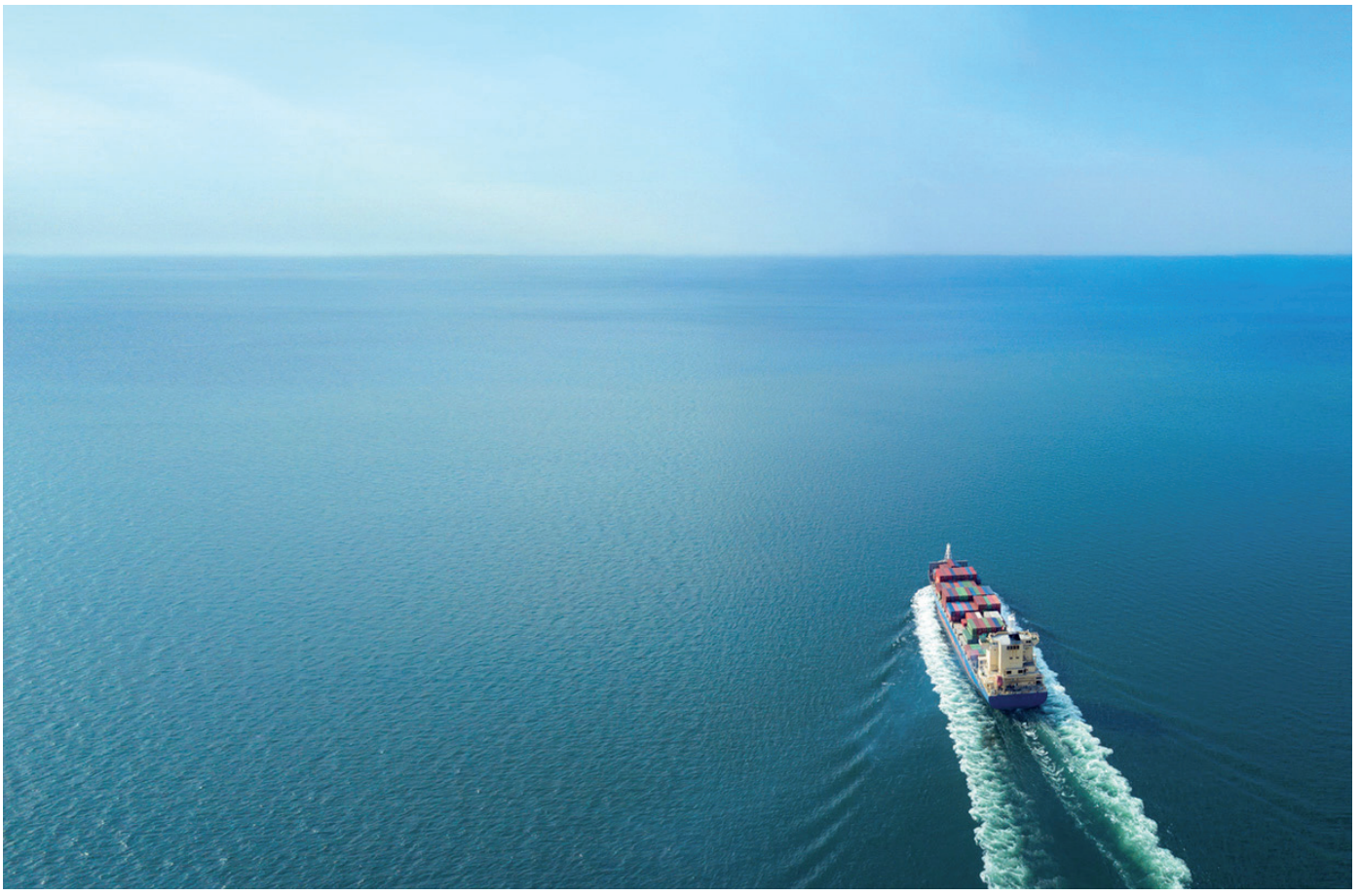

Shipping needs to be cleaner and more sustainable; hybrid power systems are one means to achieve this Source: IMO

Meeting demand for low-emission, high-efficiency propulsion

HYBRID POWER The combination of new and existing technologies can make a major contribution to cleaner operations but safety issues must be understood and addressed, writes Modesto Lezama, managing principal engineer, ABS

Hybrid power systems are defined as the combination of new and conventional technologies that make possible electric power generation in vessels for higher performance, greater efficiency and lower greenhouse gas emissions. Energy storage systems such as lithium-ion batteries, in combination with diesel engine generators, dual-fuel engines and shaft generators will continue to follow this path within the maritime sector. This supports efforts to meet emissions reduction targets and achieve key performance indicators for owners, operators, designers and integrators, and classification societies in their initiatives to improve safety, operability and reliability of assets.

Expanding capability

The concept of integrating hybrid-electric power systems with conventional power sources and the use of energy storage systems such as batteries, has become more attractive to vessel owners in recent years. However, some demonstration projects using fuel cell technologies in the maritime industry are getting noticed, too.

The main hybrid power system concepts are the integration of conventional sources (diesel engine generator sets, gas turbine generators, dual-fuel engines with or without shaft generators) and new technologies such as fuel cells, energy storage systems (batteries and supercapacitors) and in the future photovoltaic solar, wind and flywheels.

Currently, lithium-ion battery technology still dominates the use of energy storage systems. ABS expects more applications in the maritime sector, where battery systems based on solid state technology, metal-air, lithium-sulphur (Li-S) will become part of the ecosystem once more research, development and testing have taken place.

Optimising installations

Classification societies will continue to play a key role in the assessment and verification process, providing rules and guidance to help the industry adopt the safest

and most appropriate combination of those technologies.

The power generated from the combination of devices, machinery and systems results in electric and mechanical power required to supply electrical loads and propel vessels. Theoretically, most vessels can be equipped with a combination of technologies. However, there are several limitations such as maturity of technology, availability of bunkering systems, safety constraints, vessel structure, design, layout and operational profiles that may complicate the process.

It should be noted that battery system configurations require detailed design studies including simulation and optimisation processes for the integration with other technologies.

The operating guidance, maintenance and inspection plans provided by battery systems' vendors are very important to understand the life cycle of the batteries. Procedures are typically based on a manufacturer's own and other recognised standards. This documentation should be considered for all maintenance regimes.

Prioritising safety

Battery systems such as lithium-ion types have known safety issues such as thermal runaway and the risk of fire or explosion, potentially causing injuries to personnel. The thermal runaway reaction in the battery cells can lead to battery failure and potential ignition of the electrolyte separator and electrodes, causing a fire in the battery system. Battery management systems and fire protection systems must be in place to prevent this from happening and prevent further damage in the event of thermal runaway.

Some research indicates lithium-ion batteries may have nearly reached their theoretical limit in energy and power density. This may limit their potential for maritime applications where higher power and energy levels are needed, and it may accelerate the research and development of other battery chemistry technologies in the medium term. Potential alternatives to lithium-ion batteries are in different stages of research, but they may show promise for battery systems to become more practical and widespread in maritime applications in the future.

With regard to installation of fuel cell power systems, this will have to go through a rigorous design and risk assessment process prior to their installation on marine assets where personnel or crews are part of the daily operation. A maintenance and operational plan including emergency response is required and emergency operational procedures are necessary for fire-fighting and abandonship scenarios.

In the case of battery charging, procedures necessary for shore power options need to be clearly established and conducted in coordination with service providers.

The more the maritime and offshore industries participate in the adoption of hybrid electric power systems, the safer, more mature and easier to adopt these new technologies will become.

Next generation technologies

As mentioned above, in addition to lithium-ion type batteries, research and development of several other battery technologies continues and is likely to evolve for deployment in the maritime industry in the future. The use of biofuels, their contribution to the development of more dual-fuel engine types also will be a big contributor to this process. Owners and operators will need to coordinate their efforts with classification societies to apply the rules and guidelines that will enable safe installations in the field.

While hybrid systems can contribute to the reduction of fuel consumption and greenhouse gas emissions so that hybrid systems can be more sustainable, there is a need for efficient and sustainable battery technologies that can provide the required power.

The enhancement of battery systems will also enable renewable energy to be further implemented, potentially reducing emissions further. As emphasis continues to increase on reducing environmental impact, this may be an essential technology for an eventual shift to more hybrid or even all-electric vessels.

To enable owners to understand the potential of hybrid systems – as well as the required safety management processes – ABS has published an Advisory that offers an overview on hybrid electric power systems, the current status of the component technologies, the advantages and challenges of each, along with some of the applications in the marine and offshore industry. The study explores the advantages and challenges that come with hybrid systems on vessels, looking at technologies like solar energy and fuel cells that may be useful in such a system.

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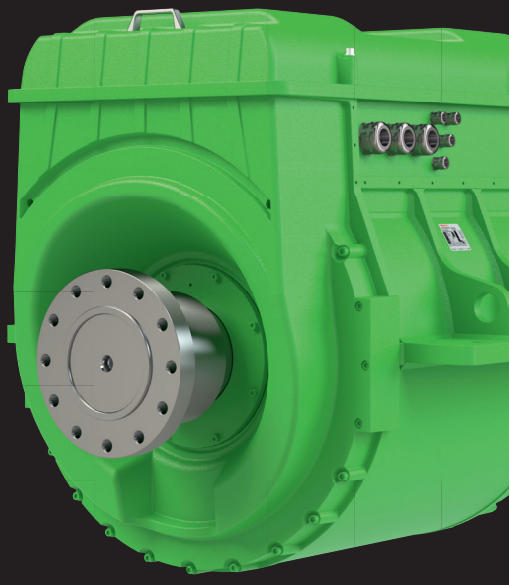

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