Briefing: Reducing NOx Emissions from Shipping

November 2009

Context

Emissions of nitrous oxides (NOx) affect human health and the environment in a number of ways and are a serious source of atmospheric pollution in the EU. Ship engines are a major source of NOx emissions which cause acidification and eutrophication (over-fertilization) of the sea and on land thus affecting biodiversity of land and coastal waters. The Baltic Sea area is particularly affected.

NOx also results in the formation of nitrate aerosols which lead to increased levels of atmospheric particulate matter (PM) and is a significant factor in the formation of ozone, a major health hazard in Europe and a cause of vegetation damage and reduced crop yields.

EU Governments have, in recent years imposed stringent restrictions on emissions of NOx from a wide range of industrial and commercial activities including road vehicle transport, but relatively little has been done to reduce emissions from ships which now account for more than a quarter of total emissions of nitrogen oxides in Europe. 75% of the urban population of southern Europe and 40% of that in Northern Europe live in cities where the ozone level exceeds the EU air quality standard. Exposure to high levels of ozone and PM results in 370,000 cases of premature death annually.

Under current growth trends, emissions from international shipping in European sea areas are projected to increase by nearly 40 per cent between 2000 and 2020. If no additional abatement measures are taken, by 2020 the emissions from shipping around Europe are expected to equal or even surpass the total from all land-based sources in the 27 EU member states combined. As a consequence, the number of annual deaths from ozone and PM exposure in Europe is likely to stay high.

NOx emission standards for international shipping are set by the International Maritime Organisation (IMO). New regulations were introduced by the IMO in 2008 which strengthen somewhat the NOx requirements worldwide for all new ships built after January 01, 2011.

In addition, the IMO decided that in designated sea areas called Emission Control Areas (ECAs), significantly more stringent rules will apply to all new ships built after 01 January 2016 when sailing in these ECAs. Affected ships will have to reduce emissions of NOx by about 80 per cent from the current limit values.

There are currently no NOx-ECAs in place, but the countries surrounding the Baltic Sea are cooperating through the Baltic Marine Environment Commission (HELCOM) to prepare a proposal to the IMO to designate the Baltic Sea as a NOx ECA. (it is currently a Sulphur Controlled Area or SECA).

In March 2009, The United States and Canada jointly proposed that most areas of their coastal waters – extending 200 nautical miles from the coast – be designated as an ECA for the control of sulphur oxides, of particulate matter and of NOx emissions. After being approved in principal by the IMO last July, the proposal is set for formal adoption in March 2010.

A problem in the context of the new IMO NOx standards is that they only apply to new ships., Ships tend to have a life of 25–35 years before being scrapped so the turnover of the fleet is slow. In addition it is feared that the new regulation could be evaded by operators only deploying older ships in ECAs.

Thus in order to not only limit the growth in ships' NOx emissions, but actually to reduce them, there is a need to cut emissions from existing vessels and to speed up the introduction of efficient NOx abatement technologies in new ships built before 2016.

Economic instruments to cut NOx

A new study[1] by the Swedish environmental economist Per Kågeson has investigated a series of different market-based instruments that could be used for this purpose, and also assessed the potential additional emission reductions that could be achieved by applying such instruments. The study focuses on the

[1] Market-based instruments for NOx abatement in the Baltic Sea (Nov 2009), APC-report No 24. By Per Kågeson. Published jointly by AirClim, T&E and EEB.

Baltic Sea, but the general conclusions are most probably also applicable to other sea areas.

Three technologies are identified that can achieve emissions that meet the stringent ECA requirements: Selective Catalytic Reduction (SCR), Humid Air Motor (HAM) and engines fuelled by gas (LNG = liquefied natural gas).

When comparing the abatement costs with the monetised health benefits from reducing NOx from Baltic Sea shipping by these technologies, it is concluded that the benefits are about five times the average cost, provided that a pay-back period of ten years is allowed. There are also other, less expensive, technologies that can reduce emissions, which are relevant when considering the economic efficiency of retrofitting old engines.

After having analysed several types of economic instruments – such as emissions trading, differentiated fairway and port dues, and emissions charging – the report proposes the introduction of a NOx-differentiated en-route charge, largely along the lines of a NOx charge that Norway has already introduced.

From 1 January 2007 Norway introduced a charge of NOK 15 per kilo (equivalent to €1,765/ton) on NOx emissions from ship engines above 750 kW. However, a number of Norwegian business organizations have entered into an agreement with the Ministry of the Environment to establish the Business Sector's NOx Fund, effectively reducing the charge to NOK 4/kg (€470/ton) for the participants. Through the NOx Fund, NOK 600 million per year will be allocated to NOx reduction projects over three years. The NOx Fund selects the most cost-effective projects, which may receive 75 per cent of the investment costs. The Fund will also support operational costs, such as urea for SCR.

A NOx-differentiated en-route charge would be relatively easy to operate. It is suggested that port authorities around the Baltic Sea would be mandated to assist a common authority that collects a mandatory charge reflecting the calling ship's emissions of NOx during its latest trip in Baltic Sea waters. The charge would correspond to emissions emitted from the point of entry into Baltic Sea waters or since departure from another Baltic port.

It is argued that as long as the revenues are not recycled to the industry, the scheme runs the risk of being legally challenged by third parties. Therefore the proceeds could be used to finance grants to ships along the lines used for recycling the revenues from the existing Norwegian NOx Fund.

A charge similar in size to that of the Norwegian NOx Fund (€470 per ton NOx) may be sufficient when the proceeds are used for grants. The combined effect of a grant and a modest charge should, for frequent visitors, be enough to justify investment in SCR in engines with a remaining life of about ten years or more. Ships should be equally eligible for the grants regardless of flag and ownership.

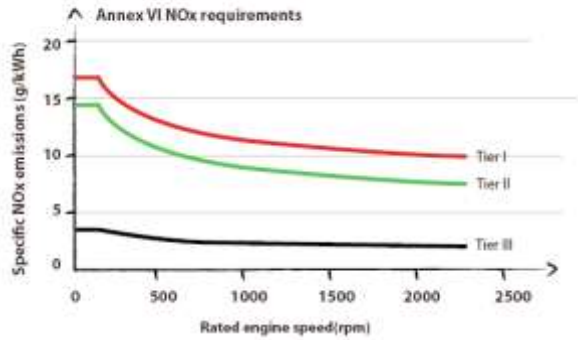

Figure: The IMO's NOx emission standards for new ship engines: Tier I applies from year 2000, Tier II from 2011, and Tier III from 2016 (the Tier III-standards apply only within NOx Emission Control Areas)

Ideally there should be only one fund for the Baltic Sea run jointly by the participating coastal states. To improve the overall efficiency it may be worthwhile widening the scheme to also cover the North Sea.

A rough calculation of the emission reduction potential indicates that application of an emissions charge, as outlined above, could cut NOx emissions from ships in the Baltic Sea by about 72 per cent. If it is assumed that only four out of five ship owners respond to the incentives in the way foreseen, the actual effect on emissions would be lowered to 58 per cent. This would correspond to an annual reduction of about 270,000 tons in NOx, from an expected business-as-usual level of approximately 460,000 tons in 2015.

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