

September Sea: A Sustainable Sloop

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Abstract

The concept of sustainability is often promoted as a noble environmental objective, but remains a goal that is unattainable for most Americans due to our dependence on a non-renewable, fossil fuel based infrastructure. The first step in achieving an elusive sustainable lifestyle is to realize the need to downsize, which is a notion that can be hard to grasp. However, once one realizes that less is more, the goal of sustainability is well within reach. For those who are content to stay in one place, a small house or cabin can fill the bill and can be set up for living off the grid. Others who are more adventurous can look to the sea for energy independence. Sailing vessel September Sea is a 36 foot ultralight sloop designed by sailboat racing legends Bill Lee and Bruce Farr and built by Lancer Yachts in 1984. While the engine is diesel powered, it burns just 0.5 gallons per hour and is only necessary for maneuvering in and out of marinas. The rest of the time, the sails do all the work. The boat is equipped with solar panels, a wind generator, a bank of four AGM batteries, an inverter to change 12 volts into 120 volts, a water maker, a 12 volt refrigerator, and a 4000 watt diesel generator to backup the systems and power their conditioner on those rare hot nights at anchor. This poster depicts the transformation of a simple sailboat into a model of mobile sustainability.



The Battery Bank

The heart of a sustainable energy system is the battery bank. September Sea uses four Absorbent Glass Mat (AGM) 6-volt batteries which are wired to produce 12-volts. AGM technology became popular in the early 1980s as a battery for military aircraft to reduce weight and improve reliability. The acid is absorbed by a very fine fiberglass mat, making the battery spill-proof which is perfect for boats. AGM has very low internal resistance, is capable to deliver high currents on demand and offers a relatively long service life, even when deep-cycled. AGM is maintenance free, provides good electrical reliability and is lighter than the flooded lead acid type. It stands up well to low temperatures and has a low self-discharge. The leading advantages of AGM are a charge that is up to five times faster than the flooded version, and the ability to deep cycle. AGM offers a depth-of-discharge (DoD) of 80 percent. Flooded batteries are specified at 50 percent DoD to attain the same cycle life. The negatives are slightly lower specific energy and higher manufacturing costs than the flooded version.



The Inverter

The battery bank is accompanied by a 3000 watt pure sine wave inverter. The purpose of the inverter is fourfold: It inverts 12 volt DC power to 120 volt AC; it automatically switches between inverter power and incoming AC power; it is capable of three-stage battery charging plus manual battery equalizing; and it allows for multiple battery bank charging. Multiple battery bank charging is provided through additional output from the built-in echo charge. The echo charge is used to charge both starting and auxiliary batteries. The digital echo charge is current limited to 15 amps and follows the three-stage charge curve of the inverter/charger and battery setting of the house battery bank. The inverter provides regulated 120 volt AC power at a crystal controlled frequency from the battery bank.

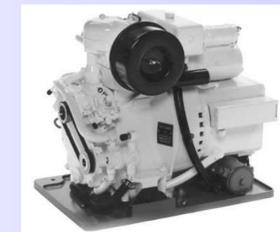


The Solar Panels

There is typically an abundance of sunshine on the open water. September Sea is equipped with six 65-watt solar panels totaling 390 watts to power the boat's refrigerator, freezer, fans, lights, computer, TV, radios, and other accessories. Solar panels generate DC power, and batteries supply DC as well. DC refrigerators and freezers can be powered without inverters for this reason. The solar panels are securely mounted to the dodger framing over the aft cockpit. A solar controller regulates the amount of energy transferred to the battery bank. The system generates an average of 150 amp-hours a day, which is about the typical daily amperage use.

The Genset

There are times when the sun does not shine and the wind does not blow. September Sea is equipped with a 4200 watt diesel generator for these occasions. While diesel is a fossil fuel, it is largely unrefined compared to gasoline, relatively cheap, and easy to find. The genset has a burn rate of half a gallon an hour, which is more than enough time to fully recharge the battery bank. It is powered by a single cylinder, high power to weight ratio engine. The engine has a roller bearing supported crankshaft, a ball bearing supported camshaft, and meets the Lake Constance II exhaust emission standards. It can be hand crank started in an emergency. A fresh water system cools the engine cylinder, cylinder head, the oil cooler, and the electrical generator. A fresh water to sea water heat exchanger prevents sea water from contaminating the engine and generator. The unit does not require any outside air for cooling. The control system includes an automatic shutdown system for low oil pressure, high engine coolant temperature, and high exhaust manifold temperature (lack of sea water flow). A special feature includes pre-flooding the engine bearings with lubrication before the engine starts.



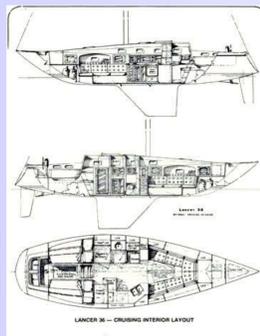
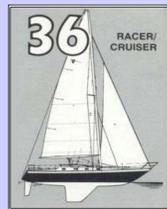
The Water Maker

The water tank on September Sea holds 40 gallons, which is good for a few days, but for extended cruising a reverse osmosis water maker is necessary. Like other equipment on board, the water maker runs on 12 volts and can be hand pumped in an emergency. At the heart of the water maker system is a high-pressure, positive-displacement pump. A lubricated gearbox converts the rotary motion of the electric motor to a powerful, reciprocating, linear motion for driving the pump piston. The pump pressurizes input seawater to approximately 800 psi, and the high pressure forces the produced freshwater through a semipermeable membrane located in the membrane housing. The water maker can produce 1.5 gallons an hour or 36 gallons a day, so the water tank is never dry. It is a mechanical marvel integrated into a single, compact piece of equipment with low power consumption, quiet operation, and a small footprint.



The Air Conditioner and Refrigerator

While not absolute necessities, September Sea is also equipped with a 12 volt refrigerator and a 120 volt marine air conditioner. The fridge consists of the boat's existing ice box with the addition of a holding plate refrigeration system that utilizes the latest technology in variable speed compressor design, low amp 12 volt fan, over sized condensing coil, and holding plate with preset expansion valve. The system operates simply and efficiently, eliminating the complexity and excess power associated with water-cooled systems. The air conditioner only runs when the diesel genset or inverter are working to produce 120 volts. It is modularized, self contained, prewired, precharged, and mounted on a solid foundation of stainless steel. All of its electrical parts are standard refrigeration components available around the world, which is useful for a sustainable sailing sloop lifestyle.



The Boat

The Lancer 36 offers brilliantly designed rigging by Bruce Farr and Bill Lee, known as The Wizard, who's trademark is Fast is Fun. Bill Lee is the designer of the Santa Cruz 27 and he and the Santa Cruz are honored in the American Sailboat Hall of Fame at the Museum of Yachting in Newport, Rhode Island. The Santa Cruz is one of the most influential yacht designs in American sailing history, and Bill Lee is one of the most influential yacht designers. He was named Sailor of the Decade from 1977-1987. The smallest winner ever of the TransPac (the sailboat race covering 2,225 miles, from the Palos Verdes Peninsula south of Los Angeles to the Diamond Head lighthouse at Waikiki) was Stuart Cowan's 35-foot sloop, Chutzpah, in 1973 and 1975. Chutzpah was the prototype for the Bill Lee designed Lancer 36. In short, September Sea was built by one of the masters of speed and innovation, the Great Bill Lee.



The Wind Generator

Sailboats are driven by the wind and so are wind generators. September Sea's wind generator has a neodymium permanent magnet alternator, which is the technology used by nearly all wind generators today. It has three blades and the output produced is measured in amps: 2 amps at 8 knots, 4 amps at 10 knots, 10 amps at 15 knots, 18 amps at 20 knots, and 30 amps at 30 knots. A toggle switch inside the cabin controls a brake that can be thrown when the wind speeds reach gale force. The design is quite simple and repairs can be made using easily obtainable parts.