Future Trends in Green Shipping

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Thorn-D Antifouling Applied in Dubai, 2013. Photo by Pieters7 (Permission under CC BY-SA 3.0)

Background

The shipping sector carries about 80 per cent of the volume of international trade in goods[1] and is linked to nations' socio-economic development. However, at the same time there are a multitude of environmental challenges such as air quality at ports, noise pollution, water pollution (e.g. oil spills), marine biodiversity (e.g. invasive species) and greenhouse gas (GHG) emissions. Indeed, shipping can have global as well as local environmental impacts. In 2012, the international shipping sector emitted 796 million tons of

Oasis of the Seas Entering Port at Nassau, Bahamas, 2010. Able to carry over 6,000 passengers, she is one of the world's largest cruise ships in the world.
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CO_2, or about 2.2 per cent of the total CO_2 emissions, 10.6 million tons of SOx (as SO_2) accounting for approximately 13 per cent of global SOx from anthropogenic sources, and approximately 18.6 million tons of NOx (as NO_2) representing 15 per cent of global NOx from anthropogenic sources.[2] Under business as usual scenarios and depending on future economic and energy developments, CO_2 emissions from the shipping sector are forecast to grow between 50-250 per cent in the period up to 2050. Thus, this sector's contribution to global emissions is expected to increase to significant levels as other sectors under national inventories decarbonise.

Future Course of Travel

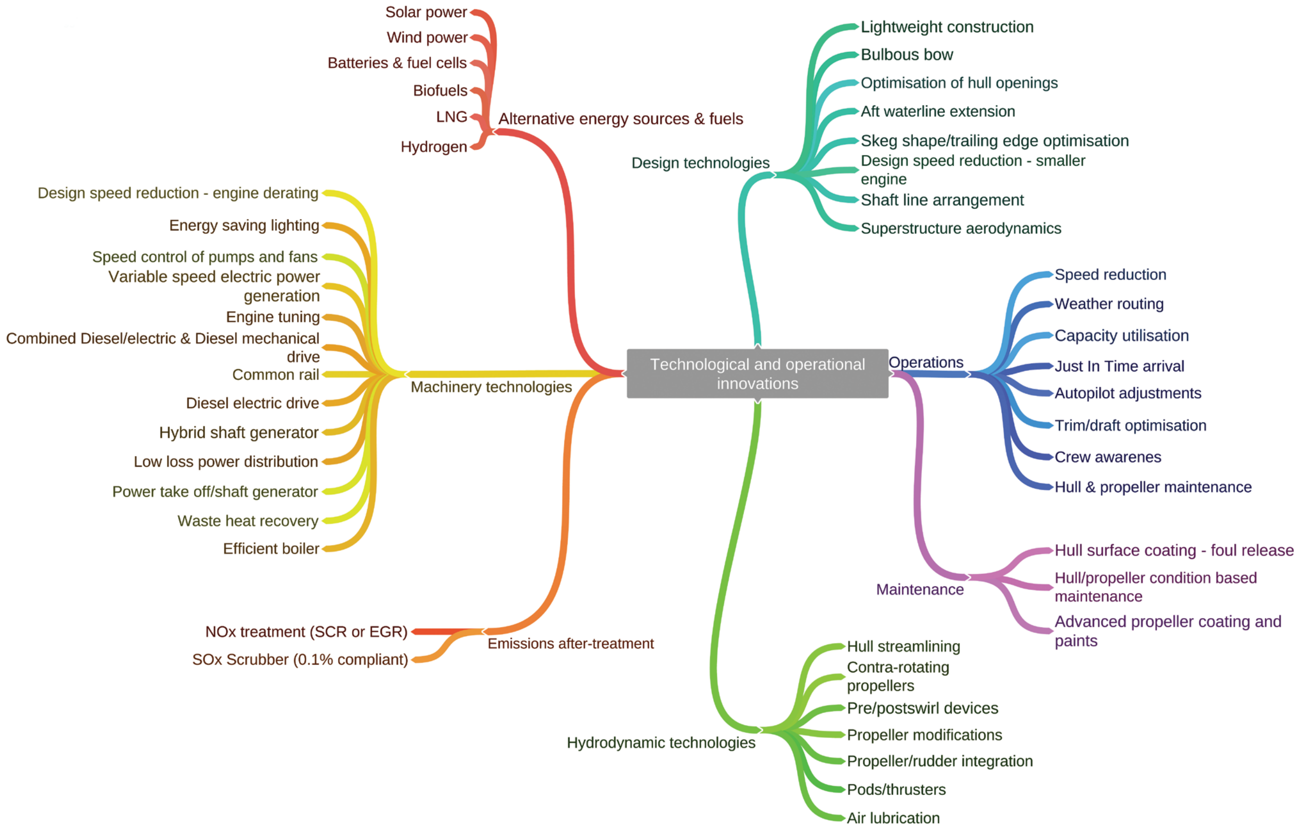
The Paris Agreement limits the increase in global temperatures to no more than 2°C, aiming for 1.5°C above pre-industrial levels and thus provides some direction as to the course of action that the shipping sector needs to take. This ambition requires deep decarbonisation across *all* sectors, including shipping. Smith et al. (2015)[3] show that under both the 2°C and 1.5°C framing of climate change (emissions budgets), taking into account the latest IPCC (Intergovernmental Panel on Climate Change) and IMO (International Maritime Organisation) studies, and shipping maintaining its current share of 2.3 per cent of global emissions, the shipping sector must halve its emissions by 2050 under the 2°C scenario and achieve carbon neutrality by 2050 under the 1.5°C scenario. Translating this at the ship level, the aggregate average operational CO_2 intensity for all ship sizes of containerships, tankers and dry bulk (which account for 60 per cent of the shipping sector's emissions) requires a reduction of 80-90 per cent on 2012 levels by 2050 in the 2°C scenario and net zero emissions in the 1.5°C scenario.

The Role of Technologies and Operations

Gains from efficiency and technological innovations can help to a large extent to achieve the transition to a sustainable shipping sector. However, innovation in shipping is mainly driven by market factors, e.g. fuel price (which can constitute about 50 per cent of the cost of operating a ship). Examples of where market factors, such as high fuel prices, have led to innovation include the period 1980 to 1985, when interest in wind propulsion as a secondary/hybrid means of propulsion increased and the recent market conditions (high fuel prices and low freight rates) which have led to various operational efficiencies such as slow steaming, Just In Time, etc. Thus, shipping innovation is more sensitive to market conditions relative to other factors, e.g., regulation, demand-side push, etc. As a cyclical industry,[4] this poses a risk to the take-up of innovations as a means to curb CO_2 emissions in shipping. An example of the latent emissions risks occurred over the 2007-2012 period, which saw a decrease in the CO_2 intensity of the fleet but an increase in the total installed power in the shipping fleet.[3] This means that if market conditions reverse, the efficiencies that are not locked in can be lost.

Haji et al. (2015)[5] use GloTraM, to observe the effect on technology up-take by varying investment parameters, market barriers, offsetting, carbon price and bio-energy availability. GloTraM is a holistic model which combines multi-disciplinary analysis and modelling techniques to estimate foreseeable futures of the shipping industry to produce a range of scenarios (for more information, see: https://www.ucl.ac.uk/energy-models/models/glotram). The results show that under business as usual for two ship types (containerships and drybulk), only a few operational measures are implemented, but in the scenario with more favourable returns to shipowners, i.e., time charter premiums for energy efficiency being fully passed to shipowners through higher charter rates,[6] the ship types investigated have the highest take-up of technologies, ranging from design measures to hydrodynamic measures. A recent survey of shipowners and operators by Rehmatulla (2015)[7] attempts to understand the present day take-up of technologies indicated in Figure 1. For the aforementioned sectors, the results show significant heterogeneity within the

Figure 1: Technological and Operational Solutions



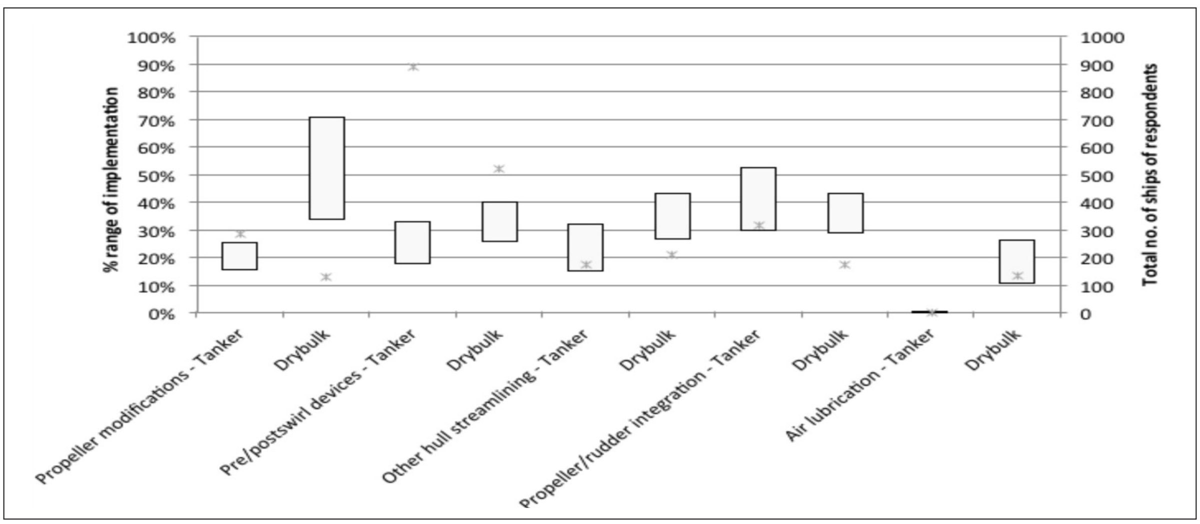
Sources: Buhaug et al. 2009,[10] Wang et al. 2010,[11] Lockley et al. 2011.[12]

market. For example, the dry bulk sector saw relatively higher take-up of the hydrodynamic technologies compared to the tanker sector (see Figure 2). The survey also shows that, in general, the uptake of energy efficiency technologies is low and the technologies that have higher uptake have small energy efficiency gains at the ship level. The current use of alternative fuels and renewable energy sources is very low.[8] This finding is further evidenced by the disconnect that exists between the present day stakeholder attitudes, and the future direction of travel required. Smith & Rehmatulla (2015)[9] show that even in the most moderate scenario (low demand growth and doubling of shipping sector's share of emissions), the carbon intensity reduction required from shipping far exceeds the levels envisioned as "commercially viable" by members of green/sustainability coalitions.

Concluding Remarks

A major challenge lies ahead for the shipping industry. Rising GHG emissions need to be halted and then reversed. Continuing on the business-as-usual course and postponing further action will increase the rate of decarbonisation required. Current regulations alone will not lead to the required emissions trajectory. Whilst the IMO mulls over future policies (e.g., global SOx limit, MRV and CO_2 targets), it is clear that decarbonising and greening the shipping sector will involve moving away from fossil fuels. Breakthroughs could come from step change technologies as well as dependable operational improvements.

Figure 2: Implementation of Hydrodynamic Energy Efficiency Technologies



Source: N. Rehmatulla, "Take-up of Innovative Energy Efficiency Technologies in Maritime Transport", extended abstract submitted to the *Annual Conference of the International Association of Maritime Economists*, 23-26 August 2016, Hamburg, Germany.

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