The Information Authority for the Workboat • Offshore • Inland • Coastal Marine Markets

Marine News

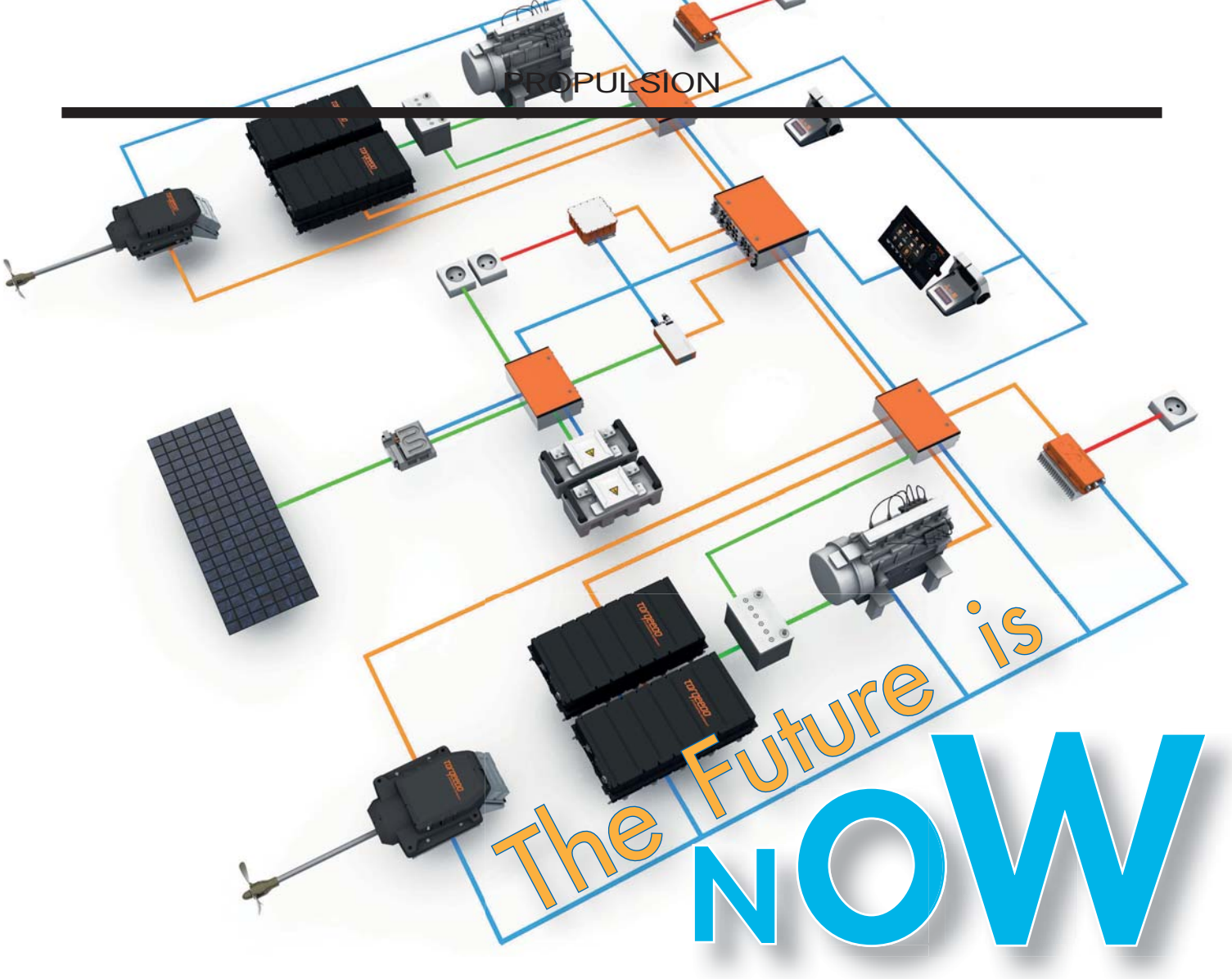
MAY 2015
www.marinelink.com

Offshore Annual

Weathering the Storm:
OSV Operators Hunker down

Hybrid Propulsion:
Hi-Tech Power for Workboats

Safety & Prevention:
New Rules, Evolving Designs



The Future is NOW

Hybrid Marine Power & Propulsion Systems for Workboats isn't farfetched. In fact, it may be essential.

By John Haynes

In 2015, two significant developments are going to make many operators, owners and builders of professional vessels consider hybrid marine power. The new emissions laws – here and abroad – and the incentives for high technology manufacturers to invest in developing highly efficient batteries are the primary drivers. That said; dramatically reducing pollution in both water and air could be the most significant impetus for change in the maritime sector since coal and steam gave way to fuel oil. Emissions from fossil fuels come at a price. Beyond this reality, professional mariners know the legislation relating to marine pollution (MARPOL) plus the serious financial implications of getting it wrong.

Fuel and Power for Shipping is Changing

The maritime sector tends to avoid change, but the blue water shipping community could not ignore the emissions regulations that came into force on January 1st 2015. This may appear a mundane issue but consider the implications as certain types of vessels are banned from entering ports around the world simply because of their diesel exhaust emissions.

Image above: Deep Blue Hybrid by Torqeedo is a fully integrated scalable system, offering hybrid propulsion and providing complete onboard energy management.

Reprinted with Permission from the May 2015 edition of Marine News - www.marinelink.com

"Certain maritime sectors are potentially well suited to 'hybrid' diesel / electric systems. These include wind farm support vessels (WFSV) and pilot boats that have relatively consistent duty cycles, often running seven days a week to drop off or collect technicians and pilots."

The diesel in ships tanks is now so light and highly treated that navies are able to run their RHIBs and boats on diesel from the mother vessel. While conventional oil based fuels remain the main fuel option for most in service vessels, Liquid Natural Gas (LNG) is now a proven and viable fuel solution for ship propulsion (in some sectors). If LNG does not fit their needs, ship operators will consider installing hybrid power systems alongside of their diesel engines. Separately, innovative energy solutions have so far been largely been ignored in the sub IMO (sub 80 feet) workboat sector, primarily because these methods are viewed negatively as part of a complicated and costly compliance process.

Diesel/electric systems have been used in large ships and submarines for many years, but these are not hybrid systems. The diesel/electric vessel uses its engines to connect directly to an electrical generator. The power in the system is then transferred electrically to the propeller shaft via motor controller and electric motor. The system may have multiple generators and multiple motors. By strict definition, this is not a hybrid, as there is no storage of electric energy.

Serial and Parallel Hybrid Power Systems

There are two main types of hybrid system. A serial hybrid, where the engine in the system only powers a generator and is not mechanically connected to the propeller shaft is one version. The other involves a parallel hybrid, where the engine is mechanically connected along with an electric 'machine' that can operate as both propulsion motor and a generator. The reduced electric propulsion, generator and battery demands of a parallel system substantially reduce the cost compared to a serial system. Parallel systems are more likely to win initial market acceptance because of a perceived greater reliability, as the 'trusted' diesel engine is still connected to the propeller shaft with the electric propulsion adding a redundant system.

Until recently, it was not been possible to transfer such systems successfully to smaller craft. A European Union funded project called HYMAR (High efficiency hybrid drive trains for small and medium sized marine craft) set out to develop an optimized hybrid system. The conclusion at the end of stage one was that the initial focus on 'serial hybrid' systems had been misplaced, and that the project's objectives would be better met by 'parallel hybrid' systems. HYMAR then developed a parallel hybrid system that has been installed, tested and validated on marine craft. HYMAR has also built a comprehensive energy management module and graphical user interface to control the energy flows of an entire craft. The optimized hybrid system developed during the project offers three major advantages. They include no detectable emissions, no discernible noise and a substantial reduction in fuel consumption.

Hybrid Power in the Workboat Sector

Industry is entering a period of rapid change and commercial opportunity in the hybrid marine market. Owners and operators can now consider various hybrid systems with marine applications. DNV-GL USA, for example, recently stated that, "energy storage is an exciting new technology, but the offshore E&P sector of the oil and gas industry has yet to truly take advantage of it. Tugboats, workboats and OSVs are particularly suitable for hybridization." Benefits include improvements in energy reliability, increased fuel efficiency, lifecycle cost reductions and reduced emissions.

Battery powered electric motors have been available on small craft for many years. But until recently electric outboard motors had been mainly under 10hp for small fishing boats, tenders and kayaks. The main obstacles to overcome before scaling up had been battery technology and the high initial cost of procurement. Deep Blue is an electric drive system that has been industrially developed

('The Explorer' is a SWASH (Small Waterplane Area Single Hull) pilot boat with a hybrid drive system from Siemens.

Courtesy: Abeking & Rasmussen AG

and manufactured by the German company Torqeedo, using high-tech components. The system is available as 40hp and 80hp inboard or outboard versions.

The next generation of cells and batteries are key technology developments that are making marine hybrid systems potentially viable. Battery chemistry such as Lithium-ion offer impressive power solutions and the business case is starting to fit for commercial operators. Since there is no single system that fits every application, it is important to work with manufacturers that have flexibility in cell manufacturing and offer scalable solutions. New factories with fully automated processes ensure consistently high quality cells and quality control of the entire battery management system.

Michigan-based XALT Energy offer several variants of High Energy, High Power, and Ultra Hi-Power cells. Robert Young, Technical Lead for Marine Applications at XALT Energy, told MarineNews, "our team of engineers have worked to the highest standards developing electric and hybrid energy solutions for the US and global automotive sector. XALT Energy not only has the necessary knowledge, but also the experience of taking high voltage battery projects from concept through production into the finished system.'

Integrating High Voltage Battery Systems on Boats

Battery banks require space and as they not usually replacing another component this can be an issue for smaller craft. Beyond this, naval architects require additional weight to be low and central for most designs of small craft. Once the onboard space and footprint are allocated, battery designers and engineers need to consider issues specific to marine applications. These include shock and vibration when a boat is underway plus the challenges of installing high voltage systems in enclosed spaces.

Although modern batteries are expected to have a long life, they need to be carefully positioned to enable access for inspection. And, integration needs to consider on board safety plans and risk management for the crew, passengers and critical systems.

Cost / Benefit implications will start with the initial purchase of the system then work out payback period based on the life cycle of the vessel and life cycle of the hybrid power system. Once a system is defined projections and audits can be based on engine management data linked to work cycles. Hybrid systems are infinitely scalable which enables owners to specify what they are trying to achieve over a period of time or an entire fleet.

When studying vessel work cycles, it is relatively straightforward to make a decision for new builds on whether to go for all electric or a diesel / electric hybrid system. For example, a ferry operating over a short route with a long stopover each end could offer the perfect work cycle for 'electric only' with a land based charging system. Other issues, such as the cost of downtime and structural alterations affect viability calculations for retrofit of in-service craft.

Hybrid Systems and 'The Hour of Power'

Certain maritime sectors are potentially well suited to 'hybrid' diesel / electric systems. These include wind farm support vessels (WFSV) and pilot boats that have relatively consistent duty cycles, often running seven days a week to drop off or collect technicians and pilots. Indentifying the viability of hybrid diesel / electric power for offshore wind farm support vessels (WFSV) is an interesting project that links green energy on board with renewable energy from the environment. Hooking up to offshore wind farm turbines may even provide charging options.

The first objective is to focus on the sub IMO (sub 80 feet) workboat, pilot boat and patrol craft sectors to investigate the engineering and systems integration required to bring together viable and sustainable solutions. With vessel life cycles of over 20 years, naval architects and builders of new craft will offer designs that have space and access routes to enable retrofit of hybrid installations. Speed limits in harbors and channel approaches at beginning and end of daily transits may mean that 'The Hour of Power' is all that is required for the electric part of the cycle.

Hybrid Power & Propulsion System Providers

BAE Systems is a provider of hybrid propulsion systems with technical experience in hybrid technology for land based applications. Today, the firm aims to partner with manufacturers of marine diesel engines to provide complete propulsion and auxiliary power systems to increase the operating efficiency and performance of a vessel, while reducing fuel costs and emissions.

ZF Marine offers a range of hybrid-ready transmissions and propulsion for larger fast craft applications. The design is based on a unique 'Power Take In' (PTI) configuration, allowing highest flexibility for customizing installations. These transmissions can be integrated into hybrid propulsion systems for all types of fast craft, from coast guard vessels to fast offshore supply vessels.

Still another firm, Siemens, has extensive experience of hybrid and electric technology for various modes of transport. Siemens offers both series and parallel hybrid systems for the commercial marine market and supplies all components related to the electrical propulsion system including the drives, generators, inverters, filters, and control system, plus step up gearboxes to attach the generator to diesel motors.

Integration of all products will be crucial and because of that, a new career path in shipyards for 'Hybrid System Integrators' will emerge. These will be individuals and teams that have a holistic approach to engineering and many will need to be qualified high voltage technicians. When integrating hybrid systems, a shipyard will need to identify which competencies are required. To warranty the system, the yard will also need to define who signs off the installation and the components on handover. Manufacturer's liability is a commercial reality that can be hidden behind factory recalls on land, but at sea, a single point of failure will reflect on all OEM,s in the hybrid power system.

Legislation, Standards ... & Partnerships, too

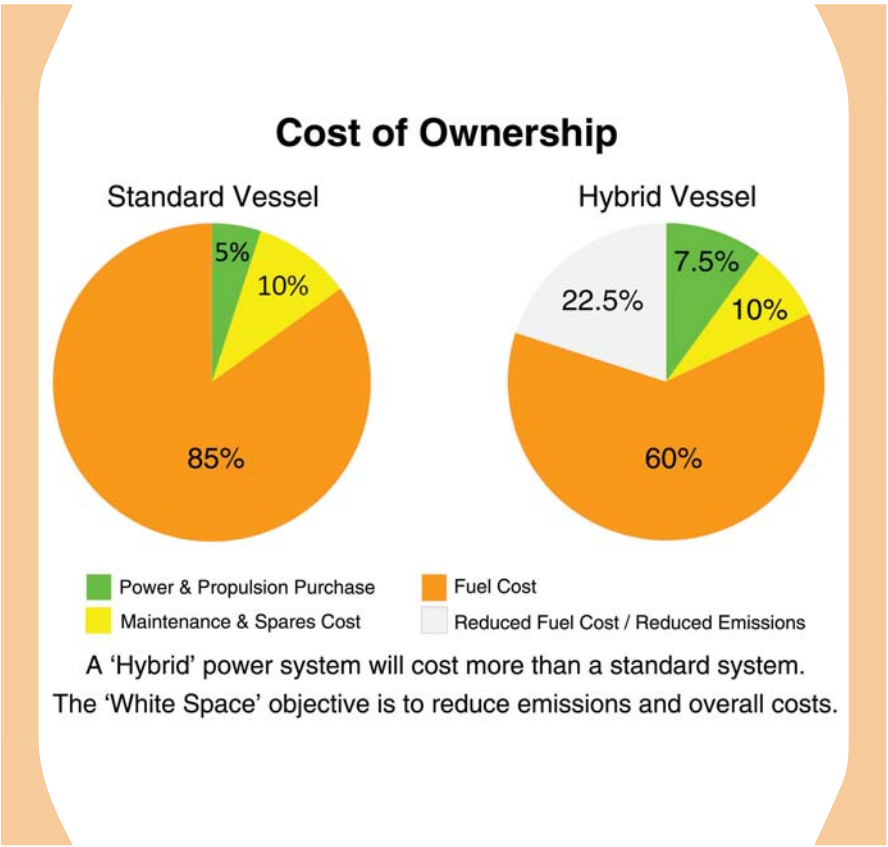
Various legislation and standards have implications for end-user organizations, boat builders and equipment manufacturers. As cells, batteries, power generation and storage evolve, it is important to address misconceptions and myths to enable progress. For example, Lithium

Ion has been part of our lives in non-marine sectors for many years as the battery power behind electric cars, city busses, smart phones, tablets, laptops and cameras. Besides how to present performance metrics, it will be essential to identify whether current standards from land based applications are valid. An environment with electricity, water and damp enclosed spaces requires specific testing and sea trial standards. A new ISO standard for high voltage DC propulsion systems and comprehensive energy management in maritime environments will be relevant.

Power and propulsion systems that are designed and built for professional or commercial operations need to run hard, often for long hours in adverse sea conditions. Users must be able to rely on these systems at all times. In certain situations failure is not an option – the engineering must not break. Professional boat operators around the world have learned that power and performance are relevant, but reliability and durability are important factors for all types of engine and propulsion.

Ultimately, the Hybrid community will need to engage with diesel engine manufacturers. New high tech companies entering the market will want (and need) to leverage existing relationships that diesel engine OEM's have with end-users, boat builders and standards agencies. The importance of an international service, spares and support network will add confidence to procurement and life cycle maintenance decisions.

If the marine industry wants to move forward quickly, it will have to build partnerships that seamlessly bring together technologies. That's because, ultimately, hybrid marine will not tolerate inferior parts. All components will need to be built to the highest industry standards and designed to integrate globally across multiple platforms. The future is now, and hybrid propulsion for workboats is here.



John Haynes *is an Associate Fellow of The Nautical Institute, Yachtmaster Ocean and Advanced Powerboat Instructor. He is Operations Director of Shock Mitigation and founder of the RIB & High Speed Craft Directory that brings together specialist boats and equipment for the professional sector.* ***www.ribandhsc.com***

Reprinted with Permission from the May 2015 edition of Marine News - www.marinelink.com