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FOR 2017

FOLLOW THE SUN
SOLAR AND HYBRID
POWER TECHNOLOGY



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FOLLOW THE SUN

WITH SUSTAINABILITY AND EFFICIENCY INCREASINGLY AT THE CORE OF YACHTBUILDING TODAY, **FRANCES** AND **MICHAEL HOWORTH** INVESTIGATE THE USE OF SOLAR POWER AND OTHER HYBRID ALTERNATIVE POWER SOURCES FOR FUELLING THE ECO-CONSCIOUS SUPERYACHT.

**GUIDED BY
THE LIGHT**
The spectacular, *Tûranor PlanetSolar* is the largest solar-powered yacht in the world, and features 500 square metres of solar panelling.

“We are nearing the crest of a wave when it comes to powering a yacht using alternative energies,” says Gérard d’Aboville, captain of *Tûranor PlanetSolar*, a 31-metre catamaran powered exclusively by solar energy. We are sitting on board this futuristic craft as she lies alongside the dock at Nausicaâ Centre National de la Mer, an aquarium on the north coast of France, whose mission is to educate the public in better ocean management and invite everyone to protect the sea.

The strange looking craft is in France as part of a public awareness campaign to demonstrate newer and cleaner ways of sailing the world’s oceans. Open to the public, she was a huge draw and subject of discussion for sailors who had joined the crowds to investigate the catamaran.

Built in Kiel (Germany) she is the perfect example of the future of alternative powered yachts. The yacht has already entered into the record books having spent 584 days sailing more than 60,000 kilometres to become the first vessel to sail around the world powered only by solar energy.

“Since we built *Tûranor PlanetSolar* in 2010 the cost of the solar panels we have used for her has dropped by over 30 percent,” says Pascal Goulpie, managing director of Planet Solar, the company that designed, built and now operates the vessel.

No less than 809 panels generated enough power during each daylight hour to keep the yacht motoring 24 hours a day at an average speed of five knots. “Slow is good,” says Goulpie, adding, “but you may like to know she has topped over 14 knots on occasions!”

RACE FOR THE SUN

Solar-powered yachts have an eight-year history of racing, despite the widely held impression that the propulsion format is still in its infancy.

Solar-powered racing began with the Dong Energy Solar Challenge in Holland in 2006. With a stated goal of initiating innovation and support through development, this year’s Dong Energy Solar Challenge will see more than 40 solar-powered boats sail along a set route starting at the Blauwestad in Groningen, and sailing for over seven days in Holland stopping at Drachten, Sneek, Harlingen and finishing in Leeuwarden.

At the Dutch event, teams from America, Poland, Brazil, China and Finland will race against each other. After competing themselves for three years, Vripack, the renowned Dutch naval architecture firm, developed the V20, a hydrofoiling solar-powered boat designed for speed that would test the skill of the racer, rather than that of the boatbuilder.

“The challenge would be in the techniques and in the drivers,” says Jeroen Droogsma, lead designer at Vripack. The idea has caught on and having sold boats to eager participants, Vripack and the Monaco Yacht Club are combining to launch the first solar-powered yacht Grand Prix at the Solar1 race, taking place inside Port Hercule in Monaco, July 10-13.

While solar power still suffers from a perception problem, it is no longer just a hypothetical yachting concept. As owners increasingly search for ways to offset the cost of fuel, advances in solar technology are decreasing the price and increasing the efficiency. In Italy, Arcadia Yachts designs boats that can incorporate solar panels, which can be used to run a yacht’s engines or generators. Greenline Hybrid Yachts in Slovenia are equally active in the recreational market.

Asked how effective solar power is as a means of crossing oceans, Patrick Boutonnet, owner of Ynovex, an environmental and renewables company based in Sydney, says, “We are not there yet, at this stage the technology is only at the experimental level.” But he can foresee a time when yachts could use this as their only means of power. He told us, “The sun can become the only source of energy for crossing oceans with the use of a form of highly efficient energy storage like hydrogen, for example.”

Ynovex is a provider of innovative marine energy storage and charging and monitoring systems. Specialising in lithium power and associated high performance charging systems for yachts, Ynovex offers balanced and managed energy systems for recreational and racing boats.

“We integrate eco-friendly and renewable energy solutions, increasing energy efficiency by making a better use of available resources,” says Boutonnet.

If Boutonnet could wave a magic wand and create the perfect, no-expense-spared yacht for world cruising, its main features would undoubtedly feature fuel cells. He told us, “The futuristic vision could for example be a yacht powered by water. This is how it would work: The sun converts seawater into hydrogen (electrolyser), when needed hydrogen is converted into electricity to power propulsion, navigation and comfort (fuel cell). In port the yacht would ‘refuel’ by connecting to shore power to refill the hydrogen tanks. This shore power can be from a renewable source like solar.”

PRACTICAL PROOF

Ynovex Energy was recently involved in the repowering of *Seachange*, a 15-metre aluminium catamaran that was moved to the tropical climes of Darwin.

In Darwin’s hot and humid atmosphere, reaching and maintaining the required level of comfort onboard requires a significant amount of energy. The generator had to be run extensively in order to run the air conditioning units, fridges, freezers, icemakers and an all-electric galley.

The existing battery and inverter system, consisting of a Victron Energy 2kVA powered by two batteries, was found to be unable to provide the power required to run the yacht’s vital systems for any reasonable length of time. 250Ah gel cells were charged using both engine alternators when underway, two solar panels (Kyocera 130 watts) and the onboard 12kVA generator. Power availability was very limited, requiring a tight management of which appliances were used concurrently.

Boutonnet says, “We undertook a



detailed energy load production and storage analysis of what was available. Based on our findings we installed a larger inverter/charger and changed the way the solar panels were configured. Once our work was completed we found efficiency to be tremendously improved, achieving a 99 percent efficiency of stored energy.”

Operationally, savings for the yacht are significant. The generator run-time has been reduced by 65 percent. The yacht’s owner has reported, “In real terms, on a four-week cruise on *Seachange*, we would save in excess of 500 litres of diesel increasing our potential range by 25 percent (some 200 nautical miles) which is an outstanding result.”

Another advantage of employing similar hybrid energy systems is the reduction in noise. For example, when generators are optimised for electricity production they run a lot more efficiently than diesel engines used for propulsion. Battery storage works as a buffer and subsequently reduces generator runtime.

Electric propulsion is significantly more efficient in a number of ways. It only uses the required amount of energy and does so with less wastage. Consolidation and simplification gained by drawing from the same energy source significantly aids propulsion, navigation and comfort.

Going green and using electricity generated with solar panels and turbines driven by wind or water are all about reducing the carbon footprint. Environmental impact is something that is beginning to worry the owners and users of luxury yachts.

EASE THE CONSCIENCE

Since 2008, one company has been providing a solution that can help ease one’s conscience, if not solve the problem of over-consumption. Yacht Carbon Offset counteracts the greenhouse gas impact from the yacht’s fuel by allocating equivalent greenhouse gas reductions achieved by renewable energy projects onshore.

We asked managing director Mark Robinson how the response to this environmental service had evolved over the past five years, and how it was being taken up by the industry.

“In 2008, the concept of carbon offsetting a yacht’s fuel was novel,” said Robinson. “Captains, yacht managers and owners had typically never thought of this approach, so our job was very much to explain how it works and how a properly documented procedure really does make a difference.

“By contrast, in 2014 we see more and more yachts where the owner, or the charter guest, chooses to offset his or her impact. This might be through providers like Yacht Carbon Offset, or as part of a wider corporate or family program. It proves that these individuals do appreciate the need to take action, whether for ethical, emotional or business public relations reasons. Similarly, we find that it is now rare to meet superyacht professionals that have not heard about carbon offsetting. That is a striking change over just five years. It is fair to say that there is a long way to go before carbon offsetting a yacht’s fuel becomes the norm, but the participation of prominent private and charter superyachts such as *Lionheart*,

Baton Rouge, *Latitude* and *Twizzle* is clear evidence that environmental leadership is a priority for today’s elite.”

COMMERCIAL COMMON SENSE

Yacht Carbon Offset illustrates another important point: whether a yacht is old or new, power or sail, designed for high performance or for economical long-range cruising, the way she is operated can make a huge difference.

Robinson says, “Superyachting is all about perfection, so there is no place for pollution. Whether it is counteracting the carbon footprint the yacht leaves behind, choosing benign laundry and cleaning products, or minimising plastic packaging onboard, there are plenty of things that any yacht can do in order to achieve the best possible environmental profile.”

Imtech Marine, with its headquarters in Rotterdam, Netherlands, is service provider and system integrator of innovative and sustainable technology solutions covering the whole ship. They have seen a considerable increase in interest in hybrid options. They told us, “Hybrid technology in combination with energy management systems makes it possible to meet the European goal to reduce the carbon footprint by 40 percent in 2020 to the 1990 level.”

While the company is a supplier to the yachting industry, its greatest success to date in devising hybrid power is with a ferry operating in the waters off Scotland. When asked to supply a hybrid propulsion system to the first ever diesel electric, hybrid seagoing ferry for the Scottish state-owned ferry operator, Caledonian Maritime, fuel savings of around 20 percent were expected. Yet following extensive trials it has been found that the actual fuel savings with the innovative hybrid system – consisting of diesel electric in combination with battery technology – were up to 38 percent.

Alexander Breijs, a marine consultant in energy systems, who was one of those on board carrying out the tests, said, “On closer examination of these fuel savings, some 28 percent came from shore charging the batteries overnight, making the system more efficient, and the remaining 10 percent is the result of the fact that Imtech Marine is using the battery energy in a ‘smart’ way using a new Energy Management System (EMS) developed in-house.”

Eventually, the batteries will be charged using wind energy, making the system even more environmentally friendly.

The systems experts started their tests onboard by measuring the efficiencies of individual components under various conditions such as the fuel consumption of the diesel generators, efficiencies of the drive and propulsion motor. Then the team sailed for several days in diesel electric mode without the batteries, recording fuel and kilowatt-per-hour consumption. This then became the baseline measurement to which they would later compare all other results.

Then the ferry sailed with its batteries in hybrid mode for the remainder of the fortnight on the run between the Isle of Skye and Raasay, an island inhabited by around 150 people. It was hoped that these tests could prove the value of hybrid technology and provide the foundation for future developments that will be of benefit to the ferry operator and ultimately those who use the services they provide.

Hybrid battery propulsion is also especially attractive for vessels where recharging ashore is a practical option, a development that could well be applied to marina-based yachts. Northern Lights is providing a hybrid system for the new floating schoolhouse for the Maritime Aquarium in Connecticut, USA. The 21-metre research vessel, designed by

“The participation of prominent private and charter super yachts such as *Lionheart*, *Baton Rouge*, *Latitude* and *Twizzle* to offset impact through a provider like Yacht Carbon Offset, is clear evidence that environmental leadership is a priority for today’s elite.”

Incat Crowther, will have a traction motor, batteries and electrical control system for quiet and efficient propulsion.

NOTHING NEW

Talk of this science is not new. For 25 years, companies have been developing, manufacturing and installing electric motor drives, process controls and integrated electric propulsion systems for ships with a focus on sustainable solutions. Diesel electric ship propulsion has been standard in cruise ships and LNG carriers for many years, and its efficiency advantages are gaining increased attention. Additionally, electric solutions can easily be combined into hybrid formulations with batteries and, in the future, fuel cell technologies.

At Ynovex, Patrick Boutonnet believes that massive progress has been made during the past 10 years with hybrid propulsion in the large vessel segment. For example, he points to the *Queen Mary 2* cruise liner commissioned in December 2003, which, “is powered by an advanced, environmentally friendly plant and electricity generated by four diesel engines and two gas turbines.

“The QM2 is propelled by four variable speed electric motors known as ‘podded drives’ for a total power of 86 megawatts. The total plant is capable of producing nearly 118 megawatts of electricity.”

He adds, “Improvements in hybrid propulsion are now made with the addition of large energy storage solutions acting as buffer in order to reduce the generators runtime. These technologies are trickling down to the luxury yacht market.”

Other propulsion system manufacturers are searching for continued improvement in fuel-efficiency technologies. Volvo Penta and its Inboard Performance System (IPS) is just one system that is now being taken seriously. In Turkey the powerboat manufacturer Numarine has announced that it will design a new range of 60-foot fast displacement yachts that begin with the IPS in mind, and from there the design will develop.

In smaller engine markets, focus continues on meeting the upcoming emission standards, but the emphasis on reducing fuel consumption is found here too. Caterpillar has released its Cat 3500 marine emission kit, an upgrade solution for existing engines that can result in lower vibration and noise levels and significant fuel savings.

It might not yet be sexy, and at this early stage may well be beyond the financial resources of the average pleasure boat owner, but there can be no doubt that alternative energy as a means of propulsion in the boating industry is about to break the surface and become mainstream. ○



FUEL OF THE FUTURE? Solar-charging batteries aboard a sailboat with photovoltaic panels.