# ELECTRIC MOTORS —

Whether you're heading out of the harbor to go racing or simply taking a cruise around the Bay, using your inboard engine is one of the least pleasant aspects of your sailing experience. If it isn't the lingering odor of diesel and oil inside the cabin assaulting your nasal passages, it might be the drumbeat of the engine clanking away under your feet that invades your eardrums. And, if neither of those sensations gets under your skin, the raw smell of diesel exhaust is certain to make you wish the breeze would pick up sooner rather than later. Fortunately, boat owners have more choices than ever when it comes to powering their boats, and many are now choosing electric motors instead of replacing an aging diesel — and the experience couldn't be more rewarding.

The historical deterrents to repowering with electric have often been technology and cost. But today, technology makes it easier than ever to manage your batteries, while the costs for hardware and batteries have dropped significantly. Now, repowering (with electric) can equal the cost of replacing the old diesel or gas-powered engine. Some systems are more elaborate than others, and in some cases, you can replace the systems yourself if you are inclined — further reducing cost. But, specific individual needs do vary and each boat has its own design criteria, making for further variation in price.

It is relatively easy to have an electric motor installed where your current diesel sits. Typically, the motors are significantly more compact and often attach with a belt drive or custom coupling to your driveshaft with a few pieces of hardware. A group of batteries is then connected from a nearby location — say where your gas tank used to be. Depending on the size of your boat and your specific motoring needs, the size of the motor and the number of batteries will vary. For the do-it-yourselfers out there, the most difficult part of the process may be taking out the old diesel. Beyond that it's mostly a matter of where you want to put your batteries, making sure you have proper mounting hardware, aligning the engine with the driveshaft, and routing the new wiring.

***The Electric Yacht 48 cost Bay Area sailor Michael Ruiz about the same as replacing the diesel engine on his Pearson Triton 28.***


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Michael Ruiz has owned his nicely maintained Pearson Triton 28, *Alma*, for about eight years and keeps her at the Berkeley Marina. Although he had planned on re-powering with electric, a leaking gas tank pushed him to make the change after only about four years of ownership, despite the Volvo MD7A's being in good working order.

"I believe that 90% of the sailboats at the docks in the San Francisco Bay Area that have diesel- and gasoline-powered auxiliary power do not need the range that these motors provide," he said. "Most sailboats just need to be able to maneuver their boats in and out of their slips and around their marinas . . . or to get home from across the Bay in a calm. Electric auxiliary power easily provides this capability. It is much cleaner, quieter, easier to maintain and more responsive than internal combustion auxiliary power."

Ruiz installed the Electric Yacht 48 Volt QuietTorque 5.0 (5kW) Plug-N-Play system himself, cutting down on overall cost, which was about the same as replacing his diesel. He was chided by the harbormaster for going too fast the first time he used his new electric motor. "I was surprised by the power provided by the system. At full power, the boat moved faster than she had with the diesel. Of course, at full power, the range of the electric motor is decreased dramatically."


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***To show its resilience and utility, Conrad Colman sailed an Oceanvolt Saildrive model SD15 around the world in the Vendee Globe.***

He sails Alma 20 to 30 times a year, using the motor for only five to 10 minutes each time, which makes his setup more than ideal.

"On very calm days, I often turn the prop with the motor at very low amps just to add a knot or two of speed. The motor can barely be heard and it can be helpful to make way against a current in low winds." As to other benefits of going electric, he listed: "Easier maintenance, cleaner, quieter, more reliable, better for

# GOING GREEN AND CLEAN

the environment, and more fun!"

Matt Kepner operates Tradewinds Sailing School out of Richmond, CA, and became aware of electric power almost by chance. "In 2010 we had an older [1980s] Catalina 30 that needed an engine replacement," he said. "At the same time, I was introduced to someone who was making a prototype [electric motor]. In exchange for some testing, we got a price break on the motor and help with the install. After that, we ended up repowering two more Catalinas because I liked them so much."

As a business owner, Kepner must always consider costs. "The maintenance plan was a big plus — basically none. We have since sold two of our electric boats, not for any reason related to the motors, but only age and natural replacement in the fleet with newer boats. The motors were all basically identical. We are still running one. It is a 3-phase, 18 pole motor with a controller that converts 48VDC to 3 Phase AC. We have four Group 8D batteries providing ~245 amp hours of available power at 48 VDC. These motors are completely sealed and enclosed. No external moving parts, reduction gears or belts. The one we have currently, we've been running for seven years without a single maintenance item — we've replaced one set of batteries, just a few months ago." Although the new batteries cost $2,000, Matt's maintenance plan on the diesels comes to $4,200 just for oil changes over the same period, not including broken parts, which he believes are inevitable.

Kepner has an interesting perspective on how people like using the motors, because so many of his students and instructors have had hands-on experience with them. "Half hate them, half love them. The half that hate them manage to run the batteries down in a short time; the half that love them bring them back with 80% charge still on them. I think it does a good job of separating the sailors who plan around tides/currents/winds and really sail from the folks who are out to have a good time on the water but don't want to pay as much attention to the intricacies of maximizing sail time."

*"Boat owners have more choices than ever when it comes to powering their vessels."*

More advanced systems act much like today's hybrid cars, and regenerate electricity while underway, using the boat's speed to turn the propeller and thus send electricity back into the batteries at the touch of a button. Reverse the process and batteries power the propellers.

One of the newest and most complex hybrid systems in the Bay Area is found on the recently launched *Matthew Turner*, a hand-built 100-ft tall wooden ship. She'll utilize twin hybrid systems when she finishes her sea trials later this year. "We're a twin-propeller system," said Allan Olson, the ship's visionary.

"And each of the systems can completely supply the boat with all of its needs. So we have an electric motor, 200 kW, which translates to 265 hp at each propeller. Then there are the lithium-based batteries for other applications that we're doing. We also have in-house generators, which are 300 hp. Cummins. There are boxes of inverters, battery management systems, and systems that convert different types of electricity going into and out of the batteries, and there's a number of pieces of sophisticated equipment that monitor these things and they all have to be synced together as well." The entire hardware and software package comes from BAE Hybrid Systems.

Since not everyone needs to power a 100-ft tall ship, small, pioneering companies have made it easier than ever to convert your sailboat to hybrid power. Innovator and all-around sailing enthusiast Philippe Khan re-powered his custom J/100 variant with Helsinki-based Oceanvolt's SD6 system. This novel system attaches directly on top of the J/100's saildrive mechanism. "We are shorthanded ocean sailors," said Khan. "It's really nice to have a clean system that is quiet and generates electricity downwind." He cited many advantages to going electric, "It's green, clean, regenerates electricity, quiet, and it's easy to maintain and fix. Range may be challenging for some if they don't use regeneration — in our case 50 miles standalone."

If you worry that hybrid systems haven't been tested sufficiently to warrant outstanding reliability when cruising longer distances, you should read about Conrad Colman. The youthful American recently completed the around-the-world-alone Vendée Globe race using an Oceanvolt system. Passionate about the environment, Colman sought to use yacht racing as a platform to improve the perception of land-based hybrid systems, while significantly decreasing his ocean-based carbon footprint.

"The fact that humans can create a difference in the environment was manifest, I could see that," said Colman. "So, this was my little opportunity to participate in that dialogue and stand up to the common misperceptions of the coming changes to our transportation system and distribution networks by using much more diverse sources of energy in the future. What I wanted to do is to take this stuff that is considered to be leading-edge technology, shake it up all over the world, show people that it can go through the Southern Ocean and survive 60 knots of wind. If it can be turned upside down, then there's nothing that should stop people from buying

***Philippe Khan re-powered his J/100 with an Oceanvolt SD6m, which attached directly on top of the boat's saildrive mechanism.***


ROSS TIBBITS

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*Combining the old with the new, the 'Matthew Turner' has twin 200 kilowatt electric motors, translating to 265 horsepower at each of its screws.*

an electric car."

Oceanvolt was instrumental in assisting Colman to install an electrical system that resulted in Foresight Natural Energy — his 60-ft IMOCA Vendée yacht — having the smallest carbon footprint in the race. "We have a Saildrive model SD15 that delivers 15kW of maximum power," said Oceanvolt's founder, Janne Kjellman." Conrad had a special 'IMOCA version' since we need almost 20kW of power to pass the IMOCA- class bollard pull test, which is 285kg of pull for 15 minutes. The SD15 is connected directly to a large 48V battery, which in turn charges a separate 12 volt/160 Ah house battery via two DC/DC converters. There is a small (4kW) diesel generator on board because IMOCA rules say that you need to be able to motor the boat five hours @ five knots. Conrad decided not to use the diesel engine on his trip around the world so all his electricity was generated by the regeneration feature of our propulsion engine."

"From our system you can get 4kW, 4,000 watts when the boat is really moving. We have automatic software on the display, so Conrad could press a button and the propeller spins open to start charging the batteries. When the batteries are full or he presses it again it stops the shaft and the propeller folds."

*"More advanced systems act like hybrid cars, using the boat's speed to regenerate electricity while underway."*

So if you find yourself needing a new engine, it's nice to know there are green options available. For many, the simplest electrical motor system will suffice. Others may choose more complex systems that provide regenerative power, ideal for offshore sailors and long-distance cruisers alike. Whichever you decide, it will most likely improve your overall sailing experience and peace of mind and significantly reduce your carbon footprint.

**— ross tibbits**