IMPRINT-EUROPE
Implementing Reform in Transport
Effective Use of Research on Pricing in Europe
An European Commission funded Thematic Network (2001-2004)

Environmentally differentiated fairway charges in practice – the Swedish experience

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Draft

This essay was prepared for the second seminar of the IMPRINT-EUROPE Thematic Network: "Implementing Reform on Transport Pricing: Identifying Mode-Specific issues", Brussels, 14th/15th May 2002

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ABSTRACT

Maritime fairways, navigational aids, pilotage, search and rescue operations as well as ice-breaking in Swedish waters, have since many years been 100 % financed by means of fairway charges. The charging bases have varied over the years, but at present charges are based on gross tonnage (GT) and the volume of goods loaded and unloaded at Swedish ports. In addition, pilot assistance is partly charged according to the pilot service provided. A similar charging system exists in Finland but in most other EU-countries the corresponding facilities and services are organisationally and financially tied to the ports.

For long there has been certain concern about the absolute level of emissions to air generated by maritime transport especially sulphur and nitrogen oxides, albeit sea transport in many cases is efficient also from an environmental point of view. Therefore the Swedish Maritime Administration, the Swedish Ship owners association and the Swedish Ports' and Stevedores' Association in 1996 agreed to employ vigorous measures to reduce these emissions by 75 % within a few years. All the parties took certain actions. The Swedish Maritime Administration and to some extent the ports decided to implement a system of environmental differentiation of the current charges. The objective of the differentiation was to create incentives to use low sulphur oil and to take measures to reduce NOx emissions from ships' engines. The differentiated fairway charging system was supplemented by a system giving certain financial support to installation of cleaning equipment or clean-burn technology.

The differentiated fairway and port charges have now been in operation for more than three years, and it is possible to draw at least tentative conclusions on the operation and effects of the system. The main experiences and conclusions up to now will are presented in the paper. While the system has been in operation, substantial reductions of emissions of sulphur and nitrogen oxides have been attained for maritime transport calling Swedish ports.

A major review of the Swedish system for fairway charges is currently going on. The purpose of this review is to investigate how the system could become more aligned to the principles of social marginal cost pricing and how still stronger incentives for environmentally friendly maritime transport could be introduced into the charging system. In the paper there is also a short discussion also on the scope of the differentiated charging systems within a possible new charging framework, considering the differentiated system's success during the years it has now been in operation.

1. FAIRWAY CHARGES IN SWEDEN

1.1 Background

Before 1st of January 1998 Swedish charges for the provision of maritime infrastructure and services were based on two elements, light dues and an additional fairway due component based on the amount of loaded/unloaded goods. At this time the charging system was superseded by a new system of environmentally differentiated fairway dues. The new system was part of a tripartite agreement between the Swedish Maritime Administration, the Swedish Ship Owners Association and the Swedish Ports' and Stevedores' Association. The three parties in the agreement set a goal to reduce emissions of NOx and sulphur for ships calling Swedish ports by 75 % in the early years of the 21st century.

The 1998 system is based on two charging components[1]. The first one, which is environmentally differentiated, is based on the gross tonnage (GT) of the ship. This portion of the due is charged a maximum of 18 times a year for passenger ferries or railway ferries and a maximum of 12 times a year for each individual cargo ship. The second component, like before is based on the amount of goods loaded/unloaded in Swedish ports and is not affected by the differentiation. The differentiation aims at establishing an incentive for ship owners to reduce emissions of sulphur and nitrogen oxides, while not per se altering the total sum of SMA charges for all ships calling Swedish ports taken together. Thus the scheme is supposed to be income neutral for the Swedish Maritime Administration.

The Swedish initiative to introduce an environmental differentiation within the framework of the fairway and port dues has attracted some attention also outside Sweden. In the White Paper on the Common Transport Policy from 2001 (COM (2001) 370), the Commission says (p 77):

> *"In maritime transport, the Commission is looking at the tariffs currently applied in Sweden in this sector, particularly port taxes and taxes to reduce pollutant emissions, in order to see whether this approach might encourage greater account to be taken of external costs elsewhere in the Community. In the light of this examination a Community framework may be proposed which links port taxes to these costs."*

1.2 The differentiation scheme for fairway dues

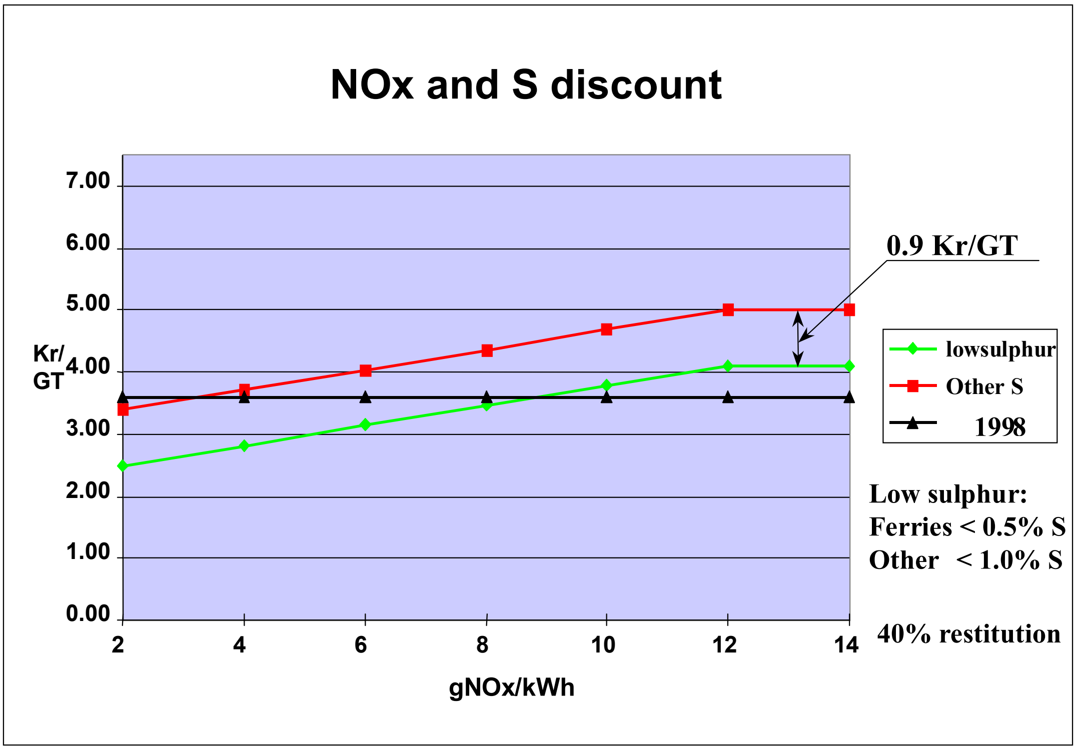
The charging levels for the GT portion of the fairway dues are differentiated with respect to two different levels of sulphur in the bunker viz. the certified emission levels of NOx per kWh for the ships' machinery.

The differentiation with respect to sulphur in the ships' bunker fuel is straightforward. A ship which certifies that it is only using low sulphur bunker fuel (< 0,5 % S for ferries, <1 % S for other ships) will be granted a discount of 0,9 SEK per GT.

[1] In this paper we will not discuss the separate charges for pilot assistance, which are a part of the total maritime charges for ships calling Swedish ports.

For NOx-emissions the differentiation scheme is slightly more complicated. The charges per GT varies according to the NOx emission rate per kWh for the ship's machinery. For ferries and other ships (not tankers) the charge is 3,40 SEK/GT if emissions are 2g/kWh/or less. The charge is increasing linearly up to the level of 5 SEK/GT if emissions are 12 g/kWh or more. The differentiation scheme is illustrated in diagram 1 below.

Diagram 1 Discount scheme for ferries and other vessels
(Oil tankers are charged somewhat higher dues)



For other ships than ferries the total GT-charges are maximised. The maximum amount for the GT due is co-ordinated with differentiation scheme for NOx in such a way that the GT dues will only be charged up to a maximum of approximately 24000 GT. Charges are not levied for ships of less than 400 GT.

1.3 Administrative procedures

For a ship to receive the discount of the GT due with respect to NOx emission reduction an application has to be filed with Swedish Maritime Administration. Based on the application the SMA will, after appropriate verification measures have been carried out, issue a certificate of NOx reduction. The certificate will define the level of NOx emissions per kWh and hence the appropriate level of the GT based fairway due.

To receive reimbursement for low sulphur bunker fuel the ship owner has to provide a document certifying that the ship permanently and under all conditions is operated with bunker fuel containing less than 0,5 % sulphur for ferries and less than 1 % sulphur for other ships.

2. THE EFFECTS OF THE DIFFERENTIATED CHARGING SCHEME

2.1 Some recent facts about the diffusion of the system

About 25 major ports have introduced environmentally differentiated port dues according to the agreement of 1996.

By December 2001 about 30 ships, including a number of SMA:s own ice breakers and utility ships, introduced far reaching measures to reduce emissions of NOx. Thereof 25 commercial ships have received the NOx-certificate.

On January 1, 2002, 1043 ships were registered for continuous operation with low sulphur bunker oil. For passenger ships and railway ferries the limit for low-sulphur is 0.5 per cent by weight. For other ships the corresponding limit is 1 per cent.

2.2 Estimated effects

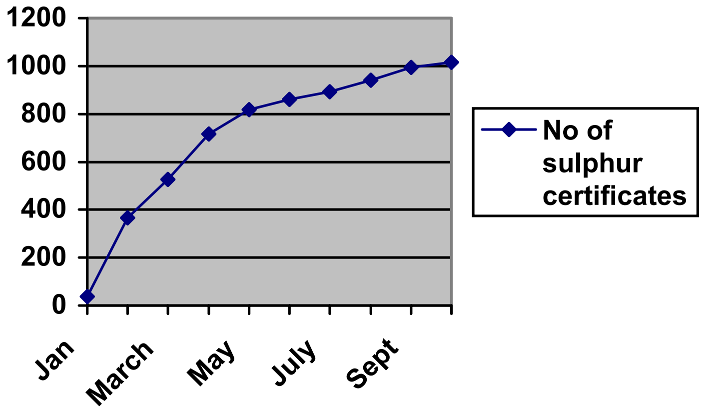
According to a recent estimate (SMA Annual Report 2001) the differentiated charging system for Swedish fairways and ports has helped to induce substantial decreases of maritime emissions of NOx and SOx. The overall emission reduction in the areas of the Baltic Sea and the North Sea has been estimated at 50 000 tons for SOx and 27 000 tons for NOx (calculated as NO2).

An evaluation of the differentiated fairway charging system was commissioned by SMA (Mariterm, 1999). The evaluation addressed the maritime emission reduction for ships calling Swedish ports within an area around Sweden[2] for which statistics had been produced for several years.

Assessing the real effects of the differentiation scheme is complicated by the fact that even before the launching of the scheme there were ships already operating with low sulphur bunker oil. Considering the construction of the discount, rebating 0,9 SEK per GT for ships using low sulphur bunker, it is only natural that practically all these ships would register as ships using low sulphur bunker oil, since this would mean an “automatic” GT-due discount of 0,9 SEK per GT. The rapid growth during 1998, of the number of ships certified as using low sulphur bunker fuel, therefore reflects not only the real conversion to low sulphur bunker oil but also the mere registration of ships already using such bunker fuel.

[2] The area extends in the Baltic Sea and the Sound to the middle line between the shore states. The area roughly corresponds to the Swedish economic zone.

Diagram 2 Growth of number of ships certified for low sulphur bunker oil during 1998



The total number of ships registered as low-sulphur ships was 1114 at the time of the Mariterm study. According to the study, the likely number of ships converting to low-sulphur bunker oil because of the differentiation scheme, was estimated at 150 ships and the reduction of sulphur emissions amounted to approximately 3900 tons (corresponding to about 8000 tons of SO2). The nominal reduction of sulphur emissions was 28 %. of the volume before the system was introduced. Eliminating the effect of traffic growth the reduction was estimated at about 30 % of the total sulphur emissions from maritime transport in foreign relations (domestic maritime transport was not included in the evaluation).

The evaluation of the effects of the NOx differentiation scheme to some extent encounters similar difficulties as was mentioned above for sulphur. Thus ships using certain propulsion technologies have inherent NOx emission levels below 12 g/kWh (e.g. some medium speed diesels, high speed diesels, gas turbines, cf, Kågeson 1999 p 9). This implies that these ships could get a NOx-certificate which entitles to a rebate on the GT due without taking any specific action to reduce NOx emissions. By November 1999 13 ships had registered for NOx emission levels lower than 12 g/kWh and therefore qualifying for a reduction of the GT due. Of these 13 ships nine had taken dedicated action to reduce emissions.

For NOx-emissions the traffic corrected reduction ascribed to the differentiation scheme was estimated by the Mariterm study at a little less than 10 %.

The lack of consistent time series of emissions from maritime transport to/from Swedish ports as well as between Swedish ports, seriously hampers the possibilities to consistently evaluate at an aggregate level the effects of the differentiated fairway and port dues. The introduction from 2000 of a new and considerably improved system for emission statistics will facilitate the evaluation of possible future changes of the charging system.

3. BENEFITS AND COSTS OF REDUCTIONS OF EMISSIONS OF SOX AND NOX

3.1 Benefits of reductions of SOx and NOx emissions

We will not here go into any detail of how to value the benefits of reduced emissions of SOx and NOx, but rather to give some idea of the formal background and the estimated magnitude of these benefits.

In the Swedish transport sector standard values have been used for many years to estimate the benefit to society of reducing emissions. These standard values (often called ASEK-values) are reassessed from time to time to incorporate new findings from research. At present such a reassessment is going on, which is scheduled to be completed early this autumn (2002).

Recently the findings of the EU ExternE-programme were published in Friedrich & Bickel (2001). The impact pathway and damage cost approach developed in the ExternE-context was applied to maritime transport in Sweden in a recently completed study commissioned by the Swedish Maritime Administration and the Swedish institute for Transport and Communications Analysis which is reported in Elektrowatt-Ekono (2002). In the study data from the EU Unite project were also used. For regional effects standard values for the Nordic context transformed to Swedish conditions, were used. In the study, the costs of local damage caused by ship emissions were estimated. For local emissions a detailed dispersion model was used to arrive at these estimates.

The current values of benefits of reductions of emissions of SOx and NOx from ASEK and the pilot study using the ExternE-methodology are summarised in the table below:

Table 1. Two sets of estimates of benefits from reductions of SOx and NOx emissions from ships

	SOx	SOx	SOx	NOx	NOx	NOx
	Local	Regional	Total	Local	Regional	Total
1. ASEK 1999	10	20	30	0	60	60
2. Swedish maritime ExternE based pilot study	0,1	6	6,1	0	14	14

Sources: SIKA Report 1999:6 and Elektrowatt-Ekono (2002)

From the table it can be observed that the ASEK values are about 5 times higher than the ExternE based values.

A separate analysis in the pilot study of emissions from a ship at open sea indicated that the damage cost of those emissions are about the same as the damage cost from en route emissions in the fairway approaches passing through Swedish archipelago areas. This is partly due to the fact that local damage cost in all cases turns out to be low compared to regional cost.

3.2 Abatement costs

The ships' abatement costs for both sulphur and NOx emissions seem to be somewhat uncertain.

For bunker oil with different contents of sulphur the price differential seems to vary over time. Mariterm (1999) claims that the market price of low sulphur bunker oil certain days has been even lower than for bunker oil with normal[3] contents of sulphur. The "normal" differences given by Mariterm (1999) referring to oil industry sources, were US $ 10-15 per cubic metre. (Approximately SEK 100 – 150). This difference seems to be valid between the "normal" grade and 1 % low sulphur bunker oil. For 0,5 % low sulphur oil a difference of SEK 300 per m3 is mentioned. Similar estimates are given by Kågeson (1999) quoting a source at the Swedish Ship Owners Association.

These figures could be recalculated to give the abatement cost per kg SO2, which turns out to be in the range of SEK 4 per kg to SEK 8,5 per kg.[4]

The ship owner's cost estimate for operating on low sulphur is however influenced by the fact that other operating and maintenance costs for the ship's machinery in many cases get lower when it is operated with low sulphur bunker oil. Unfortunately, there is no quantitative estimate of this effect available for this paper.

The level of NOx emissions from the ships' machinery depends partly on the basic technology and partly on whether NOx-reducing equipment is fitted or not. New machinery tends to have lower NOx emissions everything else being equal. It is also possible to retrofit existing machinery with equipment reducing NOx-emissions and there are quite a few different technologies available[5].

SMA experts have estimated the cost of reduction of NOx-emissions to be in the interval SEK 2,50 – SEK 7,00 per kg NOx.

Kågeson (1999) gives some estimates of the abatement cost for NOx-emissions. The cost of installing SCR is estimated in the range of SEK 250 000 – SEK 400 000 per megawatt , the lower boundary being mainly applicable for new ships. The operating costs are estimated to increase by SEK 18 per MWh due to consumption of urea and rising maintenance cost. The cost per kg reduction of NOx emissions is estimated at 6 SEK per kg NOx. The HAM-technology is sometimes claimed to be more cost efficient than SCR. However, Kågeson (1999) indicates that cost per kg NOx is of the same magnitude as for SCR.

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[3] In an internal SMA document dated 2001-10-03 (Stefan Lemieszewski) the worldwide average content of sulphur in bunker oil is estimated at 2,9 %.

[4] Assuming an average density of bunker oil of 0,9 kg/litre and a "normal" percentage of sulphur of 2,5 % by weight. The difference of sulphur contents per m3 between normal bunker and 1 % viz. 0,5 % is 12,5 viz. 17,5 kg which is equal to 25 viz 35 kg of SO2.

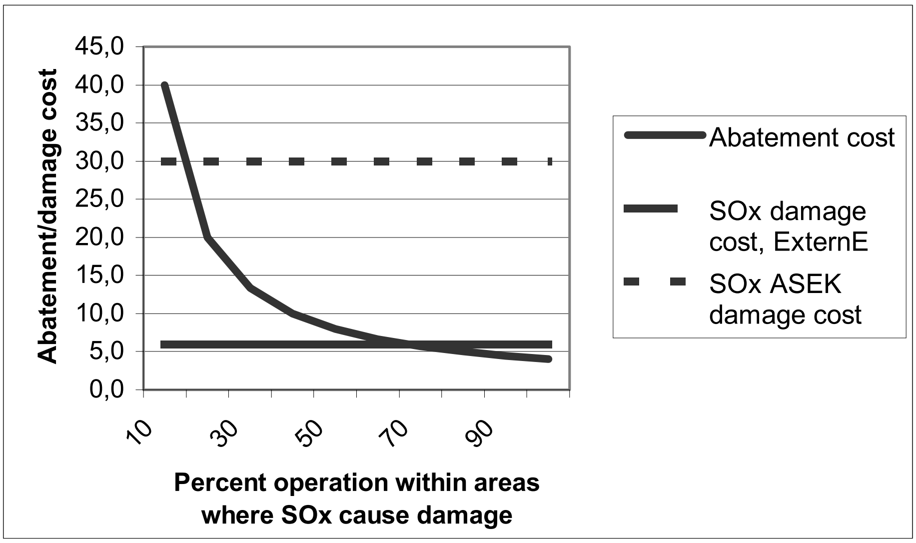
[5] SCR (Selective Catalytic Reduction) reduces NOx emissions by 85-90 % using urea. Requires low-sulphur bunker oil. HAM (Humid Air Motor) is insensitive to the sulphur contents of the bunker oil. NOx reduction will be between 50 and 85 %. There are also other less proven technologies.

3.3 Optimal maritime emission charges

3.3.1 Emissions of sulphur oxides

According to the regulations of the Swedish rebate system for using low sulphur bunker oil we assume that a certified ship will have to use low sulphur bunker oil in all areas where it operates. The average abatement cost will therefore no longer be constant but dependent on the extent to which each ship is used within the area where damage is caused by the SOx emissions. The diagram below illustrates that, given the ExternE SOx damage cost estimates assumed to be constant, converting to low sulphur oil would only be justified for ships having more than about 70 percent of their operation within the damage area. With ASEK values only a little less than 15 % of ship operation has to take place within the damage area for conversion to low sulphur bunker oil to be justified.

Diagram 3 Percentage of a ship's operation within SOx sensitive area justifying abatement measures; two alternative damage cost estimates



From an EU perspective it would seem natural to think of the MARPOL Annex VI SOx emission control areas of the Baltic and North Sea as the relevant maritime traffic areas where emissions of SOx cause damage at least at the lower level indicated in diagram 3 (ExternE). From the diagram it is clear that for all ships having more than 70 % of their operations within this area conversion to low sulphur fuel would be socio-economically justified.

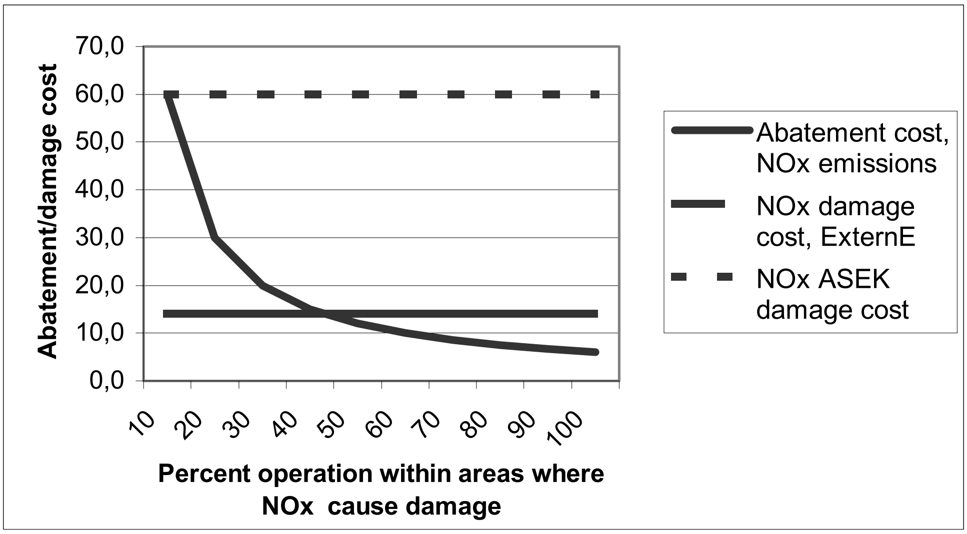
3.3.2 Emissions of nitrogen oxides

Considering the discussion on abatement cost above it seems reasonable to assume that the cost per kg reduced emission of NOx is about 6 SEK per kg NOx. This is, however, the average cost per kg reduction for the ship's all NOx-emissions during full time operation. The underlying assumption, thus, is that all emission reductions over the entire operational area of the ship are included in the denominator for the average cost when arriving at 6 SEK per kg.

If all maritime NOx emissions, regardless of the location of the emissions, were equally harmful and the abatement cost of SEK 6/kg would be valid for all ships, one could obviously conclude that NOx reducing measures would be justified from a welfare point of view for all ships since the abatement cost is lower than the damage cost estimate of SEK 14 per kg.

However, for NOx there seems to be only a weak international pressure on maritime NOx reduction as reflected in the development of the IMO regulatory framework, and there are no NOx emission control areas similar to those mentioned above for SOx. This seems to leave us in a situation, where the conception of an important NOx emission problem, justifying a damage cost value of SEK 14/kg, is restricted to certain countries as well as limited areas of the seas. Therefore it seems relevant to approach the issue of the abatement cost for NOx-emissions in a similar way as for SOx above, where the real abatement cost varies with the share of the ship's operation area included in the area where NOx emissions are recognised as causing damage. See diagram 4 below.

Diagram 4 Percentage of a ship's operation within NOx sensitive area justifying NOx abatement measures; two alternative damage cost estimates.



The diagram illustrates that with the ExternE estimates of NOx damage cost, NOx abatement measures are justified if a ship operates at least 45 percent within area(s) recognised as areas where NOx emissions are viewed as harmful. For the higher "ASEK" value it would suffice if ship operations within such areas would amount to 10 percent of the total operation time.

3.3.3 A provisional conclusion

From the discussion above it is apparent that the ship owners' perceived real abatement cost are influenced by the extension of the area in which emissions are considered harmful. A small area implies that emission reductions are only productive for the ship owner within this small area. Measures lowering a ship's emissions in is entire operation will only be beneficial to a limited extent defined by the share of operations taking place in sensitive areas.

Assuming that the figures underlying the diagrams 3 and 4 above are correct, policy measures should only aim at ships which operate within sensitive areas at least to the extent which is defined by the intersection between the abatement cost curves and the damage cost curves. That is all ships with an operating profile putting them to the right of the intersection points should be induced to take abatement measures. Obviously, the number of ships affected is influenced by the extension of the sensitive areas, the damage cost levels and the position of the cost curves

4. SOCIETAL BENEFITS AND SHIP OWNERS' INCENTIVES

In the preceding chapter we established, that a limitation of the extension of the emission sensitive areas, also will limit the scope for emission abatement measures to ships mostly active within these sensitive areas, provided those measures are to be justified from a socio-economic point of view.

Let us now look at the relation between the private incentives offered by the Swedish fairway system, and the benefits of an emission reduction for society. In the discussion of the Swedish fairway system it has been said many times, that the private incentives for ship owners are too low considering assumed level of societal benefits from an emission reduction.

The ship owners financial benefit from the differentiated charging scheme is given by equation (1)

$$\Delta K = GT \bullet N \bullet 0{,}16 \bullet (e_1 - e_2) \qquad (1)$$

that is the cost reduction for the ship owner, ΔK , due to the reduction of specific emissions from e_1 to e_2 , is a function of the gross tonnage GT and the number of calls N. The constant 0,16 is the step of the incentive scale for the GT part of the fairway charges.

The benefit for society at large, on the other hand ,is given by ΔU below.

$$\Delta U = kW \bullet N \bullet \frac{2d}{v} \bullet (e_1 - e_2) \bullet C_{NOx} \qquad (2)$$

i.e. the societal benefit is a function of the engine effect (kW), operating time (2d/v), the reduction of emissions (e_1-e_2) and the damage cost of NOx emissions. Relating ship owner cost reduction to the damage cost reduction for society at large gives the following expression.

$$\frac{\Delta K}{\Delta U} = \frac{GT}{kW \bullet T} \bullet \frac{0{,}16}{C_{NOx}} \qquad (3)$$

where T, the transport time for a port approach in and out, is substituted for 2d/v.
In formula (3) the second factor is around 10 using the ExternE damage value of NOx (expressed in g/kwh). In the first factor, the quotient between GT and kW for most ships is

greater than one, though there are a few exceptions. Assuming that the NOx sensitive area we consider in this case is restricted to Swedish territorial waters. Then the typical value for T would be around 5 hours. It follows that in most cases the quotient $\frac{\Delta K}{\Delta U}$>1, which means that the ship owners' private benefit exceeds the societal benefit, which is contrary to the common belief. It seems as if the incentive is too generous considering the societal gains. A ship with low NOx emissions calling at Swedish ports will be offered a rebate which exceeds the societal benefits.

However, since the accumulated rebates for an individual ship are maximised (to 12 for cargo ships and 18 for ferries) the discrepancy between ΔK and ΔU will start shrinking as soon as the actual number of calls exceeds the charging limits, and eventually the quotient $\frac{\Delta K}{\Delta U}$ becomes less than one, which means that the private benefits from the charging rebate is less than the societal benefit. Under some reasonable assumptions $\frac{\Delta K}{\Delta U}$=1 for N between 30 and 50 calls per year. Above this limit the ship which has installed low emission technology provides environmental benefit to society for free. Another way to put it is that for ships having frequent calls at Swedish ports the incentives offered are lower than the societal benefits.

5. THE WAY AHEAD – TOWARDS AN EFFICIENT CHARGING SYSTEM

The discussion in the preceding chapters has made it evident that the aspirations of an environmentally efficient fairway charging policy must be aligned to the political recognition of the emission problem. The key issue in the international maritime sector is that most ships will operate both in areas which are sensitive for emissions and in areas considered non sensitive. An efficient policy should aim at creating incentives for reduction of maritime emissions until the cost of the marginal measure is equal to the marginal damage cost in the recognised sensitive areas.

It is of course important that the emission problems are properly recognised, thus helping to establish realistic borders for emission sensitive areas. For any given delimitation of the sensitive areas, however, an intersection point between marginal abatement cost and damage cost could be established as illustrated in chapter 3. Abatement measures should be stimulated for ships, which are operating frequently enough in the sensitive areas.

One solution would be to establish an emission charge equal to (the constant) marginal damage cost. Most frequent ships would have an abatement cost per unit well below this level. The abatement cost, therefore will then define the net cost increase for these ships. It is unavoidable, however, that such a cost increase may influence competitive conditions between ports and routes in different countries.

Another way would be to stick to a differentiation scheme for fairway charges to provide incentives for emission abatement measures. For frequent ships (mostly ferries) the present NOx-differentiation of the GT part of the fairway dues will cover about half the abatement cost. The GT based differentiation will give a constant and uniform yearly accumulated discount amount for all ships making 18 calls or more, which implies that if cleaning technology has constant returns to scale, about half of the abatement cost will be covered for all these ships.

For the ships in the lower range of call frequency, however, the cost of the abatement measure will exceed the marginal damage cost level and therefore not be justified (if only emissions in Swedish waters are considered). This restriction is not at present reflected in the differentiation scheme, which would cover about half the abatement costs for all ships calling 18 or more times despite the fact that abatement measures for ships with low calling frequencies may not be cost efficient.

The significant reductions of NOx emissions during the existence of the differentiation scheme could probably be ascribed to the combined effect of incentives created by differentiated fairway and ports dues and the environmental concern of ship owners and shippers. For SOx, emissions have been reduced for many reasons, including the formulation of SOx control areas, lower maintenance cost for better fuels, often synonymous with low sulphur fuels. However the reimbursement of SEK 0,9/GT is also a positive factor despite the fact that the reimbursement normally amounts to only a minor fraction of the abatement cost.

Widening areas of concern for maritime emissions to the territorial waters of several countries would widen the range of ships to be included in a cost efficient emission abatement programme. For the abatement measures to actually take place, it is however necessary that suitable economic incentives are in operation. The Swedish experience has shown that environmentally differentiated fairway and port charges is one way to consider.

REFERENCES

Commission of the European Communities, White Paper, European Transport Policy for 2010, time to decide, Brussels 12/09/2001, COM (2001) 370.

Elektrowatt-Ekono, Jaako Pöyry Group (2002), Estimation of Marginal Environmental Emission Costs of Maritime Transport. pilot study based on the ExternE-methodology. Study commissioned by the Swedish Maritime Administration and the Swedish Institute for Transport and Communications Analysis, May 2002.

Friedrich, R and Bickel, P, (eds.) (2001), Environmental External Costs of Transport, Stuttgart 2001, Springer Verlag.

Kågeson (1999), Per, Economic Instruments for Reducing Emissions from Sea Transport. T&E Air Pollution and Climate Series 11, T&E 99/7

Mariterm (2001), Emissionssammanställning av sjöfartsemissioner i Nordsjön, Östersjön och för trafik på Sverige år 2000 (Emissions in the North Sea, the Baltic Sea from maritime traffic related to Swedish ports in 2000). Report from study commissioned by SMA, December 2001.

Mariterm (1999), Utvärdering av miljödifferentierade avgifter för sjöfarten, December 1999. In Swedish. (*Evaluation of environmentally differentiated maritime charges*)

SIKA Rapport 1999:6, Översyn av samhällsekonomiska kalkylprinciper och kalkylvärden på transportområdet (ASEK), July 1999.

Swedish Maritime Administration, Environmental Differentiated Fairway and Port Dues, 1998.

Swedish Maritime Administration, Annual Report 2001