



The Cleaner Way

Diesel or electric? After weighing up the options, a cruising sailor decides to go green

By Scott Monroe



After the electric conversion: a look at the small motor and large battery bank (far left) that took the place of the aging diesel engine (left)

The fifth member of our modest family is *Badger*, a 30-foot 1977 Irwin Citation sloop. A couple of years ago, its then 35-year-old 12hp diesel engine was becoming something of Frankenstein's monster, with various generations of repairs using parts of different life expectancies. It was leaking oil, failing to start reliably and generating inappropriate amounts of smoke. My wife, Elizabeth, and I agreed that an overhaul was somewhat of a band-aid solution; once the engine was pulled from the boat and rebuilt, the repair could come close to the price of a new engine with little or no warranty protection.

Re-powering would bring both reliability and more power. We liked the idea that new engines were capable of packing more horsepower into tighter spaces. The boatyard confirmed the material costs of re-powering were within our budget, but labor was a bit more of an open-ended question. The existing engine's propeller shaft was offset from center, which meant mounts and brackets that could support a new motor would have to be fabri-

cated. I was concerned about the possibility of significant (and expensive) engine compartment modifications.

While these discussions were going on, our kids were always coming home with ideas from school about ways to contribute to protecting the environment. Concern was increasing throughout Chesapeake Bay communities about recreational boaters's overboard discharges of engine cooling and bilge water into the Chesapeake Bay, fuel prices were on the rise and the nation was becoming increasingly fascinated with electric and hybrid automobiles.

THINKING GREEN

I am not a zealot about anything—in fact, I am painfully ordinary and average in every way—but like almost all sailing enthusiasts I like the idea of making as little impact as possible on the environment while we enjoy our sport.

An Internet search revealed only a few vendors offering “green” options; re-powering sailboats with electric propulsion seemed to

be somewhat of a new market. It appeared most common to see electric propulsion used for small launches intended to motor slowly around protected harbors. But I ultimately found a handful of sailboat conversions documented around the world where the owners seemed very happy with their choices, both for daysailing and cruising. A little further research indicated electric motors with the same shaft horsepower as a comparable marine diesel weighed far less, cost about the same and could be do-it-yourself installation projects once the old engine was out of the way. Having always loathed the smell of diesel and the sound of the engine, my wife and daughter wholeheartedly endorsed the idea of going electric.

Because I was likely looking at engine compartment modifications with re-powering anyway, I engaged an electric motor vendor to size and price a system for me. It requires a good bit of homework to determine the right motor, reduction ratio, propeller and battery bank to obtain the desired speed and range for a given boat, let alone select all the other ancillary components and set it up properly. Most vendors of marine electric drives will work with you to define the optimal combination of components to support your intended use, and such sizing calculations and resulting cost proposals are typically offered for free. I wound up doing business with Annapolis Hybrid Marine and appreciated their active participation in not only specifying the optimal combination of components, but also their willingness to supervise the conversion and work closely with the boatyard team. This was the first time my preferred boatyard, Tidewater Yacht Service Center in Baltimore, had done an electric propulsion conversion. They gave the project a great deal of attention, and their craftsmanship, teamed with the electrical engineer on staff at Annapolis Hybrid Marine, produced an excellent result for me.

Lacking the time to do the job myself and also wanting to ensure all the work was done to ABYC standards, I was happy to delegate to the boatyard. They removed the old diesel and all its supporting systems, removed and glassed over the cooling water outlet on the transom, reconditioned the propeller, shortened and aligned the propeller shaft, installed a new dripless shaft seal, replaced the cutlass bearing, removed the motor mounts bed and replaced it with a custom bed further aft, fabricated a bed for four large batteries, and installed, cabled



Clockwise from top left: The author's daughter at the helm; *Badger* on the hard; enjoying a day on the water; the standard throttles on the steering post before the conversion; new digital engine controls; the new battery charger control; the new battery monitor

and tested all of the components supporting the electric propulsion system.

The resulting system has four 12-volt, 185Ah absorbent glass mat (AGM) sealed deep cycle batteries weighing 128 pounds each where the engine used to be. Immediately abaft the batteries is a 48-volt Thoosa 7000 HTD 7 kilowatt permanent magnet electric motor that delivers the equivalent of about 20hp while weighing only 47 pounds. Other additions included a key switch, digital throttle, a four-quadrant motor controller, a ProTournament 300 Quad battery charger and a high-precision battery monitor. My original bank of house batteries and related 12-volt systems are now only charged through shore power.

After the yard and Annapolis Hybrid Marine sea-trilled the system and gave it their blessings, I found my new electric system to be highly responsive and particularly effective in close-

quarters maneuvering. Dialing-up the throttle from a dead stop, the response is instantaneous. My only remaining concern was how much motoring could be done on an overnight battery charge. Recognizing that my boat sails very well even in light wind, I opted to have shore power as the only means to replenish the charge on the AGM propulsion batteries.

After two seasons with the boat, including daysails, overnight passages and long weekends without plugging into shore power, I have found that with modest throttle speeds I can expect to be able to motor for approximately 8 hours or so without stressing my batteries. At full throttle, this would likely drop to a little under 4 hours. When cruising, I am either sailing or motor-sailing and really only tax my system coming in and out of marinas. I am comfortable cruising for three days, give or take, between “plugging-in” stops at marinas. The battery monitor usually indicates when I am recharging that the batteries are topped off again in about 3 to 4 hours. Relying only on shore power to recharge my batteries works for the type of sailing I do, and would likely be a good choice as well for racers who just need a way to power from the marina to the racecourse

and back after racing. With this electric propulsion configuration and the dripless shaft seal, I have virtually eliminated any overboard discharges, making this an ideal solution for sailors on lakes and ecologically sensitive waterways.

WAS IT WORTH IT?

Repowering with electric propulsion actually cost me more than it would have to install a new diesel engine. I purchased large, expensive high-end batteries that made the total bill for all of the electric propulsion components come to more than a replacement diesel engine and transmission. I spent about \$9,500 on the electric motor, the motor controller, gear reduction belt and pulley, the digital key switch, the digital throttle, the battery charger, the battery monitor, stainless steel mounting brackets and the properly sized cables. The bank of four deep-cycle AGM batteries cost about another \$1,300.

Racers could certainly select smaller, lighter and less expensive batteries, as could cruisers that already have an onboard generator. For the sake of time and professional results, I used the boatyard for all tasks and went a bit over budget in this area of the project. I



added some tasks to get optimal results, such as having the propeller reconditioned and switching to a driplless shaft seal. I could have been more budget-minded by not being in a hurry and doing those jobs that were low-tech but labor intensive myself. This would have included doing the removal and cleanup of the now useless diesel systems after the engine and transmission were pulled out. I could have mounted the ancillary systems and relied on the boatyard to cable and test them.

What doesn't figure into my cost calculations is that I am now forever free from oil changes, filter replacements, clogged seawater strainers, impeller problems, transmission fluid changes, fuel quality concerns, hose replacements, starter problems, overheating, tune ups and engine winterizing. An unexpected surprise for me is how much more I now use my boat in the off-season. Winter in the mid Atlantic states means temperatures can be in the 30s and 40s one week, and the 50s and 60s the following week. Electric propulsion has no winterizing requirements, so I now feel free to take the boat out for a couple of hours on a nice winter afternoon without the burden of de-winterizing and re-winterizing an engine. I have also been able to clean my bilge, and easily keep it clean. But the most important benefit for me in the end is that my family is happy that we now have a clean, quiet, odor-free and environmentally responsible source of propulsion for our fifth family member, and that means we use and enjoy our boat more often. **S**

Scott Monroe has sailed dinghies on lakes in the Midwest, keelboats along the southern California coast, and now calls the Chesapeake Bay home.



Torqeedo Deep Blue



Oceanvolt SD electric saildrive

CHARGED UP

THE ELECTRIC PROPULSION WAVE IS BUILDING

Electric and hybrid propulsion systems may be getting their time in the limelight now, with the "green" craze that is sweeping the world's major auto manufacturers, but in reality the technology has been around for quite a long time. The Electric Launch Co., better known to those in the boating industry as Elco, built 55 electrically propelled launches to shuttle visitors around the 1893 World's Fair in Chicago. (They were popular—Henry Ford bought one, as did Thomas Edison.) After being placed on the backburner for several decades, the technology is having a resurgence of popularity, as new technology and innovation push the boundaries of what is possible in electric propulsion in terms of power, reliability, cost and installation. Here are a few choices for those looking to go electric.

Elco (yup, that Elco) is still in the electric propulsion game, and now offers a variety of electric inboard motors ranging from the EP-600 (the equivalent of a 6hp combustion motor) up to the EP-10000 (the equivalent of a 100hp combustion motor). The company also debuted two outboards this year, a 6hp and a 7hp, and have plans for a 9.9hp electric outboard to debut in early 2015, with 15hp and 25hp outboards to follow. "We plan to grow our product suite to get to 500hp on the inboard," says Elco CEO Steve Lamando. "Then on the outboard side, we see a lot of opportunity to grow beyond where we are with our 5, 7 and 9.9, and then the 15 and 25. We're going to see where the market demand goes for that, but we're at least penciled to look at horsepower beyond 25." elcomotoryachts.com

German manufacturer **Torqeedo** has been building electric outboards since the company was founded in 2005 and now offers 14 outboards ranging from 1hp to 80hp. Last year the company Torqeedo Deep Blue—electric inboard and outboard motors that come in 40hp and 80hp, for which they took home the NMMA Innovation Award. Available in single or twin configurations, the Deep Blue series provides the control of your typical combustion engine with a throttle-control for speed and direction and an engine display screen that shows battery life and range. The company also offers solar panel charging mechanisms for the motors that help to extend life and would come in quite handy while, say, cruising through territory where shore power is scarce and sun is abundant. torqeedo.com

Oceanvolt (a Finnish electric propulsion company whose North American distributor is none other than Annapolis Hybrid Marine) is relatively new to the electronic propulsion game but has made quite a name for itself for its high level of engineering quality—the SD electric saildrive took home a 2013 Pittman Innovation Award. The unit is almost entirely self contained and ideal for installation in a small, compact space. The unit is also water cooled, so overheating isn't much of a worry. One of the really interesting aspects of the SD electric saildrive is that it is also doubles as a hydro-generator—while in neutral the system is configured to spin just enough to extend the blades while a computer monitoring system regulates the prop, resistance and shaft speed, allowing for the propeller to charge the battery. Pretty slick. oceanvolt.com

—Christopher White



An electric motor setup from Elco