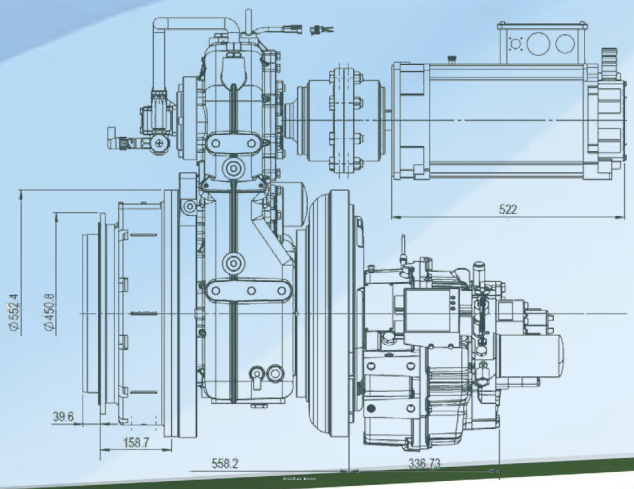
esco POWER

guides you into the Hybrid Era !





PARALLEL HYBRID SOLUTIONS

Esco Power's Parallel Hybrid Solution gives your driveline the exceptional advantages of both power sources:
diesel and electric



Parallel Hybrid Transmission - PHT

There are various reasons to look for an alternative to the conventional Diesel driveline and some may include:

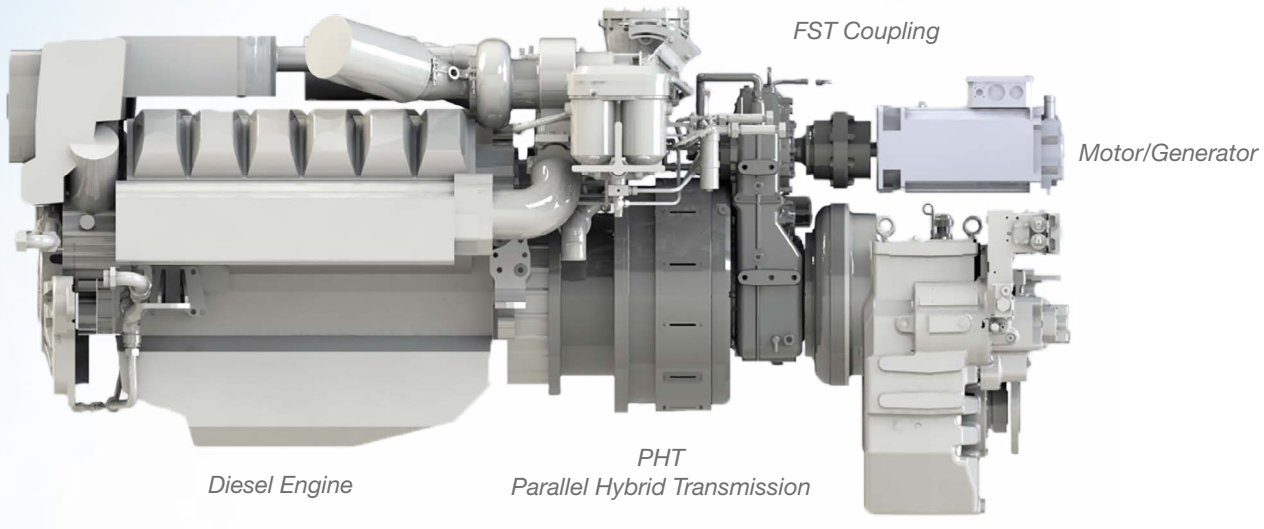
- Lowering fuel consumption
- Meeting stricter pollution or noise regulations
- Extending Diesel engine service life
- Increasing efficiency of the entire driveline

No matter the reasons,
ESCO POWER has a Parallel Hybrid Solution for you!

ESCO POWER offers:

- A unique Parallel Hybrid Transmission PHT, ideal for a refit and a new build of hybrid installations
- A complete Hybrid Electric System Package HESP, with fantastic features such as Automatic Mode in standard
- An EPB Battery System, properly sized and perfectly matching both PHT and HESP
- A perfect cooperation with the local integrators and shipyards, often supported by enthusiastic local partners
- Technical Support at every stage of the project: technical assistance in selection of the individual components, preparation of project specific documents: specifications, single line diagrams, installation overview diagrams, cables overview, installation plans, installation and maintenance manuals, overviewing installation and commissioning.

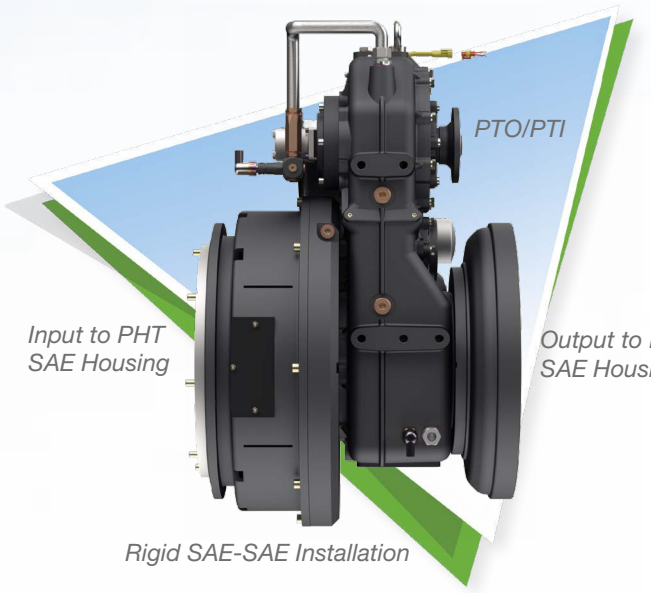
Example of Hybrid Installation with Esco Power Parallel Hybrid Transmission



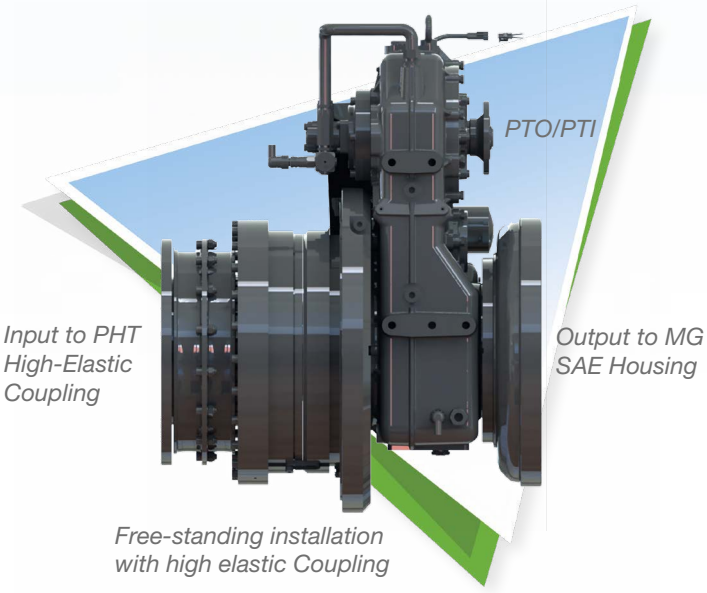
Parallel Hybrid Transmission - PHT

The heart of the Parallel Hybrid Solutions by Esco Power is its own unique Parallel Hybrid Transmission. The PHT unit is designed to allow any vessel or any industrial machine to run on two power sources connected in parallel.

The PHT can be easily installed between the diesel engine and the marine (or industrial) gearbox, via SAE connections, or as a free-standing unit to be connected to the diesel engine through a high elastic coupling.



Rigid SAE-SAE Installation

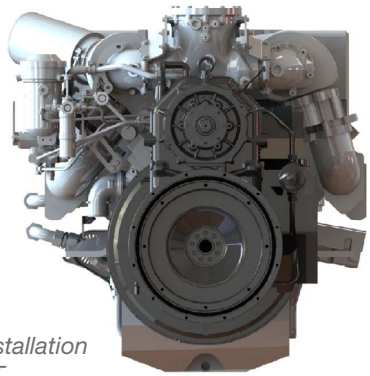


Free-standing installation with high elastic Coupling

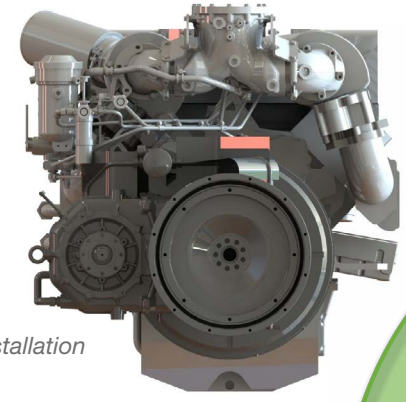
The PHT has a built-in, robust electromagnetic clutch for disconnecting the diesel engine from the main driveline.

The PHT standard models suit engines up to 7000 Nm torque, about 147kW/200HP -1655kW/2250HP.

The PHT unit can be installed vertically, horizontally or angularly.



Vertical installation of the PHT



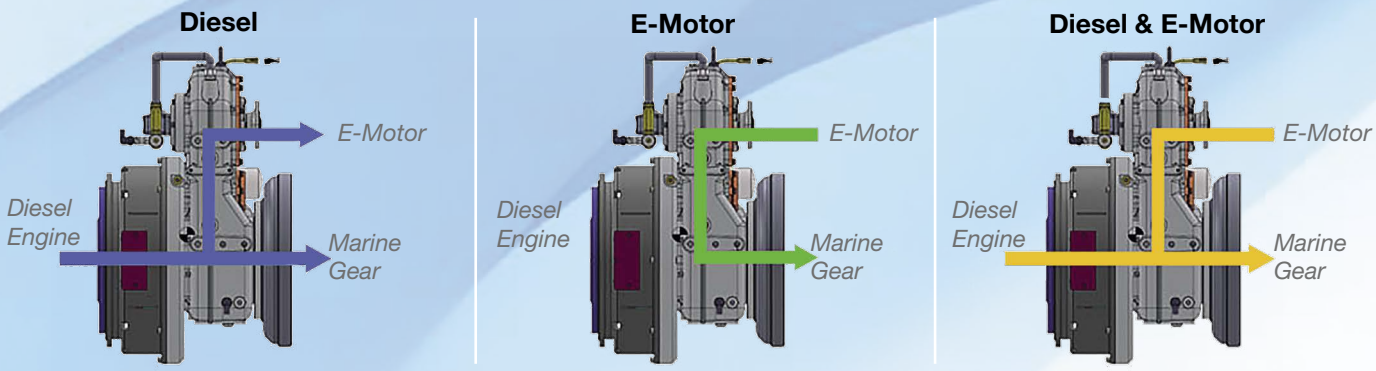
Horizontal installation of the PHT

Lloyd's Register and Bureau Veritas (BV) type approvals available.

Parallel Hybrid Transmission - PHT

PHT Working Principle

The PHT unit is designed to connect two power sources: Diesel engine and E-motor into one parallel hybrid driveline. The PHT Electro-magnetic clutch works independently from any other part of the transmission, allowing engagement and disengagement of the diesel engine from the main driveline.



With PHT clutch engaged, power of the diesel engine is transmitted directly to the marine gear like in a conventional diesel installation.

The electric machine (motor/generator) is connected to the secondary input/output of the PHT, located above the main output, by the use of a flexible or elastic coupling.

The PTO/PTI output has an integrated ratio built in (1.27, 1.47 or 1,70). Thanks to the ratio all the installed E-power can be available for the propulsion.

When operating on the Diesel engine with the electric machine in function of a generator, the speed of the diesel engine at the PTO output is increased by the selected ratio.

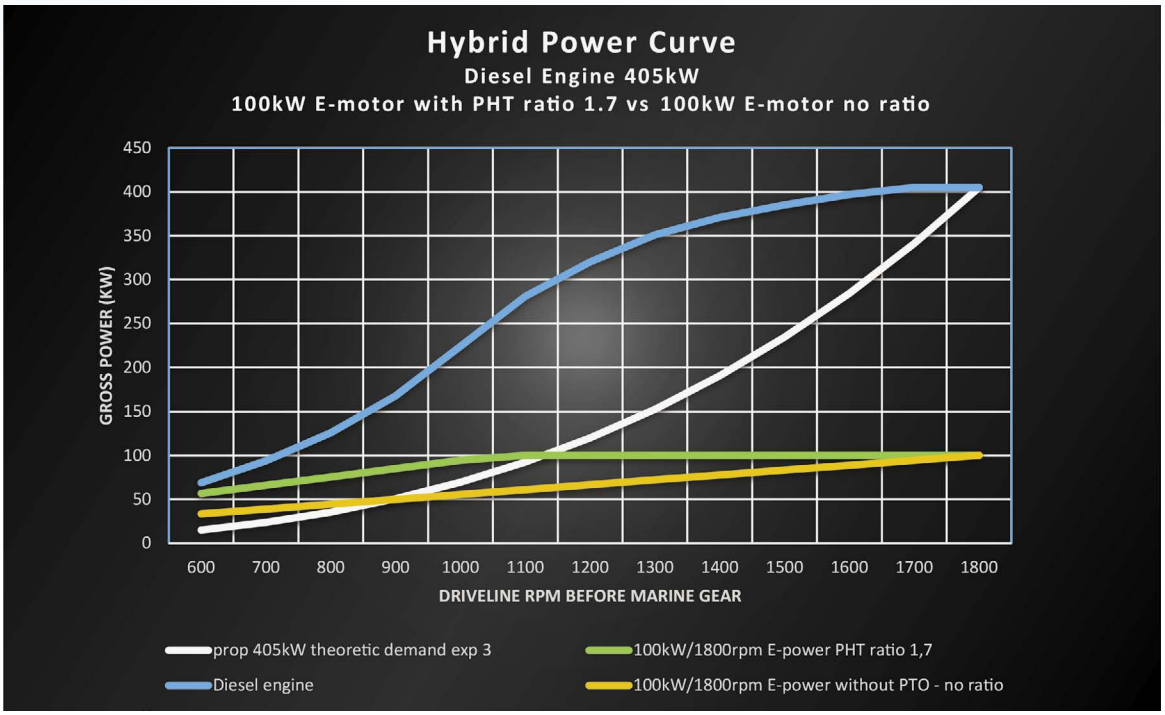
The maximum generating capacity will be achieved with the Diesel engine running at minimum the speed calculated from the rated E-machine speed divided by the chosen ratio.

Standard PHT Models

	PHT 300A	PHT 420A	PHT 700A	PHT 700B	PHT 900A
Electromagnetic clutch	24 VDC	24 VDC	24 VDC	24 VDC	110VDC
Max main input torque	1500 Nm	2100 Nm	3100 Nm	5200 Nm	7000 Nm
Max PTO/PTI torque	1500 Nm	1500 Nm	1500 Nm	1500 Nm	1500 Nm
Ratio to PTO/PTI	1.27 - 1.47 - 1.70	1.27 - 1.47 - 1.70	1.27 - 1.47 - 1.70	1.27 - 1.47 - 1.70	1.27 - 1.47 - 1.70
Main Input	SAE 2 & 11.5” SAE 3 & 11.5” SAE 4 & 10” High Elastic 11.5”	SAE 1 & 14”	SAE 1 & 14” High Elastic 14”	SAE 1 & 14” SAE 0 & 18” High Elastic 14” High Elastic 18”	SAE 1 & 14” SAE 0 & 18” SAE 00 & 21”
Main Output	SAE 3 & 11.5” SAE 1 & 14” Flange	SAE 3 & 11.5” SAE 1 & 14” Flange	SAE 1 & 14” Flange	SAE 1 & 14” FW 18” Flange	SAE 1 & 14” FW 18” Flange

PHT Ratio Advantage

The PHT PTO/PTI output benefits from the integrated ratio (1.27–1.47–1,70) making all the installed E-power available at the driveline. There is no other Hybrid Solution providing the ratio benefit than Esco Power Parallel Hybrid Transmission.



The above graph shows the availability of E-power for propulsion in two situations:

- **Yellow Line:** 405kW Diesel engine & 100kW E-motor with NO ratio advantage
- **Green Line:** 405kW Diesel engine & 100kW E-motor with the PHT ratio 1.70

In the situation when there is no ratio benefit, the vessel can be propelled by E-motor only up to the speed of 900 rpm (before marine gear), with the E-motor providing only half of its nominal power, i.e. 50kW in this example.

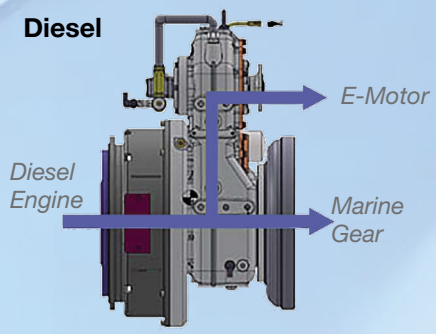
In the situation with the PHT installed ratio 1.7, the same vessel can be propelled by E-motor up to the speed of 1130 rpm (before marine gear), having access to all of the installed E-motor power, i.e. 100kW in this example.

In addition, an installation with the PHT and ratio provides a large safety margin in the E-working range, making the electric propulsion a very reliable solution.

Hybrid Electric Solution Package HESP

In addition to the Parallel Hybrid Transmissions, ESCO POWER has developed a complete Hybrid Electric Solution Package HESP consisting of efficient electric motors, frequency inverters, electronic control and command system, control levers, screens, and software to benefit from various operation propulsion modes: Diesel - Electric - Automatic and additional working modes as: generator - back up - cross-feed.

All the HESP control features are displayed and can be operated via the touch screen.



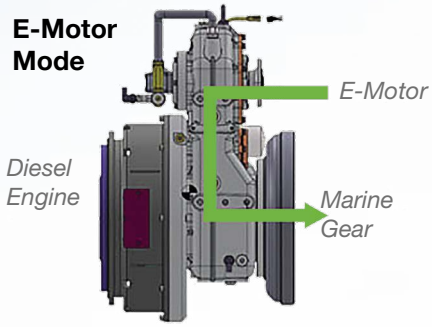
HESP Propulsion Modes

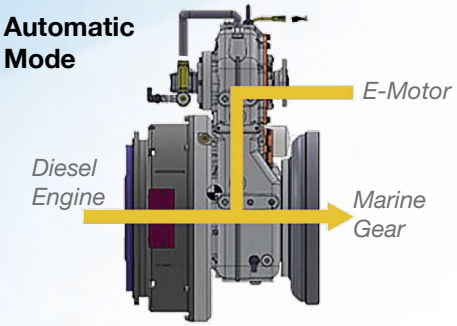
Diesel Mode

When the diesel engine is running, the clutch is engaged and directly drives the marine gear. Thanks to the PHT, the diesel engine can also power the generator. With the generator not working the axis will spin idle inside the generator. Thanks to the ratio (1.27, 1.47 or 1.7), the rpm of the diesel engine at the PTO/PTI will increase by the ratio allowing to downsize the electrical motor size.

E-Motor Mode

The PHT in E-mode disconnects the diesel engine by disengaging the clutch, the diesel engine can be shut down or left idling. The electric motor drives the marine gear or transmission directly through the PHT gears. The E-motor speed will be decreased at the marine gear by the selected ratio, the torque will be increased. The electric motor is run by a gen-set or by the on-board batteries.





Automatic Mode

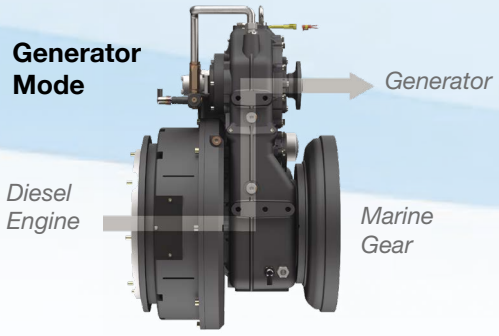
In this mode, the vessel or industrial machine starts its operation being run by E-motor. The E-propulsion full power working range is set from 0% to 40% detent of the lever. When more power is requested further detent of the lever (beyond 40%) switches operation to the Diesel engine (40-100% range).

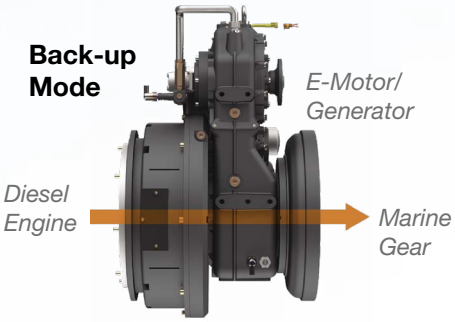


HESP Additional Working Modes

Generator Mode

When diesel engine is in operation and the PHT clutched, generator mode can be activated. The mode can be used even with the vessel at quay, anchored or loitering. In order to use the generator mode with the vessel parked, the marine gear needs to be overridden with the use of the power commander. It is possible to program specific automatic generating modes following the operator's requirements.



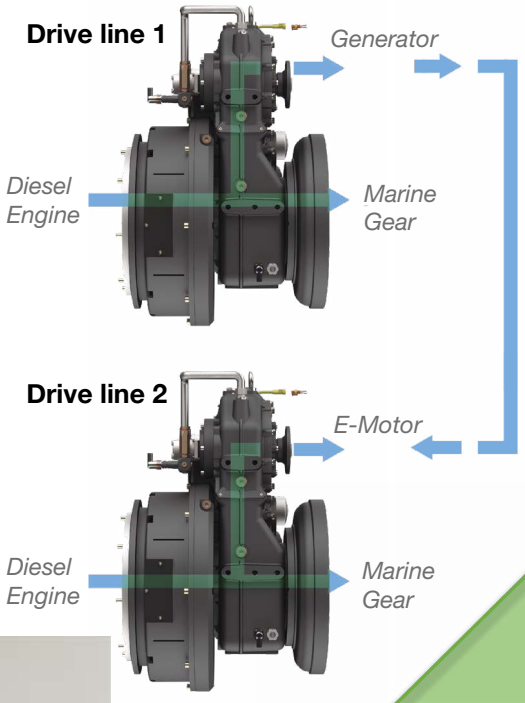


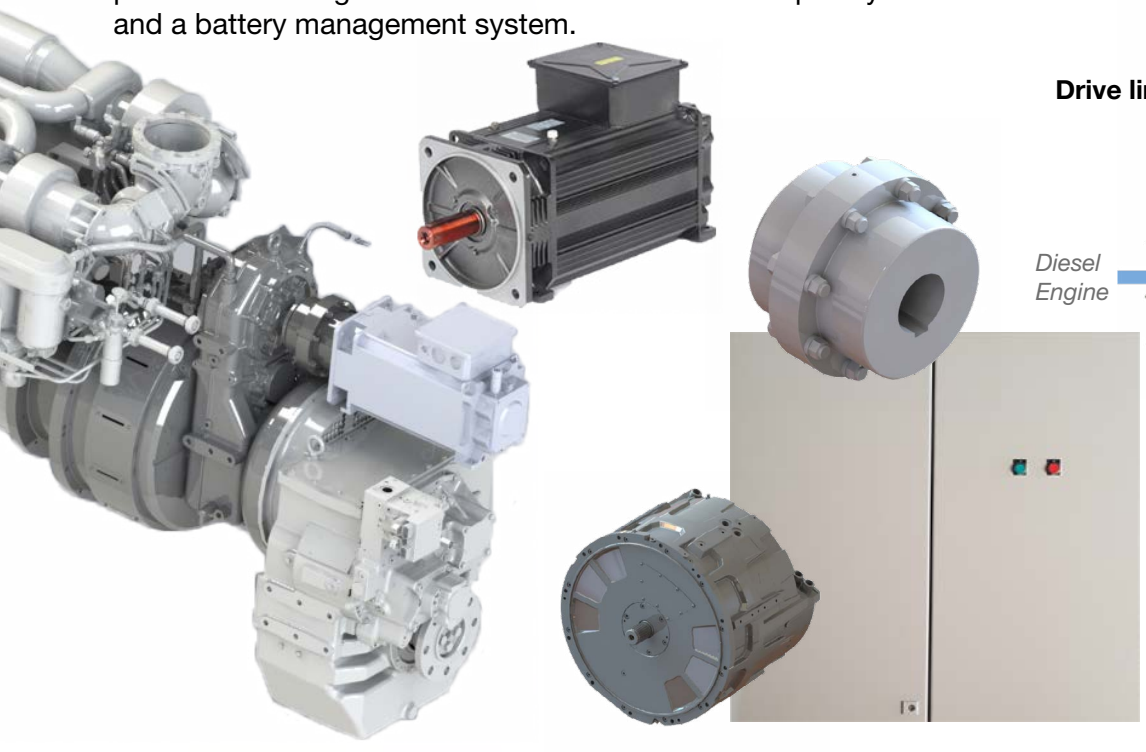
Back-Up Mode

In an emergency situation with hybrid propulsion not working, Back-Up mode is foreseen making the installation highly redundant. In the Back-Up mode the vessel will switch to standard diesel engine driven propulsion, with clutched PHT. Lever position 0% ->100% for diesel operation (100%= full diesel engine power/diesel engine speed). No hybrid functions, as PLC & hybrid software are bypassed.

Single/Cross-Feed Mode

In a twin-engine installation, standard operations of both drivelines will be synchronized (=similar mode for both lines). Through touch screens, split operations can be activated: running with one engine 'single' or in cross-feed operation 'cross'. In cross-feed mode the PHT will transfer energy from one driveline to another using one electromotor as a generator and another as a motor. This energy is passed from the generator to the motor over the frequency inverters and a battery management system.





esco POWER

ESCO POWER, part of the Belgian ESCO Group, Belgium based manufacturer of Parallel Hybrid Transmissions (PHT) and Hybrid Electric Solution Packages (HESP) designed for both marine and industrial heavy-duty use in applications where combining two sources of power, diesel and electric, in one drive system is beneficial.

After over 75 years experience in manufacturing of high torque couplings, distribution, and sales of marine and industrial drive components, ESCO POWER designed and implemented an innovative, unique solution where the emerging hybrid market will definitely benefit from: Parallel Hybrid Solution!







Pictures Courtesy of GreenLine Yachts

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