



Shipping Emissions

International Shipping

- Between 80-90% of world trade, by volume, is carried by sea.
- In 2007 the world fleet comprised of more than 100,000 ships over 100gt and the overall annual growth in tonne miles was an estimated 4.1%.
- Annual increase in shipping emissions is in the region of 1.9-2.7%, which is driven by the expected growth in trade transported by sea.
- On a tonne mile basis shipping is the most efficient form of transportation, however it must be remembered that ships may operate in ballast or not at their optimum speed for much of their journey. Trade is also invariably intermodal and cannot be considered in isolation from other parts of the chain.
- International shipping uses primarily, high sulphur, residual fuels that are the 'bottom of the barrel' in the refining process. These fuels also often contain a range of metals, chemicals, or other contaminants.

Emissions from Shipping

- In 2007, shipping CO₂ emissions were estimated to be 1,046 million tonnes (3.3% of global emissions), of which international shipping accounted for 870 million tonnes (2.7% of global emissions).
- Exhaust gases are the primary source of emissions from ships, with nitrogen oxide (NO_x), Sulphur Oxide (SO_x) and particulate matter (PM) being the primary gases. There may also be volatile organic compounds (VOCs) in the exhausts.

Effects of Emissions

- Air pollution from ships contributes to the impairment of various ecosystems including nitrogen nutrient loading, acidification, smog caused by NO_x and other precursor gases, and changes in visibility.
- SO_x and NO_x emissions from ships are carried over land and they and their derivatives (including PM and sulphur and nitrogen containing compounds) are deposited on surface waters, soils and vegetation.
- Importantly, air pollution can contribute a significant portion of the sulphur and nitrogen loading that an ecosystem receives.
- Some areas are more sensitive than others and many have multiple stressors.
- Emissions have both positive and negative effects on global warming due to radiative forcing.

- Some ecosystems are sensitive especially to acidification due to sulphuric and nitric acids formed from SO_x and NO_x, whilst other ecosystems are particularly sensitive to excess nitrogen, which contributes to aquatic eutrophication that alters biogeochemical cycles and harms animal and plant life.

Why Shipping is an Issue at COP 15

- One outcome of the Kyoto protocol in 1997 was that the responsibility for management of CO₂ emissions from shipping rests with the International Maritime Organisation (IMO), however, as with the International Civil Aviation Organisation (ICAO) this will come under review at COP 15 in December 2009.
- The European Union position is that, should the IMO fail to deliver tangible progress soon they will enforce the EU emissions trading system by 2012.
- There is increasing pressure by ports and coastal waters for ships to reduce emissions and regional restrictions may be applied before IMO regulation.

RECENT IMO LEGISLATION

Future NO_x Emission limits in MARPOL Annex VI

The revised Annex VI introduces a stepped approach to the reduction of NO_x emissions. The original emission limit from Annex VI is now referred to as "Tier I", while future emission limits, named "Tier II" and "Tier III", will be introduced in 2011 and 2016 respectively.

Fleet average emission factors depend on the composition of the fleet each year, which in turn depends on vessel lifetimes and the growth of the fleet. Growth of the fleet is also linked with reductions in speed; therefore speed reductions could have an indirect positive effect on NO_x by accelerating the introduction of new ships and engines. Future emission factors for NO_x are based on a scenario of growth of the fleet by 3% per year and an average ship lifetime of 30 years.

Future SO_x Emission limits in MARPOL Annex VI

Present Global limit 4.5% and Emission Control Areas 1.5%

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| 01 July 2010 | Emission Control Areas 1.0% |
| 01 January 2012 | Global limit 3.5% |
| 01 January 2015 | ECA limit 0.1% |
| 01 January 2020* | Global limit 0.5% |

*Note. This may be postponed to 2025, subject to review in 2018

Particulate Matter (PM), otherwise known as ash, is significantly reduced in a ship when the sulphur content of fuel is < 1% (distillate)

Policy options

A number of policies to reduce GHG emissions from ships are conceivable. Studies have set out to identify a comprehensive overview of options. The options that are relevant to the current IMO debate have been analysed in detail. These options are:

- A mandatory limit on the Energy Efficiency Design Index (EEDI) for new ships;
- Mandatory or voluntary reporting of the Energy Efficiency Operational Indicator (EEOI);
- Mandatory or voluntary use of a Ship Efficiency Management Plan (SEMP);
- Mandatory limits on the EEOI value, combined with a penalty for non-compliance;
- A Maritime Emissions Trading Scheme (METS);
- An International Compensation Fund (ICF), financed by a levy on bunkers.

The IMO has agreed to the formula for the technical and operational EEOI and EEDI but has not made progress on Market Based measures before COP 15. Dependent on the outcome of COP 15 the IMO will give the market based measures consideration in 2010.

Coastal Action

- The IMO have currently adopted two sulphur emission control areas (SECAs) in the North Sea and the Baltic Sea and is currently considering an ECA around the USA and Canada extending for 200 miles from their coast line.
- 'Cold Ironing' is the practice of shutting down the ships' own power in ports and the use of shore side power. This is a complex matter and not easy to provide for or harmonise for all shipping systems. This also may be a false measure to reduce emissions where shore power stations are coal fired.

Other Operational and Technical Solutions

- There are continued improvements in engine performance both in reducing emissions, particularly NOx, and increasing overall efficiency; however, there are various engine types and configurations so it is extremely important to match optimum efficiency with the normal operating speed of the vessel.
- The primary operational consideration is voyage optimisation including weather routing, just in time arrival, optimum ballast and trim.
- Technical design can include, engine recycle systems, hull design, hull resistance, propeller design and resistance, wind assisted, solar power etc.
- It is considered that by 2040 there could be 59% efficiency improvement.

Abatement systems

- The new legislation allows the use of abatement systems as an alternative method to reduce exhaust emissions from ships using high sulphur residual fuels despite the fact these systems are to date unproven. Sea water scrubbing of the exhaust will undoubtedly be the preferred by the oil industry as ultimately it saves the refineries from investment into upgrades and allows them to continue selling residual fuels. Scrubber systems unfortunately have been estimated to increase the ships workload by 70%. There is also the problem of disposing of acidic sludge ashore and controlling the quality of the waste seawater discharge overboard within limits.
- Urea based catalytic converters are increasingly used to reduce the NOx emission but are not suited to all ships.

Availability of low sulphur fuels

- In a catch 22 situation the oil industry will not invest in updated refineries producing low sulphur fuels until the demand is certain and even then there is at least a six year lead in period. The new Marpol Annex VI legislation allows for the availability of fuels to be reviewed in 2018 and if they are not available in sufficient quantity the implementation may be deferred to 2025.
- Carbon capture, particularly to dry wells, is much more feasible at the refinery than any current system on ships but unfortunately there is little indication that refineries are taking any measures to introduce this technology.

The ITF Seafarers' Section is actively involved in addressing the issue of shipping emissions in a number of forums, including the International Maritime Organisation (IMO) and will be attending UNFCCC COP 15 in December 2009 as part of an ITF Delegation.

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