



***MARINE PLUG-IN HYBRID
POWER SYSTEM
(600KW DIESEL-ELECTRIC)***

ADVANCING BATTERY TECHNOLOGY TO ELECTRIFY THE MARINE INDUSTRY



Through radical thinking and collaboration, we've developed a marine plug-in hybrid power system for a Steber 43ft boat, advancing the decarbonisation of commercial and private vessels.

The hybrid diesel-electric boat is suitable for applications across defence, government and private sectors. It is power efficient, features lower CO₂, NO_x, and carcinogenic particulate emissions and can operate with a noise reduced function, making it a more environmentally conscious option to meet maritime needs.

HOW IT WORKS

Steber 43ft hybrid vessel has a series hybrid topology that fully unlocks the electric powered propulsion. The power is delivered from the combination of an on-board battery system and a standard issue marine diesel engine re-vectoring to drive a high-power density electric generator.

The propulsion system is comprised of two permanent magnet synchronous electric motors, rated for 300kW continuous power each, to direct drive the propellers. This does not only give an advantage of fly-by-wire technology but also greater propeller torque and speed control. A specially designed docking mode lowers the propellers' speed while retaining full control of the control head operational range to ease navigation in closed waters and docking.

The currently installed 150kWh marine graded battery system allows the vessel to plane continuously on electric power only. Approximate electric propulsion range is:

- 4 knots = 12 hours
- 6 knots = 8 hours
- 8 knots = 3 hours
- 10 knots = 1 hour
- 20 knots = 0.5 hour

The closed loop isolated glycol liquid cooling circuits for all major electrical power system components allow for independent flow regulation, component redundancy and reduction of the pump sizes. The system has been tested with warm water temperatures ranging up to +33C, simulating vessel operation in locations such as Cairns, Darwin and Broome.

The marine plug-in hybrid power system deployed in the Steber 43ft vessel is integrated with our marine remote monitoring software, which allows real-time position and status monitoring.

BENEFITS

The modular and scalable nature of this marine electric power system facilitates the implementation of a tailored performance profile for both new and retrofitted vessels.

- Reduced operational costs
- Electric propulsion controllability
- Improved diesel engine efficiency due to constant operational point
- Emission, noise, and diesel vibration-free operation in electric mode
- Reduced CO₂, NO_x, and carcinogenic particulate emissions in hybrid mode
- Integratable marine remote monitoring software for real-time position and status monitoring.
- Vessel future-proofing to meet the upcoming maritime decarbonisation needs.



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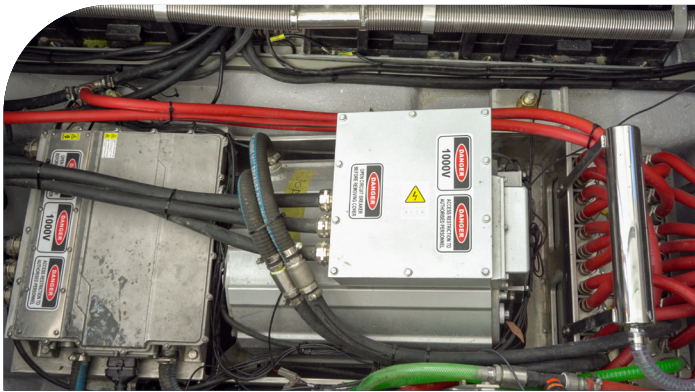
COST-BENEFIT ANALYSIS

Based on the historical operational data of a standard twin diesel commercial Steber vessel, a typical eight-hour day shift was studied to validate the economic feasibility of a hybrid conversion.

NOTIONAL VESSEL SPEED PROFILE FOR A SINGLE DAY				
Profile	Cruising	Idling	Sprint	Standstill
Speed	15 knt	6 knt	25 knt	0 knt
Duration	2 hours	4 hours	10 min	2 hours
Aux, Hotel Load	5kW throughout the whole shift			

The following assumptions were made for this study:

- Battery fully charged once a day at the dock before the start of the shift.
- Electricity cost: \$0.3/kWh
- Diesel oil price: \$1.8/L
- Minor diesel service after every 250 operational hours
- Major diesel service after every 1000 operational hours
- CAPEX and OPEX are based on the Steber's historical commercial data
- Battery and electrical inspection twice a year, as per our specifications.



Pictured Above: Ampcontrol 300kW Propulsion Motor

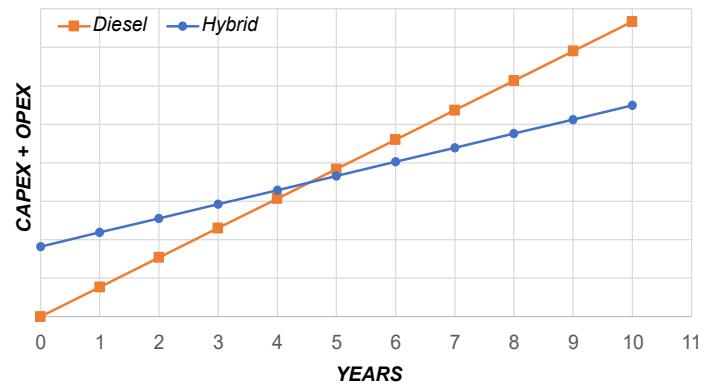
For comparison purposes, different vessel utilisations were considered, ranging from three to seven days per week:

VESSEL UTILISATION					
Usage day/week	3/7	4/7	5/7	6/7	7/7
Return on investment, years	7.8	5.7	4.5	3.7	3.2
Diessel vessel 1x Diesel engine operational hours per year	965	1286	1608	1929	2251
Hybrid vessel 1x Diesel engine operational hours per year	339	452	565	678	791
Hybrid vessel battery cycles per year	157	209	261	313	365

It is worth pointing out that the hybrid vessel not only costs less in terms of fuel expenditure to operate compared to a traditional diesel vessel, but it also resulted in fewer diesel engine operational hours per shift, leading to lower diesel engine servicing costs.

The return on investment of the hybrid vs diesel powered vessel:

Hybrid Topology: Return on Investment (5/7 days usage)



43FT HYBRID BOAT SPECIFICATIONS

SPECIFICATION	
Shipyard	Steber International
Country	Australia
Year Built	2023
Hull	
Type	Commercial
Material	Fibreglass
Length	43ft (13.1m)
Breadth	15.6ft (4.7m)
Max Passengers	Up to 20 + 2 crew
Cargo	Up to 2 tonnes
Power and Propulsion	
Type	Series Hybrid
Fuel	Diesel-Electric
Propulsion Motors	Ampcontrol 2x 300kW
Onboard Engine/Generator	Commercial diesel/Ampcontrol generator - 350kW
Onboard Battery	Ampcontrol 300kW
Aux Power	Ampcontrol 15kVA
Operational Performance	
Max Speed	27 Knots
Economic Speed	15 Knots
Planing Mode	Electric/Diesel/Hybrid
Electric-only	8 hours @ 6 knots 1 hour @ 10 knots 0.5 hour @ 20 knots
Capacity	
Battery	150kWh
Fuel	200 - 1000L
Water	100L

The 43ft Hybrid Vessel is a collaboration between



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