VALUE OF ELECTRIC PROPULSION FOR SAILBOATS PART 3: CAN MY BOAT BE RETROFITTED WITH ELECTRIC?

Most likely yes. Comparing costs is a bit complicated because normally when installing a new diesel motor, you are only comparing the price of the motors since the fueltank and saildrive might remain the same. With an electric propulsion system, in addition to the slightly pricier electric motor and a suitable saildrive, you also need a large propulsion battery pack and a bunch of other electronics which add up to the cost of the complete system.

From an installation point of view, replacing a small and light electric motor seems straightforward, even the easiest step to perform, but in addition, the boat must be fitted with the battery pack and some electronics, while maintaining the boat's center of gravity in the optimal position.

But perhaps the most important factor influencing the decision to convert to electric is the use of the boat, how long the engine is driven and whether charging is available?

Some theory

The specifications of an electric motor should never be done by comparing horsepower and kilowatts, but rather by comparing the torque of a diesel and electric motor and the draft or weight of the boat.

A sailboat is a displacement boat when driven under engine, where a rule of thumb of 1.25 kW / boat weight can be used for motor sizing. We can also say that 1 kW of power from an electric motor corresponds to about 2-3 horsepower of an internal combustion engine. The available battery capacity is rated 1.3 to 2 times the motor power. For example a suitable system for a 4-ton boat, used in inland waterways, would be a 5kW electric motor with a 6,5 kWh battery pack

The efficiency of an electric motor is much better when we compare, for example, the energy transfer of diesel fuel through an internal combustion engine to the propeller. At least 85% of the electric energy of an electric motor is transferred to the propeller (up to 90% with a 48 V system), while only 15-20% of the energy of petrol or diesel is needed. So an electric boat needs less than 18% of the energy required by an internal combustion engine. Therefore, the batteries should not be calculated to match the 80-liter diesel tank in the boat. Diesel will be refueled in the spring for the summer, electricity for the next leg and replenished as the journey progresses.

The electric motor produces torque (power to the propeller) immediately from the lower revs and enables better efficiency for the propellers. The diesel engine develops an optimum torque between 1,800-2,000rpm, while electric motors deliver it from 0 to around 2,000rpm.

A lighter boat is usually achieved in total weight, the old internal combustion engine is removed and replaced by a much lighter electric motor. The fuel tank with hoses are also removed. This is offset by the higher weight of the battery, but the result is a lighter boat.

Weight difference Diesel vs Electric in Salona S35		
Weights in kg	**Diesel**	**Electric**
Motor	144	43
Batteries (house/propulsion)	95	68
Fuel	200	0
Charger	4	9
Start battery/house battery	27	27
TOTAL	**470**	**147**
Weight difference Diesel vs Electric in Arcona 435		
Weights in kg	**Diesel**	**Electric**
Motor	264	47
Batteries (house/propulsion)	192	131
Fuel	200	0
Charger	20	21
Start battery/house battery	27	27
TOTAL	**703**	**226**

Weight difference Diesel vs. Hybrid in Voyage 480		
Weights in kg	**Diesel**	**Hybrid**
Motors (incl. generator)	640	359
Batteries (house/propulsion)	264	186
Fuel	400	200
Charger	20	21
Start battery/house battery	27	66
TOTAL	**1351**	**832**

About boat speed and consumption

Hull speed is basically the maximum speed of a sailboat with an electric motor when aiming for a reasonable battery and engine capacity. The hull speed is the speed of the boat at which the wavelength of the bow wave is equal to the length of the waterline of the boat.

The frame rate can be calculated by the formula: hull speed = 2.43 x √waterline lenght in meters.

As an example, the length of a sailboat waterline is 8 meters, 2.43 x √8 = so the hull speed is about 6.9 knots.

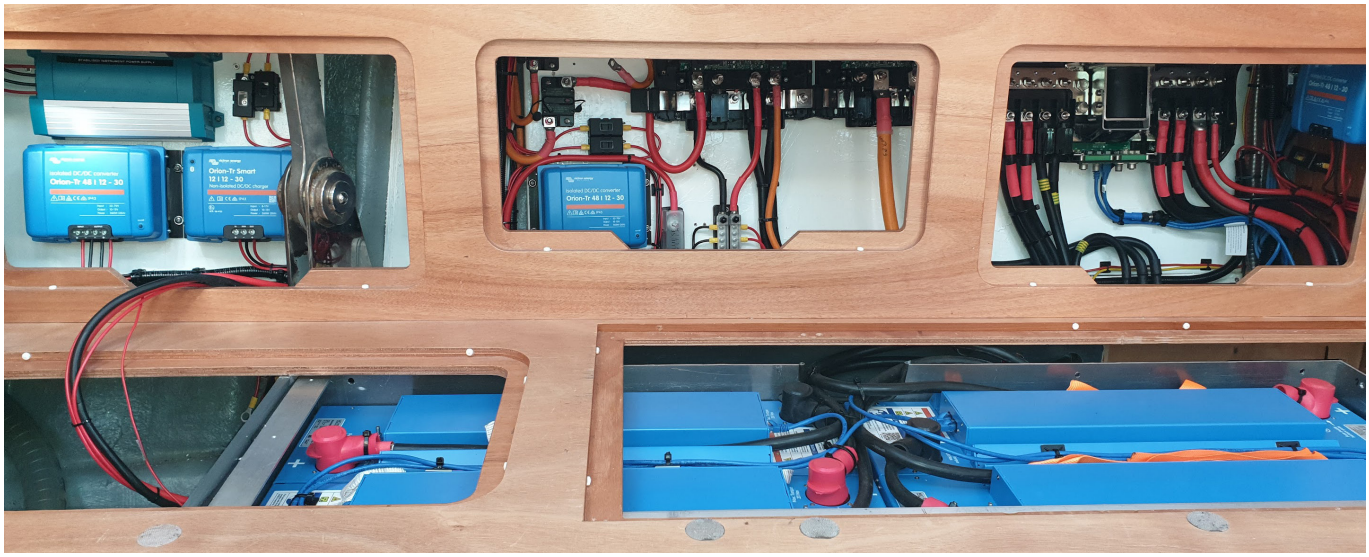
In addition, the rule of thumb for displacement boats is that they move most economically and efficiently at a speed that is about 60% of the boat's theoretical hull speed. For the boat above, this is 4.1 knots.

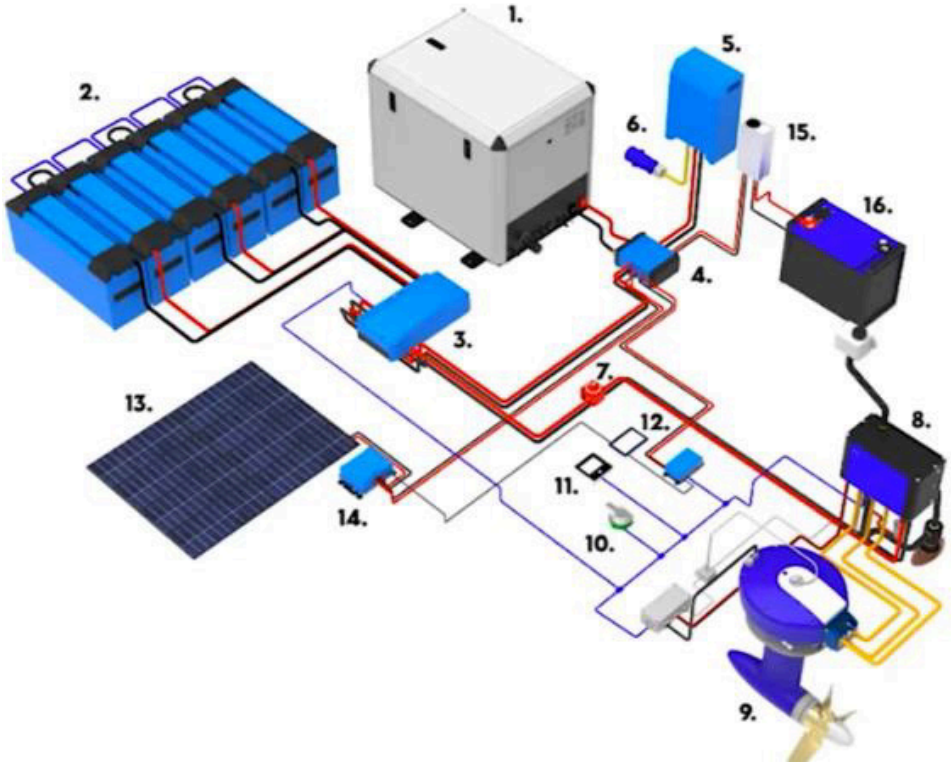
Installing an electric motor on a sailboat

The change begins with the dismantling of the old diesel engine, saildrive unit, fuel tank, diesel fuel lines, exhaust and instrumentation with remote controls. The easiest solution is to bolt the electric motor mounting plate directly onto the hole of the old saildrive. Next, the motor and saildrive are secured in place. These steps are perhaps more straightforward, installing a new electric motor and drive that is much lighter than a diesel engine - quick to see, easy and neat looking.

For axel drives, the axel is left in place or, in some cases, the axel drive has even been replaced by a saildrive, which provides better efficiency when using the motor as a hydrogenerator.

The next step is a bit more challenging. You need to find a place for the batteries that is favourable in terms of weight distribution. In addition, the motor control unit, possible cooling system, battery controller and charging system for both onshore and solar energy must be installed. In addition, cabling is needed. The propulsion battery pack also supplies power to the boat's house battery and a DC converter is needed to convert the energy from 48 volts to 12 volts. A larger battery capacity allows the boat to even have an electric refrigerator or other electric appliances.





The diagram above illustrates the system, with the addition of a DC generator as an option.

1. An optional DC generator that allows power to be generated to the motor and the system is called a hybrid. The generator is used as an accessory in larger boats to prevent the size of the battery pack from becoming too large. The batteries can also be charged with the motor (9) while sailing, with the solar panels (13) or with shore power (5).
2. 48V Battery
3. & 4. Battery management and connection
5. Shore power charger
6. Shorepower plug
7. Main switch
8. Motor controller (water cooled)
9. Electric motor (saildrive)
10. Motor control lever (forward / reverse)
11. Motor control display
12. Remote management and diagnostics
13. Solar panels
14. Solar panel charger
15. DC/DC Converter 48 / 12V
16. House battery