Shipping Transport

Highlights

■ **Technology Status –** Shipping carries around 90% of international world trade, and is almost exclusively powered by internal combustion engines. Currently, only around a third of the energy released during fuel combustion is converted to useful ship propulsion. There are many technical measures that can inprove fuel efficiency, including optimising the design of the vessel, engine and propellers. Most options to improve the design of the hull and engines are only suitable for new-build ships, whereas changes to the propulsion system are more readily applied in retrofit as well as new-builds. The majority of ships currently rely on heavy fuel oil (HFO). Alternative energy sources which are in use today include biofuels, liquefied natural gas (LNG), solar and wind propulsion. Other sources such as hydrogen and nuclear are less well developed.

■ **Performance and Costs –** Various technical options are usually applicable to most ship types, although with varying degrees of effectiveness. Technical retrofit and maintenance strategies could reduce CO_2 emissions from the existing fleet by 20%. These include: hull coatings (short payback), waste heat recovery (medium payback) and advanced propeller designs (short/medium payback). The potential for CO_2 emission reductions from improved new-build vessel design is around 30%. Examples include: optimising the vessel size (long payback), lightweight construction (short payback), and designing the hull for reduced frictional resistance (short payback). Using alternative energy sources can also reduce fuel consumption and CO_2 emissions, e.g. biofuels (up to 75-85% CO_2 reduction), wind power (~15-25% fuel savings), solar (4% fuel savings) and LNG (20-25% GHG reduction).

■ **Potential and Barriers –** Estimates of future shipping activity from the IMO predict a global increase of 150-300% from 2007 to 2050. International policies on mandatory requirements for shipping energy efficiency are being developed and are expected to play a crucial role in driving the uptake of advanced technologies. There is currently excess ship capacity in the market which will need to be cleared before investment in innovative new ship construction becomes attractive. Barriers include high costs, the long lifetime of ships (typically ~25-32 years) and the inherent conservatism of the ship building industry. In the short term, retrofit techniques are likely to be the major source of efficiency gains. LNG is seen as a potential alternative to HFO in the short term in some applications. Wind power – such as the use of kites or sails to supplement main engine power – is seen as a viable technology in the short to medium term. After 2020, other options are expected to become more important, such as hull optimisation, lightweight construction, and propulsion technology. By 2050, almost the entire fleet will have been replaced therefore measures which can only be applied to new ships will have diffused into the fleet.

Technology Status – Maritime transport currently carries about 90% of international world trade [1], and accounts for roughly 9% of total transport fuel use [2]. **International shipping** takes place between ports of different countries and excludes military and fishing vessels. It accounts for the majority of maritime fuel use (~90%) [2], and relies primarily on heavy fuel oil (77% of total maritime transport fuel) [3].

Shipping activity doubled between 1985 and 2007 [3], fuelled by increases in international trade – particularly Asian manufacturing and exports to other countries [2]. However, the global recession caused demand to contract by 4.5% in 2009, reflecting weak consumer confidence in the retail sector and low levels of capital investment [4]. Prospects for shipping are expected to recover in 2011 and beyond as manufacturing activity resumes.

Ships can be broadly categorised into the following types: **Container ships** are fully cellular ships which operate on scheduled voyages at high speeds. They are designed for efficient transport of containerised cargo. **Bulk carriers (bulkers)** transport dry cargo such as grain and coal. **Tankers** are for transporting liquid cargo such as chemicals and oil. Tankers and bulkers tend to operate on long distances with infrequent port calls; therefore design optimisations should be focussed on efficient running at sea. **Roll on-Roll off (RoRo) & vehicle** vessels are designed to transport wheel-based cargo. They are characterised by multiple short stops and high speeds. **Passenger vessels** such as ferries operate on short, fixed routes with variable speeds.

Container vessels account for the largest share of fuel use. In 2007 they represented 16% of all maritime trade by weight and a much larger share by value [3]. Tankers and bulkers also use significant amounts of fuels, while passenger vessels only account for around 10% (see Table 1).

Only one-third of the energy produced from fuel combustion results in propulsion; the rest is lost due to thermodynamic and mechanical inefficiencies [5]. A wide range of technical measures are available to improve shipping energy efficiency. Taking the options together, the overall potential for CO_2 emission reductions from improved new-build vessel designs is estimated to be around 30% [3]. Technical retrofit and maintenance strategies could reduce CO_2 emissions from the existing fleet by up to 20%. Operational improvements are alternatives to technical solutions

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