ENERGYTECH®
MARINE GROUP
Version 1.2 3/21/09

EnergyTech Marine's Pulse Buffering Power Core™ Hybrid Energy System is offered for marine vessels up to 200'. The Power Core is a proprietary closed system, which converts various energy sources to stored charged ions in its internal super capacitors or lithium-ion energy storage system. It replaces the standard diesel propulsion engines, diesel generators, and lead acid battery banks of a normal installation. The Power Core hybrid system converts a vessel to all-electric, for propulsion and hotel loads. To learn how it works see the "Pulse Buffering Power Core" paper at ***EnergyTechMarine.com*** home page.

Let us look at fuel consumption test results for the EnergyTech Marine 83 HD-J vessel under *power only tests* with standard diesel propulsion vs. the Power Core hybrid electric system. The specific fuel consumption for the energy requirements of each mode can be very accurately measured. This example demonstrates entry-level savings at the smallest end of the spectrum.

## *Ten hour outing* for private 83' twin-engine luxury yacht with guests.

**A boat ride with 8-10 guests around the harbor for a ten-hour outing.** You depart at 9 am and return at 7 pm. You travel 34 miles out then 34 miles back. You are motoring continuously. You cruised 40% of the time at 8 knots and 60% at 5 knots (the harbor speed limit).

The air conditioning runs as needed. The all-electric galley is making ice and heating food. The 30 kW generator runs continuously. This is a typical mission for a luxury yacht in a harbor city.

Let us compare the cost efficiency of two standard diesels connected to shafts and props along with an accompanying 30KW generator running constantly, with the EnergyTech Marine hybrid system with twin electric propulsion motors and the identical hotel loads. Let's apply the current marine diesel price @ $3.00/gallon.

With **standard propulsion and generator**:

| | | |
|---|---|---|
| **Fuel burned @ 5 knots** | **5.8 gallons** | **$ 17.42** |
| **Fuel burned @ 8 knots** | **23.8 gallons** | **$ 71.28** |
| **Fuel burned by genset** | **16.3 gallons** | **$ 48.90** |
| **Total fuel cost of outing** | | **$137.60** |

By comparison, the EnergyTech Marine Power Core hybrid system operates in total electric mode. It can charge with the electric plug-in at the dock or can charge from its enclosed diesel-powered 400 kW of industrial alternators while underway. This offers a stunning difference in cost compared to standard propulsion. The power company sells a kilowatt-hour of energy for $0.13 cents. Let us assume that the Power Core lithium-ion storage system was charged only 80% by the shore power prior to departure. We will assume the super capacitors were not charged at all at the dock.

For **Pulse Buffering Power Core** operating in full electric mode (after losses):

| | | |
|---|---|---|
| **Energy burned @ 5 knots** | **55.2 kWh** | |
| **Energy burned @ 8 knots** | **338.1 kWh** | |
| **Energy burned for hotel loads** | **19.6 kWh** | |
| **Total kWh burned (including losses)** | **412.9 kWh** | |
| | | |
| **Kilowatts charged by shore power** | **320.0 kWh** | **$41.60** |
| **Cost of diesel for kWh made underway** | **92.9 kWh** | **$17.64** |
| **Total energy cost of outing** | | **$59.24** |

Even after 15% losses incurred by all the electrical systems, the cost for the Power Core system is only 43% of the cost of the standard diesel propulsion with generator.

In this typical example, shore power at $0.13 cents/kWh, provided most of the kilowatt-hours needed for the outing. However, only 80% (320 kWh) of the lithium-ion 400 kWh capacity was charged at power company prices prior to leaving. Therefore, more kWh had to be generated underway to supply the remaining 92.5 kWh needed for the voyage. This was generated by running one Power Core diesels, feeding the hybrid system for 28 minutes (after losses) at a cost of $17.64 for diesel fuel.

The net result is that for identical performance, one diesel ran (fully loaded with dramatically less emissions) for 28 minutes with the Power Core hybrid system. Three diesels ran (drastically under-loaded) for 30 combined running hours for the standard propulsion system plus its genset, for a net cost efficiency comparison of 232% for the “Pulse Buffering hybrid system”. The emission comparison is off the chart by orders of magnitude.

In the pulse buffering example, the diesel ran only 1.5% as long as the sum of the diesel’s combined running times in the standard direct-coupled diesel example. This points out that extended engine life is another plus.

Not all outings can be powered so extensively by inexpensive shore power. Read “Typical Weekend Outing” at ***EnergyTechMarine.com*** home page for longer voyage cost efficiencies.