreen Operator Panel with built-in controller is mounted in the front of GreenBattery BMS. The state of charge (SOC), voltages and temperatures of a string can be read on the touchscreen Operator Panel. The controller takes care of cell balancing, cooling control and safety functions. In addition, the controller is equipped with quad Ethernet ports for communication to external Mega-Guard High Power Inverters for battery charging and to a Mega-Guard Energy Management System. The GreenBattery BMS contains as well a DC bus contactor with pre-charge.

A temperature controller is built inside GreenBattery BMS for external valve (liquid cooled) or for external fan (air cooled) control. A liquid cooled EES does not heat up the battery room. An air cooled EES should be equipped with additional air conditioning capacity to take away the heat of each GreenBattery-Energy (0,22kW). The recommended ambient temperature of battery room and liquid cooling fluid (in case of liquid cooling) is 22°C in order to reach highest life cycle of the ESS.

## Battery Rack

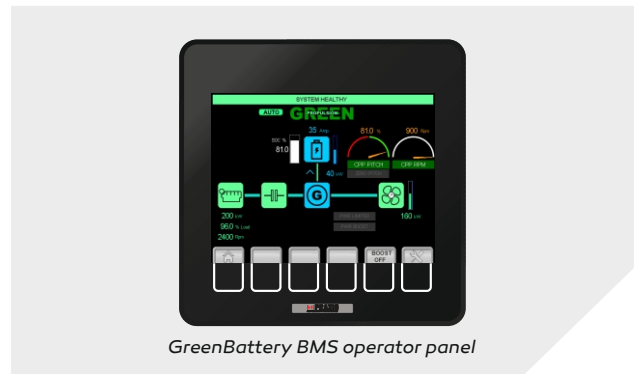
GreenBatteries and the GreenBattery BMS are placed in a specific designed Battery Rack. The Battery Rack contains cooling channels (air or liquid) and makes it possible to exchange a GreenBattery by sliding out and in. Battery Racks are supplied in two different mechanical lay-outs: a vertical one for space saving and a horizontal one which is applied when not enough room height is available.

Battery Racks need to be installed in a battery room in accordance with class regulations.

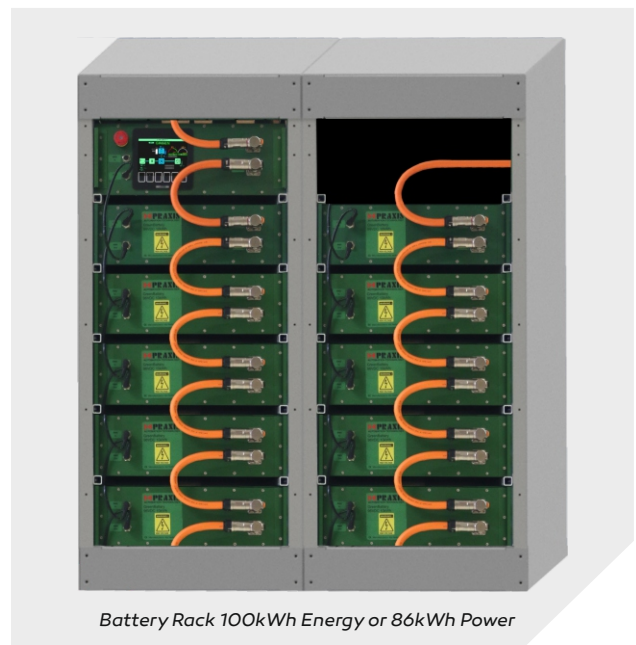
The following Battery Racks are available:



GreenBattery liquid cooled



GreenBattery BMS operator panel



Battery Rack 100kWh Energy or 86kWh Power

GreenBattery Energy capacity	GreenBattery Power capacity	Rack size vertical W x H x D	Rack size horizontal W x H x D	Air cooled Weight	Liquid cooled Weight	Number of GreenBattery	Nominal DC bus voltage
40kWh	34,4kWh	520x1020x760mm	n/a	395kg	420kg	4	384VDC
60kWh	51,6kWh	520x1350x760mm	n/a	560kg	595kg	6	576VDC
80kWh	68,8kWh	520x1670x760mm	1035x1020x760	735kg	775kg	8	768VDC
100kWh	86kWh	520x1995x760mm	1035x1350x760	890kg	950kg	10	960VDC

Vessel Management System



Power Management System



Fire Alarm System



CCTV Video Distribution



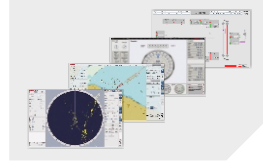
Ship Performance Monitor



Fleet Management System



Integrated Navigation System



Heading Control System



Propulsion Control System



Dynamic Positioning System



BNWAS Watch Alarm System



Navigation Light Control



Wiper Control System



Energy Management System



Electric Propulsion Motor



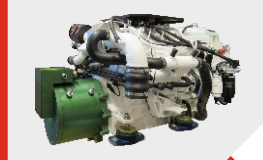
Electric Steerable POD



High Power Inverter



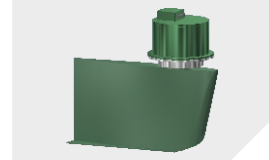
DC bus Generator



Electric Energy Storage



Electric Fin Stabilizer



*Ship automation,  
navigation and  
electric propulsion*