ΝΙΚΟΛΑΟΣ Α. ΒΕΡΝΙΚΟΣ 20 4 2016

The shipping industry is the backbone of global trade and a lifeline for island communities, transporting approximately 90% of the tonnage of all traded goods, as estimated by the International Chamber of Shipping. According to the United Nations Conference on Trade and Development (UNCTAD), the global shipping tonnage loaded annually increased from 2.6 billion to 9.5 billion tones between 1970 and 2014. The demand for shipping is predicted to grow further, owing to the changing configuration of global production, the increasing importance of global supply chains and the expected growth in many economies. Also for the foreseeable future, seagoing ships will continue to carry the bulk of that trade.

The energy source for the propulsion of ships has undergone significant transformations over the last 150 years, starting with sails (renewable energy) through the use of coal to heavy fuel oil (HFO) and marine diesel oil (MDO), now the dominant fuel for this sector. The consumption of these fuels has been increasing over the years in line with rising demand for shipping. The International Maritime Organisation (IMO) estimates that between 2007 and 2012, on average, the world's marine feet consumed between 250 and 325 million tons of fuel annually, accounting for approximately 2.8% of annual global greenhouse gas emissions. However, compared to other modes of transport, shipping produces the lowest emissions of carbon dioxide (CO ) per tone per kilometer travelled. Still, emissions are expected to rise with shipping demand and could triple by 2050 if left unchecked.

Emissions from the shipping sector must be curbed in order to reduce air pollution and climate change impacts. The International Convention for the Prevention of Pollution from Ships (MARPOL) has stipulated mandatory technical and operation measures, which require more efficient maritime energy use and, simultaneously, less emissions.. These regulations came into force in 2013. The industry itself has set targets to reduce carbon dioxide emissions by 20% by 2020 and 50% by 2050. Ship operators, therefore, need to consider cleaner fuel and power options, including the use of renewables, to meet these targets. Furthermore, rising bunker fuel prices, amid a globally volatile market, provide another compelling reason to scale up modern shipping solutions based on renewable sources and technologies.

Renewable energy can transform the global shipping feet at all levels and in varying magnitudes, including: international and domestic transport of goods, people and services; fishing, tourism and other maritime pursuits. Renewable power applications in ships of all sizes include options for primary, hybrid and/or auxiliary propulsion, as well as on-board and shore-side energy use. Potential renewable energy sources for shipping applications include wind (e.g. soft sails, fixed wings, rotors, kites and conventional wind turbines), solar photovoltaics, biofuels, wave energy and the use of super capacitors charged with renewables. These clean energy solutions can be integrated through retrofits to the

existing feet or incorporated into new shipbuilding and design, with a small number of new ships striving for l00% renewable energy or zero- emissions technology for primary propulsion.

The transition to a clean energy shipping sector requires a signifcant shift from fossil fuel-powered transport to energy-efficient designs and renewable energy technologies, starting today. The contribution of renewables to the energy mix of the shipping sector, however, is limited in the near and medium terms—even under optimistic scenarios.
Nevertheless, developers are increasingly enhancing ship designs and proof-of-concept pilots demonstrating major savings in some applications. The development of renewable energy solutions for shipping has been hampered by over-supply of fossil fuel-powered shipping in recent years and the related depressed investment market. The main barriers to increased penetration of renewable energy solutions for ship- ping remain: 1) the lack of commercial viability of such systems; and, indeed, 2) the existence of split incentives between ship owners and operators, resulting in limited motivation for deployment of clean energy solutions in this sector. Ultimately, market forces working within a tightening regulatory regime will govern the speed of uptake of renewable energy technology for shipping, although this will also be tempered by infrastructure lock-in and other non-market factors. Therefore, a set of organisational/structural, behavioural, market and non-market barriers needs to be removed before renewables can make meaningful contributions to the energy needs of the shipping sector. Most importantly, the transition from fossil fuels to clean energy for shipping needs to be planned carefully.

Significant efforts and support measures must be applied now to demonstrate and increase the role of renewable in shipping. In particular, support policies and incentives to promote research, innovation and proof-of-concept examples are crucial in order for renewable energy shipping solutions to achieve commercial viability. For quick-win solutions, support should focus on small ships (less than 10 000 dead weight tonnes), which are more prevalent world- wide, transporting less of the total cargo but emitting more of the greenhouse gases per unit of cargo and distance travelled, compared to larger ships.