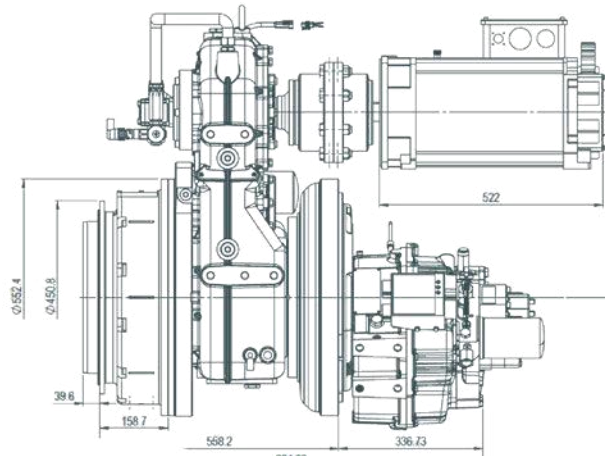




# GL POWER

## PARALLEL HYBRID SOLUTIONS

Great Lakes Power offers 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.



[www.glpower.com](http://www.glpower.com)

800-325-6880

## Parallel Hybrid Transmission - PHT

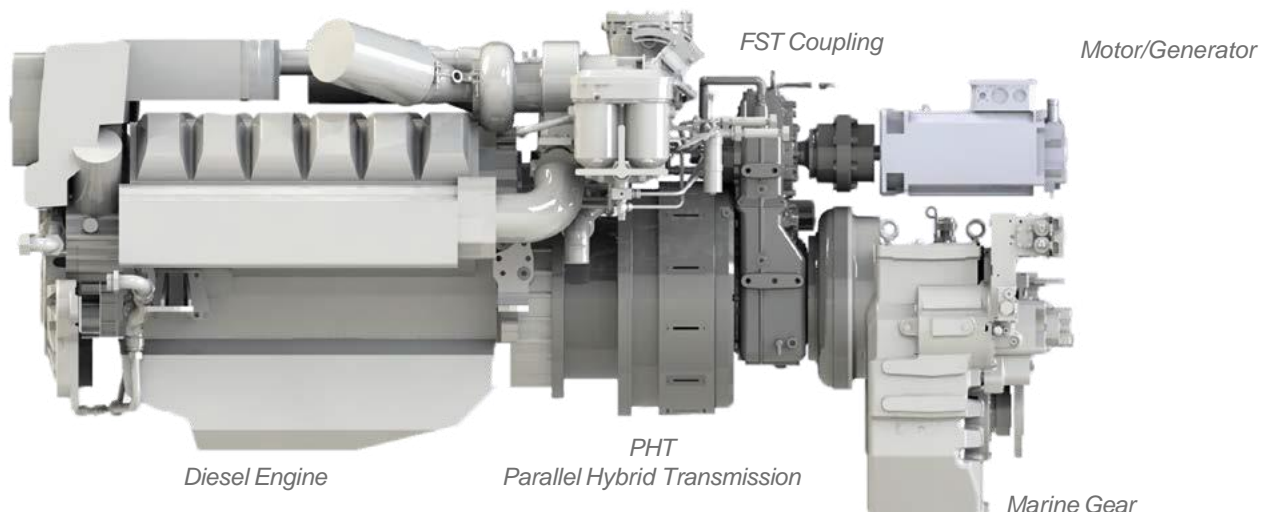
There are several reasons for an alternative to conventional Diesel drivetrain which include:

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

### GREAT LAKES POWER has a Parallel Hybrid Solution for you!

- A unique Parallel Hybrid Transmission PHT, ideal for a refit and new builds of hybrid installations
- A complete Hybrid Electric System Package HESP, with features such as Automatic Mode standard
- An EPB Battery System, properly sized and matching to both the PHT and HESP
- 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, over viewing installation and commissioning.

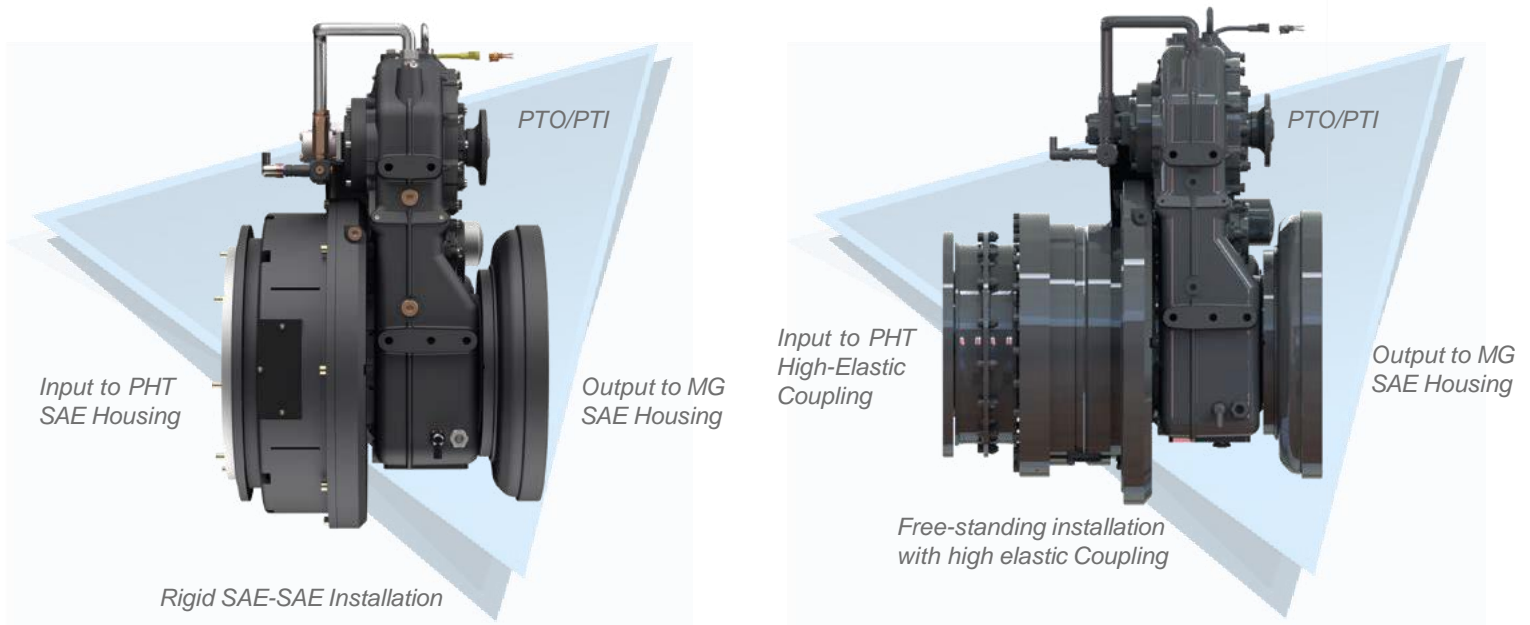
### Example of a Hybrid Installation with Great Lakes Power's Parallel Hybrid Transmission



## Parallel Hybrid Transmission - PHT

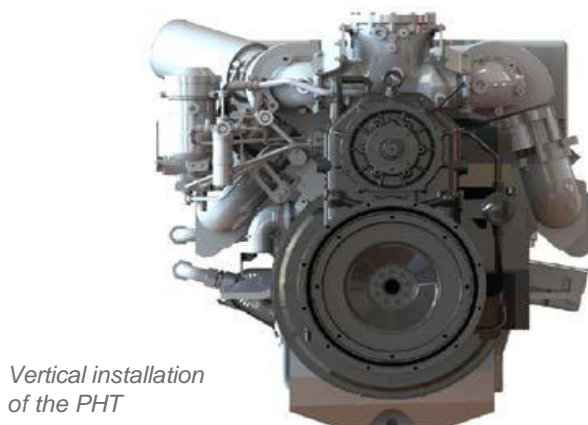
The heart of the Parallel Hybrid Solutions by Great Lakes Power is the Parallel Hybrid Transmission. The PHT unit is designed to allow any vessel or any industrial machine to run on two power sources connected in parallel.

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



The PHT has an integrated, robust electromagnetic clutch for disconnecting the diesel engine from the main driveline.

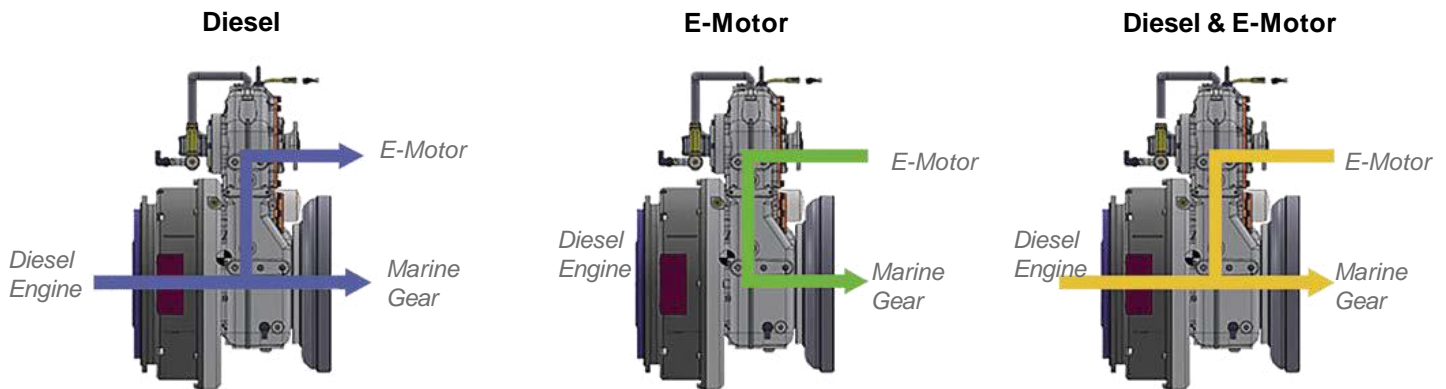
The PHT standard models suit engines up to 5200 ft-lbf torque, or 147kW/200HP to 1655kW/2250HP. The PHT unit can be installed vertically, horizontally or at an offset angle.





## 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 Electromagnetic 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 E-machine (motor/generator) is connected to the secondary input/output of the PHT, located above the main output, through a flexible or elastic coupling.

The PTO/PTI output has an integrated gear reduction built in (1.27, 1.47 or 1.70). The ratio allows all of the installed E-power to be available for propulsion.

When operating the Diesel engine with the E-machine in generator mode, the speed of the PTO output is increased by the gear ratio.

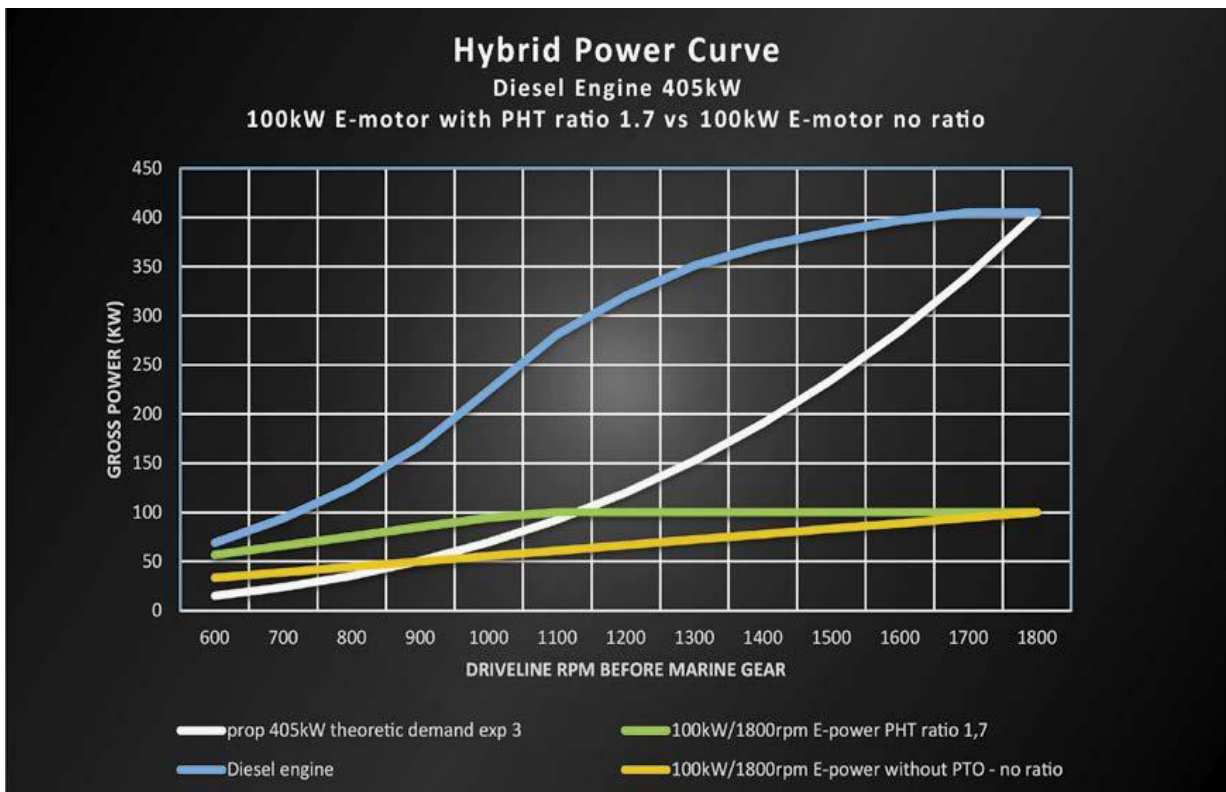
Maximum generating capacity is achieved with the Diesel engine running at lower speeds with the beneficial gear ratio.

### 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	1100 ft-lbf	1550 ft-lbf	2300 ft-lbf	3800 ft-lbf	5200 ft-lbf
Max PTO/PTI torque	1100 ft-lbf	1100 ft-lbf	1100 ft-lbf	1100 ft-lbf	1100 ft-lbf
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" Elastic 11.5"	SAE 1 & 14"	SAE 1 & 14"  Elastic 14"	SAE 1 & 14" SAE 0 & 18"  Elastic 14" 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 Epower available at the driveline. There is no other Hybrid Solution providing the ratio benefit of the Great Lakes Power Parallel Hybrid Transmission.



The above graph shows the availability of Epower for propulsion in two situations:

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

In the situation when there is no ratio benefit, the vessel can be propelled by Emotor only up to the speed of 900 rpm (before marine gear), with the Emotor 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 Emotor up to the speed of 1130 rpm (before marine gear), having access to all of the installed Emotor power, i.e. 100kW in this example.

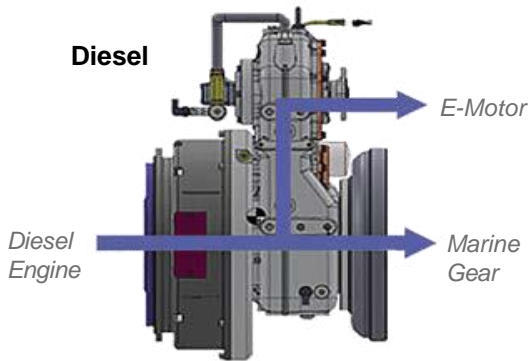
In addition, an installation with the PHT and ratio provides a large safety margin in the Eworking range, making the electric propulsion a very reliable solution.

# Hybrid Electric Solution Package HESP

## HESP Propulsion Modes

In addition to the Parallel Hybrid Transmissions, Great Lakes 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 crossfeed.

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

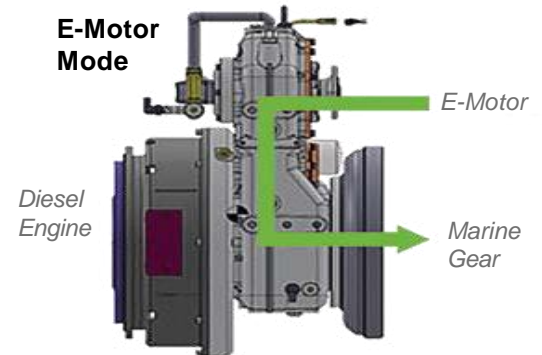


### Diesel Mode

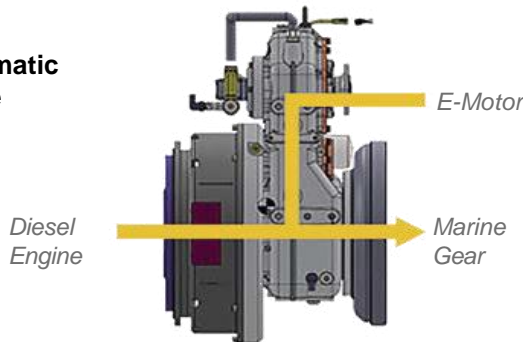
When the diesel engine is running, the clutch is engaged and directly drives the marine gear. Thanks to the PHT, the diesel engine can also power the generator. With the generator not working the axis will spin idle inside the generator. Thanks to the ratio (1.27, 1.47 or 1.7), the rpm of the diesel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

### E-Motor Mode

The PHT in Emode 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 Emotor speed will be decreased at the marine gear by the selected ratio, the torque will be increased. The electric motor is run by a genset or by the onboard batteries.



### Automatic Mode



### Automatic Mode

In this mode, the vessel or industrial machine starts its operation being run by Emotor. 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).

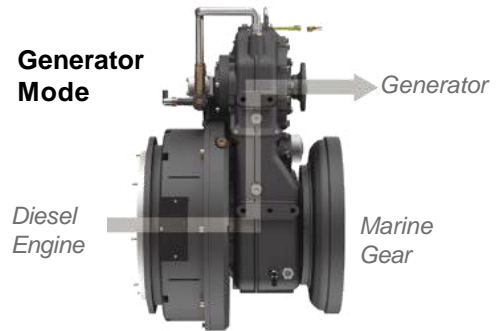




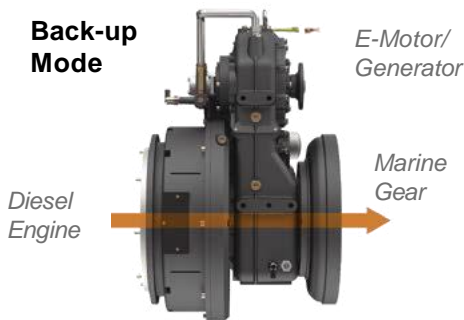
## HESP Additional Working Modes

### Generator Mode

When the diesel engine is in operation and the PHT clutch engaged, generator mode can be activated. The mode can be used even with the vessel docked, anchored or loitering. In order to use the generator mode with the vessel parked, the marine gear remains in neutral. It is possible to program specific automatic generating modes for each application.



### Back-up Mode



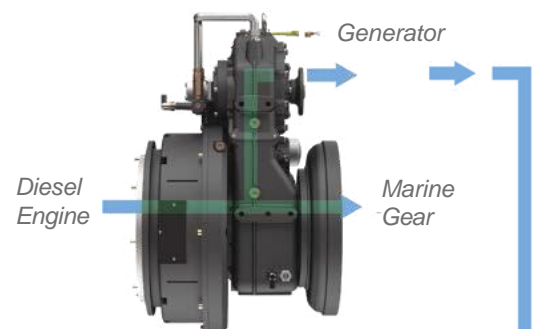
### Back-Up Mode

In an emergency situation when the hybrid propulsion system is not available, conventional propulsion is available. In the Back-Up mode the vessel will switch to standard diesel engine driven propulsion, with PHT clutch engaged. Lever position 0% >100% for commands diesel speed. The PLC & hybrid software are bypassed.

### Single/Cross-Feed Mode

In a twin engine installation, standard operations of both drivelines are synchronized. Through touch screens, split operations can be activated: running with one engine 'single' or in crossfeed operation 'cross'. In crossfeed 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.

#### Drive line 1



#### Drive line 2

