



# Balance of power

Everyone wants to go electric but considerable limitations remain... particularly when you step into the world of high performance. However, by trying not to change the world in one go advances are being achieved – with a handful of performance-oriented boat builders leading the charge. Gunboat's William Jelbert describes what has been going on during his particular watch

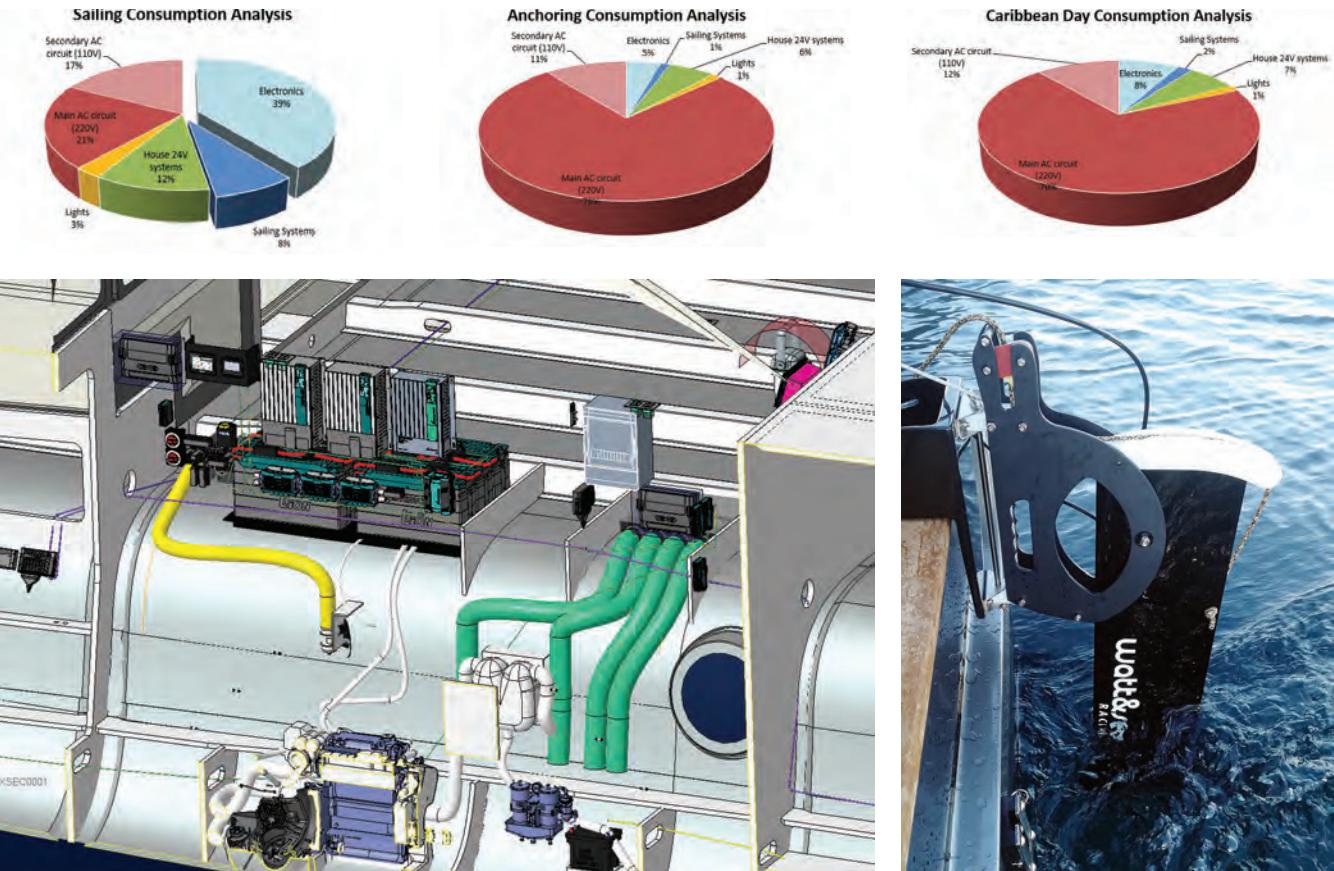
When designing a lightweight cruising catamaran we are faced with some tricky problems to solve: conventional propulsion or hybrid, how much solar and hydro generation, how big to go on alternators and battery banks... and where do we anticipate the next jump in efficiency, size and weight savings? Then there's the issue of how we accurately spec for power demands on a luxury, large performance catamaran, with all of the amenities, keeping weight-sensitivity and maintenance in mind, with the appropriate number of redundancies and amount of reliability... and decide that the system is 'optimised'?

Only a real understanding of the use-cases can properly inform the conceptual design of truly optimised systems. For this

purpose our design team flew around the world meeting some of the most experienced Gunboat skippers onboard their boats. We have placed our team on all the models in the fleet during a regatta, gone cruising, joined in on yard talk during refits, and listened to successes and innovations as well as areas for improvement. The messages were clear: no internal combustion engines under berths; less is more; use the very best components; consider maintenance at every decision; and always with top performance and low weight in mind.

So for the latest Gunboat 68 we made a pivotal decision to put the engine room amidships; offering more internal floor area and centralising weight, which along with the flat hull rocker greatly reduces pitching,

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*Top, left to right:* before designing a holistic power system for the new Gunboat 68s different usage models were explored in detail, the results illustrated here in pie charts: sailing consumption; anchoring consumption; Caribbean day consumption. A hybrid main power system was considered but rejected on weight, performance and reliability grounds (though this situation is fast improving). Different forms of fossil-free power generation are employed including solar cells (opposite) and hydro-generators (right) which have proved efficient even at low speeds. Major components are all sited (above) amidships to concentrate mass and minimise cable runs

further increasing performance. Nearby spaces were allocated for the battery compartment, inverters/chargers and switchgear – managing to nearly halve the wire weight on the Gunboat 68 by placing the switchgear (Mastervolt's CZone system) in the closest practical proximity to the loads.

Having carefully analysed scenarios that required supplemental power sources we worked with Yanmar to utilise excess main engine power with high-efficiency, high-output alternators and with Solbian to optimise an efficient 3kW solar array along with an optimised core power system. (Why two fossil fuel main engines? The Gunboat 68 relies on two Yanmar 80s, but we're watching closely as hybrid systems are moving from early adopters to mass market – for suitable reliability, cost and weight for this project. And it should be noted that a Gunboat 68 is anticipated to motor only 3% of the time in its lifespan. We placed the focus of our engineering efforts on 40% of the energy requirement, which is during sailing and anchoring.)

With the spaces and major components properly arranged we then focused on real-world optimisation. The traditional exercise is to add up all the consumers over 24 hours and match them with sufficient suppliers, to arrive at the size of the alternators, genset, solar and battery bank.

To me this always seemed silly. The load consumers aren't spread equally over 24 hours and neither are the producers, especially the renewable sources – but these

systems had always leaned on the presence of a genset as a base load producer that is always available, and didn't warrant a closer evaluation of this question. The more the other power components evolved the more that gensets seemed like a very heavy get-out-of-jail-free card that, no matter the brand, also seemed to be a pain for everyone in the fleet (noise, cost, maintenance, poor access for maintenance, weight, weight allocation/location on the boat, loss of storage...). Could we get rid of it?

To find out we created a tool for evaluating real-world scenarios (such as a 'Caribbean day' with some motoring, anchoring and sailing; 24 hours sailing during a passage; and 24 hours at anchor), and tracked the state of charge of the battery bank hour by hour as virtual loads were turned on and off, while making best and worst-case assumptions for solar input.

For the 24-hour sailing scenario with many loads running and no engines, our tool highlighted a small deficiency in the curve that could be remedied by a Watt & Sea hydro-generator (with the option to add a second).

One unit produces up to 600W of constant power while sailing above 7kt – and it's a safe bet the Gunboat 68 is doing more than 7kt the majority of the time under sail. Below 7kt it is likely the owner will choose to run the motors which produce huge amounts of power. So in essence you always have an available power source.

However, the most stress you're going to

put on the electrical system is air-conditioning, so we showed our first two owners how many hours they would have to run the engines if they wanted to use aircon when unplugged from shore power.

Gunboat 6801 Condor went with the standard battery bank – they were only interested in using aircon at the dock. Gunboat 6802 Dash wanted to be able to run a few cabins through the night at anchor. We added two additional Mastervolt batteries to the system and ran the simulation again, showing that it can be done, and also clearly showing worst-case scenarios for filling the batteries again the next day. As a result the first four owners became fully committed to the compromises and keeping gensets off their boats became a priority for them.

Beyond its utility for our design team the tool we have created allows owners to be well-informed and make decisions based on real-world expectations from the start.

The 68 and her systems 'evolve' appropriately on each new boat we build. With the energy density of batteries increasing daily and the efficiency of the loads and the producers consistently improving, we may not see generators on this Gunboat series until they become the producers for propulsion too, as in a serial hybrid system.

Right now the innovation to be celebrated is an ever-refined approach to building more efficient systems that owners understand and appreciate during their sailing adventures onboard Gunboats. We've put the balance of power in their hands. □