Annexes 1-3

Emissions Trading Schemes in Europe for SO_2 & NO_X including shipping

Swedish Shipowners' Association

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Öhrlings

PRICEWATERHOUSECOOPERS

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Annex 1 - Environmental issues

Acidification[1]

Acidification is the process whereby air pollution – mainly ammonia (NH_3), sulphur dioxide (SO_2) and nitrogen oxides (NO_x) – is converted into acid substances.
This 'acid rain' is best known for the damage it causes to forests and lakes. Less well known are the many ways in which it damages freshwater and coastal ecosystems, soils and even ancient historical monuments, or the way in which the heavy metals these acids help release into groundwater.

Sulphur dioxide and the nitrogen oxides are primarily emitted by burning fossil fuels. As some of the reports in this section show, the 1990s saw these emissions drop substantially, thanks to a combination of European Directives forcing the installation of desulphurisation systems, the move away from coal as a fossil fuel, and major economic restructuring in the east German Lander.

Acidification is nevertheless still a major environmental problem in Europe. It is a cross-border issue, requiring coordinated initiatives across countries and sectors. This section brings together the EEA's reports on the scale of the problem and the effectiveness of the solutions tried to date.

Eutrophication[2]

Eutrophication refers to an increase in the rate of supply of organic matter to an ecosystem, which most commonly is related to nutrient enrichment enhancing the primary production in the system (Nixon, 1995). Eutrophication levels vary due to natural causes from area to area.

Overloading with nitrogen (N) and phosphorus (P) can result in a series of undesirable effects. Excessive growth of plankton algae increases the amount of organic matter settling to the bottom. This may be enhanced by changes in the species composition and functioning of the pelagic food web by stimulating the growth of small flagellates rather than larger diatoms, which leads to lower grazing by copepods and increased sedimentation. The consequent increase in oxygen consumption can, in areas with stratified water masses, lead to oxygen depletion and changes in community structure or death of the benthic fauna. Bottom dwelling fish may either die or escape. Eutrophication can also promote the risk of harmful algal blooms that may cause discoloration of the water, foam formation, death of benthic fauna and wild or caged fish, or shellfish poisoning of humans. Increased growth and dominance of fast growing filamentous

1 European Environment Agency, http://themes.eea.eu.int/
2 European Environment Agency , Topic report 7/2001, http://reports.eea.eu.int

macro algae in shallow sheltered areas is yet another effect of nutrient overload which will change the coastal ecosystem, increase the risk of local oxygen depletion and reduce biodiversity and nurseries for fish.

The major impacts of eutrophication are thus:

- · changes in the structure and functioning of the marine ecosystems;
- · reductions in biodiversity;
- · reductions in the natural resources of dermersal fish and shellfish;
- · reduced income from maricultures of fish and shellfish;
- · reduced recreational value and income from tourism;
- · increased risk of poisoning of animals including humans by algal toxins.

Ground level ozone[3]

Ground level ozone (O_3) is formed by a chemical reaction between nitrogen oxides (NO_x) and volatile organic compounds (VOC) in the presence of heat and sunlight. Ground-level ozone is a harmful pollutant and the main constituent of smog.

Ozone is a strong photochemical oxidant, causing serious health problems and damage to ecosystems, agricultural crops and materials. Human exposure to elevated ozone concentrations can give rise to inflammatory responses and decreases in lung function. Symptoms observed are cough, chest pain, difficulty in breathing, headache and eye irritation. Ozone exposure of ecosystems and agricultural crops results in visible foliar injury and in reductions in crop yield and seed production. For vegetation, a long-term growing season average exposure rather than an episodic (short-term) exposure is of concern. Adverse effects on vegetation can be noted at relatively low ozone levels.

Harmful ozone concentrations are observed over the whole of Europe. Formation of ozone takes place at various space and time scales: the high emission density of reactive precursors in urban areas might lead to high ozone levels within the city or at short distances downwind. But ozone precursors may also be transported over distances of hundreds to thousands of kilometers, resulting in ozone formation far from the sources.

[3] European Environment Agency, http://themes.eea.eu.int/ and U.S EPA, http://www.epa.gov/

Annex 2 – The DEMO Project: Monitoring and verification of emission reductions - Executive summary

The Demo project was launched during spring 2003 and finalised in June 2005. The project demonstrates, in practice, that the monitoring and verification of NO_X and SO_2 emission reductions from sea-going ships is feasible.

More information regarding the DEMO Project is presented in the "Summary" and the "Final report" on the DEMO project web page http://www.demoproject.org/.

Scope of the Demo Project

The scope of the Demo Project was to demonstrate, in practice, that the monitoring and verification of NO_X and SO_2 emission reductions from sea-going ships is feasible. The monitoring and verification was tested on reduction techniques for NO_X emissions:

- Internal Engine Measures
- Selective Catalytic Reduction

and reduction techniques for SO_2

- Low Sulphur Fuel
- Scrubbing technology

Project organization

The primary stakeholders of the Demo project are; Broström, Rederiaktiebolaget Gotland (Gotlandsbolaget), the Peninsular and Oriental Steam Navigation Company (P&O), Stena Line, SEAaT (Shipping Emissions Abatement and Trading) and the Swedish Shipowners' Association. The sponsors of the project are VINNOVA (Swedish Agency for Innovation Systems), Swedish Maritime Administration, Wallenius Lines and Biofriendly Ltd. The project has been conducted by Sustainable Business Solutions at PricewaterhouseCoopers, Sweden. IVL (The Swedish Environmental Research Institute) and CA Clase have contributed to the tasks in the project.

Background to the Demo Project

The launch of the Demo Project was a direct response to the initiative by DG Environment during 2002 as regards a request for a demonstration that monitoring and verification of nitrogen oxides (NO_X) and sulphur dioxide (SO_2) emission reductions at sea are feasible. The request to execute the demonstration was made to the Swedish Shipowners' Association and PricewaterhouseCoopers following their presentation to DG Environment of the proposal for an EU-wide emission trading system of NO_X and SO_2,

which includes shipping. At a meeting with the head of the Margot Wallström Cabinet, the cabinet showed great interest in an emission trading system as a successful means to reduce emissions from shipping in EU waters.

To strengthen the possibilities for such a legislative development, the EU officials recommended and requested that some critical issues should be demonstrated and clarified. The main issues to be demonstrated and clarified were that the reductions can be monitored and verified in practice, that the reductions are real and that trading can be cost-efficient.

A similar request by DG Environment was made to the primary stakeholder SEAaT when presenting the proposal for SO_2 emissions trading in a shipping benchmarking consortium.

Project phases

In the Demo Project the following project phases have been conducted:

- Pre-evaluation of potential methodologies for monitoring and verification
  In this phase a pre-evaluation of potential methodologies to monitor emission levels, to calculate emission reductions and verify emissions reductions from different SO_2 and NO_X reduction techniques have been conducted. The phase has also included discussions regarding general requirements for trading of emission reductions in European waters.
- Onboard testing of the selected monitoring methodologies
  Within the scope of the project, five on-board tests (on the ships of the project participants) have been performed by and/or engaged by the project participants. One test for each oh the reduction techniques listed in the scope of the DEMO project has been conducted (NOX emissions: Selective Catalytic Reduction (SCR) and Internal Engine Measures and SO2 emissions: Low Sulphur Fuel and Scrubbing technology). Additionally, one test focused on the positions monitoring, logging of parameters and reporting of emission reductions.
- Practical testing of verification methodologies
  The verification methodology developed in the pre-evaluation phase was tested in practice on three of the on-board monitoring tests.
- Communication of results and recommendations
  The communication of results and recommendations to policymakers and other stakeholders has been an important task of the project. The results and activities of the project are presented on the web page of the project: http://www.demoproject.org/.

Main results and conclusion

The conclusions of the Demo Project are based on the pre-evaluation and the subsequent practical tests. The main results and conclusions from the DEMO project are the following:

- Monitoring of NO_X emission reductions created by ships equipped with SCR or Internal Engine Abatement is feasible
- Monitoring of SO_2 emission reductions created by ships equipped with Scrubbing Technology or by ships using Low Sulphur Fuel is feasible
- Secure monitoring of position (interconnected with the emissions monitoring) is feasible
- The construction of an onboard full scale monitoring and reporting system, sending emissions data to a server ashore, is feasible
- Verification of reported NO_X and SO_2 emission reductions created by moving ships at sea is feasible. Additionally the verification process has the ability to offset any uncertainties in the measuring process, and hence make the reductions credible.
- The policies and routines important for the monitoring and reporting of NOX and SO2 emissions/emission reductions could be included into the overall management or security systems of the ships
- There is potential for cost-effective emissions trading:
    - Cost-effectiveness is the balance between the cost of implementing emission abatement and monitoring technology, together with their operating and maintenance costs, opposed to the financial gains from trading emission reductions. Consequently, the regulators must take cost effectiveness into account when deciding on the demands for measurement uncertainty.
    - The DEMO project has, in general, focused on continuous emissions monitoring methods with low uncertainty levels in the same range as the larger land-based emitters. If the cost effectiveness of the system is to be improved the monitoring (and verification) requirements could be adjusted to the amount of emissions each ship creates, e.g. a larger emitter could be required to report with higher accuracy and smaller emitters could use simplified and less expensive methods (as has been the approach in the EU Emissions Trading Scheme for Greenhouse Gases).
    - A launch of an emissions trading scheme for NO_X and SO_2 will drive the development and marketing of new monitoring

techniques which may enable monitoring at a reduced cost and improved measurement uncertainty.

Annex 3 –Emissions trading schemes for NO_X and SO_2 in the context of existing EU regulation

Among the most important EU framework regimes for the control of polluting emissions from major industrial sources is the Directive concerning integrated pollution prevention and control (also known as the IPPC Directive). This is complemented by various measures dealing with specific sectors, like the Large Combustion Plants (LCP) Directive, the Waste Incineration (WI) Directive, the Solvent Emissions (SE) Directive 1999/13/EC4 and the Landfill Directive, and by other pieces of EU legislation, such as the Greenhouse Gas Emissions Trading Directive.

In order to implement emissions trading schemes for NO_X and SO_2 on an EU level or a member state level, the interaction with some of these Directives needs to be considered.

The IPPC Directive

The EU has a set of common rules for permitting and controlling industrial installations in the IPPC Directive of 1996. In essence, the IPPC Directive is about minimising pollution (e.g. acidifying substances, wastewater emissions and waste) from various industrial sources throughout the European Union. Operators of industrial installations covered by the IPPC Directive are required to obtain an environmental permit from the authorities in the EU countries. The major principles in the Directive are the integrated approach to pollution, permit conditions based on best available techniques (BAT), flexibility in determining permit conditions and public participation. Approximately 50,000 installations are covered by the IPPC Directive in the EU.

The IPPC Directive could, in some cases, result in a lack of space for efficient trade for the included installations and, consequently, difficulties in planning the emission reduction strategies over a longer period. The objective in the Directive for Best Available Techniques (BAT) will probably make the emissions limits decrease over time. Together with the demand on the member states to ensure that the permits are currently revised for eventual updates, this could result in the installations needing to invest in new abatement techniques, even though they had planned to reach compliance solely through the purchase of allowances and credits.

However, there are several options for creating opportunities for emissions trading of NO_X and SO_2 alongside the IPPC Directive. One is to define strict emission limits (on each installation or on sector level through allocation of allowances) based on national or sector targets and BAT and combine these limits with a weaker interpretation of BAT, when the BAT the objective is applied in practice. In this way the environmental integrity is safeguarded at same time that a scope for emissions trading and flexible solutions for the industry can be created. Already today, this option is utilised for installations in the

Dutch NO_X emission trading scheme which operates alongside the IPPC Directive covering partly the same installations.

Another means of creating opportunities for EU level emissions trading of NO_X and SO_2 alongside the IPPC Directive is to continue with BAT-based permitting, but make the appropriate amendments in the IPPC Directive, as is already the case with the EU Greenhouse Gas emissions trading scheme. That is to say, when the EU Greenhouse Gas emissions trading scheme Directive was implemented, carbon dioxide emissions (CO_2) from the installations were lifted out from (the integrated approach) the IPPC Directive. A similar procedure could be used for NO_X and SO_2 when implementing a EU level trading scheme for these emissions.

The Swedish Shipowners' Association proposes an amendment of the IPPC Directive to enable the implementation of the proposed emissions trading scheme instead of IPPC requirements on NO_X and SO_2 emissions. Through this amendment important issues for the industry can be secured, e.g. emission limits set on longer time horizons and the use of general binding rules instead of individually permit conditions. Such an amendment will provide the land-based installations the possibility to more efficiently plan and established strategies for their emissions development.

Ongoing review of the IPPC directive

The European Commission has recently launched a review process[4] of the IPPC Directive and related legislation on industrial emissions. The IPPC Review will proceed through 2006 and will be concluded in 2007. The review will evaluate the scope to improve the functioning of the Directive, its coherence and complementarity with other industrial emissions-related legislation, and the effectiveness of market-based-instruments in this context. In order to inform the review, the Commission has launched several external projects[5] covering specific issues.

One of these projects *"Project nr 4: Assessment of options to streamline legislation on industrial emissions and analysis of the interaction between the IPPC Directive and possible emission trading schemes for NO_X and SO_2"*[6] deals specifically with emissions trading of NO_X and SO_2, as is evident from the project title. The drivers for investigating these specific issues are several. One important driver is the fact that several stakeholders advocated for more significant changes to the IPPC Directive, e.g. to enable emission trading for certain pollutants, in the consultation process regarding the possible future development of the Directive launched by the Commission prior to the start of the review.

[4] The IPPC Review Homepage, http://europa.eu.int/comm/environment/ippc/ippc_review_process.htm
[5] The IPPC Review Homepage, http://europa.eu.int/comm/environment/ippc/ippc_review_process.htm
[6] IPPC Review Task 6, http://europa.eu.int/comm/environment/ippc/pdf/ippc_streamline_legislation.pdf

The main objectives for the *"Project nr 4"* are to provide an assessment which will assist the Commission Services to develop plans and proposals concerning the possible evolution of the IPPC Directive, its interaction with other instruments and the EU's overall approach to controlling the environmental impacts of industry. In particular this includes an assessment on the interaction of the IPPC Directive and possible emission trading schemes for NO_X and SO_2 at national or EU level and the environmental, economic and social impacts of such trading. One of the tasks of the project is to assess the overall structures established for the control of industrial emissions in other developed economies (e.g. USA and Canada) and to use this information in the assessment and selection of streamlining options for EU legislation.

Another specific task is to review the main issues surrounding possibilities for and potential impacts of introducing emission trading schemes for industrial emissions of pollutants such as NO_X and SO_2 at EU or national level. Key issues in this task are

- the pros and cons of implementing emission trading alongside or in place of IPPC requirements,
- the review of international experiences and existing national schemes, e.g. NO_X trading in the Netherlands,
- the legal compatibility of the IPPC Directive with emission trading in respect of industrial emissions, either within a Member State, among Member States or at EU-level and,
- the specific issue of whether changes would be required to the Directive to allow effective emission trading to take place (according to the scenarios mentioned above).

Other tasks in the project include a questionnaire to stakeholders and Member States, detailed case studies of certain installations and creation of streamlining scenario proposals. According to the Commission, the scenarios could include emission trading of NO_X and SO_2 either within Member States or among specific Member States, or the development of EU-level emission trading. As pointed out by the Commission, the different scenarios are not necessarily mutually exclusive, since, for example, BAT-based permitting under IPPC could continue alongside EU level emission trading, given the appropriate amendments (as is already the case with the EU ETS Directive).

The Swedish Shipowners' Association is very positive to this review and stresses the importance of *"Project nr 4"*. The Swedish Shipowners' Association also wants to stress the importance of considering the possibilities of emissions trading including emission reductions credits from shipping in the overall IPPC review and in *"Project nr 4"*.

The Large Combustion Plants Directive and other relevant legislation

The Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants (the LCP Directive) has the overall aim to reduce emissions of acidifying pollutants, particles, and ozone precursors. The LCP Directive tightened the Community requirements for air pollution control from new combustion plants in line with the substantial technical progress that had been made in this sector since the old Directives for this sector was adopted. The LCP Directive also encourages the combined generation of heat and power and sets specific emission limit values for SO_2, NO_X and dust.

In 2003, the Commission appointed an external consultant to undertake an assessment concerning the LCP Directive, including the need for further measures. A task in the appointed project was to assess the feasibility and desirability of market based instruments for SO_2 and NO_X (e.g. emission trading schemes) in the EU LCP sector. A general conclusion of the consultant in the final report[7] from 2005 is that market-based instruments have a number of advantages over conventional command and control regulations, especially in respect of the potential for compliance cost minimisation for the industry and continuous technological change.

The Directive 2000/76/EC on the incineration of waste (the WI Directive) came in to force in 2000 with the aim to prevent or to reduce negative effects on the environment caused by the incineration and co-incineration of waste. This is to be achieved through the application of operational conditions, technical requirements, and emission limit values for waste incineration and co-incineration plants within the EU. Reductions for air emissions will be achieved for nitrogen oxides (NOx), sulphur dioxide (SO2), hydrogen chloride (HCl), heavy metals, particles, and dioxins and furans.

The interaction of the WI, LCP and IPPC Directives is currently being examined as part of the Commissions' review of the IPPC Directive and related legislation.

The Swedish Shipowners' Association wants to stress that emission trading is an option for implementing these directives and that the use of emission reductions credits from shipping should be applied in this trading.

[7] "Preparation of the review relating to the Large Combustion Plant Directive - A Report for European Commission, Environment Directorate General", Entec UK Limited, July 2005

The NEC Directive and CLRTAP

Directive 2001/81/EC on National Emission Ceilings (NECs)[8] determines national emission targets for 2010 for NO_X and SO_2. Emissions from international maritime traffic are not included in the national targets. The national targets could limit the trade of allowances between sources in different EU countries and the selling of credits from sources not included in the NEC:s. A solution to this issue is to change the NEC Directive so allowances and credits from other countries and sectors can be used to comply with the national target. A review of the NEC Directive is ongoing and the assessment of emission trading schemes for NO_X and SO_2 and the issue of market based instruments are included in the review. A new proposal is expected in 2007.

The 1999 Gothenburg Protocol of the Convention on Long-range Transboundary Air Pollution (CLRTAP)[9] also sets national emission ceilings for 2010. In analogy with the considerations regarding the 1999 Gothenburg Protocol of the CLRTAP the national emission ceilings for 2010 could limit the trade of allowances and credits between sources in different EU countries. However, in CLRTAP emission trading between the countries is considered as one option to comply with the convention.

The Swedish Shipowners' Association wants to stress that emission trading has a clear potential for reaching these targets in a more cost-efficient manner, and that possible amendments to the agreements should be made in order to take full opportunity of this potential.

[8]Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants

[9] United Nations Economic Commission for Europe's (UNECE) Convention on Long-Range Transboundary Air Pollution. The eight protocol of the convention is the "The 1999 Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone". The Protocol sets national emission ceilings for 2010 for four pollutants: sulphur, NOx, VOCs and ammonia. More than 30 countries are included in the protocol, for example, Canada, USA and the countries of the EC.