

# ISLAND PILOT

Tomorrow's Technology. Today's Most Innovative Yachts.

An Island Pilot LLC White Paper

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## Island Pilot DSe 12m Hybrid

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## Introduction

Island Pilot LLC has developed a hybrid-powered cruising yacht, the DSe 12m, for the eco-conscious boater.

## Problem Statement

Power cruising yachts, even the most economical, rely on fossil fuels for propulsion and for electricity generation while living aboard when anchored.

## Previous Options

Limited electrical generation from renewable sources, both from sun and wind, have been used to supply small quantities of power. Mostly used by cruising sailing yachts to keep batteries charged for pumps and lighting, these solutions have not allowed for the same lifestyle aboard provided by diesel generators.

## Island Pilot DSe 12m Solution

The DSe 12m has combined the latest technologies from around the world to create a sustainable, live-aboard lifestyle with little or no use of fossil fuels

First, an extremely slippery, fuel-efficient hull form was needed. George Petrie, N.A., designed a catamaran with wave-piercing bows that proved to be capable of displacement speeds using minimum energy during original tank testing in Shanghai, China.

A unique superstructure design followed with both the space for live-aboard amenities and to carry the necessary amount of Photo Voltaic panels to generate power for both propulsion and for a comfortable life on board.

For the power train, Island Pilot chose the award-winning Steyr Motors hybrid drive system, introduced in January 2008. This combines a “monoblock” diesel (capable of burning 100% bio fuel) with the hybrid drive (a permanent magnet, brushless, generator-motor) mounted behind the flywheel of the diesel. When either the diesel or the electric motor is running, power is transmitted to a ZF sail drive transmission and then to the propellers. A pair of SCC (Steyr Control Center) touch screens is located at the helm – these units provide ALL the information for the Steyrs, in both diesel and electric mode

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(normal engine monitoring, fuel levels, fuel use rates, stored energy levels, energy use/charge, warnings, etc.).

For the solar array, Island Pilot chose the Sun Power panels due to their high efficiency – each panel is rated at 16 watts/square foot. The total rated capacity is 6 kW in two equal strings of 3 kW each. This is mounted out of the way up off the roof of the bridge and deckhouse to insure proper cooling of the panels.

For storing the energy, Island Pilot chose the Odyssey “True Lead” series of AGM-style batteries. Two separate 48 VDC arrays each have a capacity of 200 Amp Hours (about 10 kW hours each/20 kW hours total). These batteries have both a long life (400 plus full cycles) and the ability to handle great amounts of discharge and charge currents.

For charging the batteries from the PV array, Outback Power MX60 MPPT charge controllers were installed (2 each) with the capacity of 60 Amps each (approximately 3 kW). The “float” charge of these controllers is set higher than the other charge sources so that whenever the sun is shining, some of the charging is coming from the PV array.

For charging the batteries from shore power, 2 each Outback Power FX3648 inverterchargers were chosen. These units charge the 48 vDC battery arrays at 30 Amps and invert up to 3.6 kW of 120 VAC each and are 92% efficient.

For charging the batteries away from the dock, the Steyr hybrid charges the batteries at up to 5 kW each (10 kW total) whenever the diesels are running.

For lighting, Island Pilot chose LED for ALL domestic and running lights from Imtra Marine Products. The entire domestic load is less than 400 watts.

For refrigeration, an extremely high-efficiency refrigerator/freezer from Hitachi is used. With close to 15 cubic feet, this unit uses an average of 35 watts.

For cooking, CookTek MCD-1800 induction cook tops were installed (2 each). Each burner has a capacity of 16,000 BTU using only 1,800 watts and does not get hot – only the cookware gets hot. Induction cooking is about 30% more efficient than either gas or “normal” electric burners.

For laundry, the Splendide WD2100XC washer/dryer is hidden behind a door in the guest shower – this is a single, vertical-loading unit that washes using the minimal amount of water and energy. When washing is completed, it dries automatically.

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For entertainment, a KVH TracVision M3 DX high-definition, gyro-stabilized, satellite antenna with DISH HD receiver is installed and supplies all 4 TV outlets and the Bose 3.2.1 home theater.

For the dinghy outboard motor, the Torqeedo Travel electric motor has been chosen. This uses no fuel other than electricity to charge its battery.

For land excursions, a Segway i2 Personal Transporter is standard equipment. This modern means of transportation has a range of about 20 miles on a single charge. A special davit and hatch are installed to facilitate storage and off loading onto a dock.

For navigation, a 15" Garmin GPSMAP 5215 touchscreen plotter has been installed. This unit is both powerful and intuitive and combines the radar, depth, GPS and satellite weather functions.

For interfacing with the drive train, a fly-by-wire system from Tecnautic in Switzerland incorporates the autopilot, gear shifters, throttle and steering in a single unit. A remote that can be operated from the bow or either side deck has all the same functions as the unit at the main helm. This is similar to "big ship" technology.

For water making, the Newport 400 MKII, has been chosen for its efficiency and silent operation. In low energy mode, it produces each gallon of water for less than 15 watts.

None of this high-tech equipment detracts from the livability and comforts to be found aboard the DSe 12m. The master stateroom is on deck with a forward-facing queen-sized "Sleigh" bed with 270 degree panoramic vistas. The deckhouse has similar vistas, lounging room for the crew, efficient galley and home entertainment center with a 26" HDTV and Bose home theater. Guest quarters are in the port hull with a convertible berth area (twins, queen or king), ensuite head, stall shower and dressing room. The starboard hull has the ensuite master head, shower, dressing room plus the starboard machinery/storage room. Three zones of air conditioning keep the interior comfortable. The bridge has seating for 12, can be opened to the weather or heated and cooled as conditions dictate. Wide side decks lead aft to the swim platforms and forward to the roomy foredeck – space for 6 loungers plus a plug for the remote control – the foredeck becomes the de facto "fly bridge."

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## *Benefit 1 – ZERO-EMISSIONS ELECTRIC MODE*

In electric mode, the DSe 12m can cruise at modest speeds while creating NO EMISSIONS. Another benefit, NO MACHINERY SOUNDS – only the sounds of water rushing past the hulls reach the bridge. At 4 knots on a sunny day, the DSe's PV array can generate the same amount of power being used by the pair of Steyr hybrid electric motors – this gives a virtually unlimited range and ZERO GPH.

At anchor, the cruising couple can live aboard INDEFINATELY without ever running the internal combustion motors. Energy from the sun is stored in the battery arrays for use throughout the days and the nights. Again, there is NO GENERATOR SOUND or vibration as is typically found on power (and some sailing) yachts at anchor.

## *Benefit 2 – DIESEL-ELECTRIC MODE*

Testing is now being conducted for a “quasi” diesel-electric mode. Not being a true “Serial Hybrid” drive (one with a generator at one end and an electric drive motor at the other), the Steyr hybrid is designed to used in either diesel or electric mode. But since the DSe 12m has a pair of Steyrs, a diesel-electric mode is possible.

This is done by joining the two 48 volt battery arrays together, running one Steyr in diesel mode (simultaneously generating a charge current) and running one Steyr in electric mode.

The reasons to run in this mode are:

1. Batteries are down and need charging – not enough sun to do the job
2. More speed desired than available in pure electric mode
3. Save fuel from pure diesel mode – preliminary sea trials show a savings of 10% to 15% at similar speeds
4. Minimize hours on the diesels

Final results from a series of trials will be posted to the website upon completion.

## *Benefit 3 – DIESEL MODE*

Whenever the diesels are running, the 48 volt battery arrays are being charged. This is an automatic function of the HCU (hybrid control unit) that is a part of each Steyr installation. By running both diesels, maximum charge is 10 kW – the batteries are charged quickly and efficiently by the propulsion motors.

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Each diesel is housed in a sound-deadening enclosure minimizing the noise pollution of the surrounding areas. At a relatively fast speed of 9 knots, the sound levels on the bridge are only 69 decibels (about the same as found in an office). Decrease the speed to 5 knots, and the reading is 61 db, the same as conversational speech.

With her exceptionally slippery hulls, the DSe 12m gets exceptional mileage in diesel mode – 8+ NM/Gallon at 5 knots – 5.9 NM/Gallon at 6 knots – 5 NM/Gallon at 7 knots. By mixing modes, the careful owner will be able to average even higher total miles per gallon.

The Steyr diesels are engineered with a “monoblock” design – there is no separate head, head gasket, head bolts, etc. By eliminating the problems associated by the proximity of dissimilar metals at the hottest part of the engine, the Steyr is easier to cool. In fact, at less than 1,500 RPM, the Steyr can be run indefinitely with no external cooling water present. This ability is one reason why most of the Steyr diesels are used in rescue and military applications.

## *Benefit 4 – REDUNDANCY*

The DSe 12m has a total of 4 (four) motors connected to the two propellers – 2 diesels and 2 electric. This means that up to 3 motors can fail and the DSe still has “get-home” propulsion.

## *Benefit 5 – LIFESTYLE*

Only by experiencing the DSe 12m away from the dock, can one begin to appreciate the uniqueness of life aboard a totally SILENT cruising yacht. Silent underway. Silent at anchor. The solar PV array SILENTLY generating electricity day after day after day.

The DSe 12m leaves a minimal carbon footprint while providing a cruising, live-aboard lifestyle.

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## Implementation

The DSe 12m has been engineered to make operation by the cruising couple as seamless as possible. Here is a brief primer on operations in the various modes:

When leaving the dock, the skipper first chooses the mode of operation (electric, diesel-electric, diesel). Reasons for the choice of the different modes could be:

1. Electric – only a short distance is contemplated, perhaps up to 20 NM and the day's weather lends itself to regenerating power from the PV array
2. Diesel-electric – perhaps the batteries are low and/or a longer distance is contemplated and/or the sun is not intense enough for significant power regeneration
3. Diesel – similar to diesel electric but perhaps more speed is desired and/or night cruising is planned

Once this decision is made, the motors are “started.” All modes begin with turning the key switch to “on.”

If diesel mode is desired, the key switch is turned a bit more to initiate the starter and start the diesel (this is what most boaters do every day with “normal” propulsion boats). The diesel(s) idle as one would normally expect, awaiting commands.

If electric mode is desired, the electric mode button is pushed, disengaging the hybrid drive from the diesel so it can turn freely. Nothing apparently is happening as the electric motors are motionless - the system awaits quietly commands from the controls.

If diesel-electric mode is desired, one motor is started in diesel and one in electric. If the two battery arrays are not already combined, now is the time to join them so that the power of the one diesel generator can be simultaneously be used by the electric motor in the other hull.

The next step is to unplug the shore power cables (if plugged in – one can stay dockside using only power from the PV array, if so desired). At this point, no other switching is required of the electrical system – the inverters kick in automatically, fast enough that the microwave's clock doesn't miss a tick.

Driving is done the same regardless of mode – there are two single lever controls: one shifts and throttles the port drive motor and the other, the starboard. The same controls are used in the same manner for both electric and diesel mode. A knob located between the levers is used for steering – a pump is activated turning the rudders to port or starboard in increments relative to the amount the knob is turned. Autopilot and

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navigation modes (interfaced with the Garmin GPS for steering to a waypoint) are engaged at the push of a button. A “constant rate turn” mode combines auto-pilot functions for straight-ahead running with constant-rate turns when the knob is turned to one side or the other. The plug-in remote has the same functions.

Monitoring – the SCCs each show the use or generation of electricity, the rate of fuel being used, the fuel remaining, the rate of power being used, the amount of battery charge remaining plus more “usual” indications such as temperature, oil pressure, exhaust temperature, etc.). Like driving any boat (or car) with limited amounts of fuel on board, it is up to the owner to keep a watch on the amount of “fuel” remaining. In the DSe 12m, the “fuel” is both the diesel (or vegetable oil) in the two fuel tanks AND the amount of energy in the battery arrays. All this information is available at the helm.

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## Summary

The DSe 12m has been designed and engineered to provide the eco-conscious owner a sustainable lifestyle aboard a live-aboard motor yacht.

The “ideal” use of the DSe 12m could be a live-aboard couple spending time in a southern climate (good sun) such as the Florida Keys, the Bahamas and the Caribbean. They can spend unlimited days at anchor in their favorite cove NEVER using the Steyr internal combustion diesels to generate electricity. ALL their electrical needs – for cooking, heating and cooling, laundry, entertainment, dinghy – can be met by the 6 kW PV array on the roof.

After several days, weeks or months in a particular anchorage, they may choose to move on to another one down the bay or at the neighboring island. Hoisting the anchor at 10:00 AM and motoring at 4 knots or so on electric mode gets them to a new anchorage 16-20 nautical miles away. Using only electric, zero-emissions mode. Burning no fossil fuels. In total silence.

This can be repeated and repeated and repeated as the owners choose, at no sacrifice in comfort or lifestyle. Actually, the lifestyle is enhanced due to the absence of machinery sounds and vibrations. There is NO pollution – not even sound pollution.

Fresh water is replenished as needed, using energy from the sun. Laundry can be done, meals cooked, wine cooled, water heated, showers taken, dinghy explorations, DVDs watched, CDs listened to – all with renewable energy.

Like all high-tech products, the DSe will evolve, adopting the latest technologies as they mature – lithium batteries – wind generation – higher efficiency solar. Each step forward will enhance the owner experience of life aboard the DSe 12m, an owner experience that already has features previously unavailable to the cruising, live-aboard couple.

For ongoing new information, log onto: [www.dsehybrid.com](http://www.dsehybrid.com).

Island Pilot LLC was founded in 2004 by Reuben Trane and started delivering fast, efficient cruising yachts in fall of 2005 – the Island Pilot 395. The Island Pilot 435 using Volvo-Penta’s revolutionary IPS drive train was introduced in 2006. The DSe 12m Hybrid made her debut at Fort Lauderdale Int’l Boat Show in October, 2008.

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## Appendix

Sea Trial results from Power & Motoryacht – January 2009 – Page 51

PRIMARY DIESEL PERFORMANCE >>>							
RPM	MPH (KNOTS)	GPH	MPG (NMPG)	SM RANGE	NM RANGE	DECIBELS	TRIM (DEGREES)
1000	5.8 (5.0)	0.6	9.67 (8.41)	1044	908	61	0.3
1250	6.8 (5.9)	1.0	6.8 (5.91)	734	639	66	0.3
1500	8.0 (7.0)	1.4	5.71 (4.97)	617	537	66	0.0
1750	8.7 (7.6)	2.0	4.35 (3.78)	470	409	64	0.0
2000	10.0 (8.7)	2.8	3.57 (3.11)	386	335	67	0.0
2250	10.5 (9.1)	4.0	2.63 (2.28)	284	247	69	0.0
2500	10.9 (9.5)	5.2	2.10 (1.82)	226	197	71	1.0
2750	11.0 (9.6)	6.8	1.62 (1.41)	175	152	74	2.0
3000	11.9 (10.3)	10.8	1.10 (0.96)	119	103	77	3.5

  

ALL-ELECTRIC PERFORMANCE >>>								
AMP	MPH	KNOTS	RUNNING TIME (IN MINUTES)	RUNNING TIME (IN HOURS)	SM RANGE	NM RANGE	DECIBELS	TRIM (DEGREES)
30	4.5	3.9	380	6.3	28.4	24.6	55	0.5
45	5.3	4.6	220	3.6	19.1	16.6	57	0.5
60	5.6	4.9	160	2.7	15.1	13.2	55	0.5
75	6.2	5.4	125	2.1	13.0	11.3	56	0.5
90	6.5	5.6	110	1.8	11.7	10.1	58	0.5
105	6.6	5.7	90	1.5	9.9	8.6	57	0.5
120	6.7	5.8	75	1.3	8.7	7.5	59	0.5
150	7.0	6.1	55	.92	6.4	5.6	59	0.5
175	7.3	6.3	45	.75	5.5	4.7	60	0.5

**CONDITIONS:** 64°F; humidity: 47%; wind: 20-25 mph; seas: 2'-3'; load: 110 gal. fuel, 110 gal. water, 3 people, 40 lbs. gear. Speeds are two-way averages measured w/ Stalker radar gun. GPH taken via Steyr fuel-monitoring system. Range: 90% of advertised fuel capacity. Decibels measured on A scale. 65 dB is the level of normal conversation.

LINKS:

DSe 12m high resolution images:

[http://www.dsehybrid.com/html/dse\\_hybrid\\_high\\_resolution\\_ima.html](http://www.dsehybrid.com/html/dse_hybrid_high_resolution_ima.html)

DSe 12m Video:

<http://link.brightcove.com/services/player/bcpid1243754555?bclid=1305014067&bctid=6155356001>

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Power & Motoryacht review:

[http://powerandmotoryacht.com/engines/the\\_way\\_forward\\_island\\_pilot\\_dse\\_12m\\_hybrid/index.aspx](http://powerandmotoryacht.com/engines/the_way_forward_island_pilot_dse_12m_hybrid/index.aspx)

MotorBoating "Best of the Year" Award:

[http://www.dsehybrid.com/DSe\\_MotorBoatingBestOfYear.pdf](http://www.dsehybrid.com/DSe_MotorBoatingBestOfYear.pdf)

Passagemaker review: [http://www.passagemaker-](http://www.passagemaker-digital.com/passagemaker/200903/?sub_id=WJ3feKVZK2RT&folio=64)

[digital.com/passagemaker/200903/?sub\\_id=WJ3feKVZK2RT&folio=64](http://www.passagemaker-digital.com/passagemaker/200903/?sub_id=WJ3feKVZK2RT&folio=64)