NATUR VÅRDS VERKET

Proposal for a Permit Fee System for Nitrogen and Phosphorus

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Proposal for a Permit Fee System for Nitrogen and Phosphorus

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Foreword

This report describes how a cross sectorial fee system, with features of a permit trading system can be designed with the aim of reducing nitrogen and phosphorus loads to the Baltic Sea and the West Sea in a cost-effective manner. The work has been carried out by the Swedish Environmental Protection Agency on behalf of the Swedish Government and following consultation with the competent authorities for the West Sea, the Southern Baltic and the Northern Baltic.

Erika Budh and Henrik Scharin at the Swedish Environmental Protection Agency have acted as project leaders. Kerstin Blyh, Oskar Larsson, Linda Karlsson, Kristian Skånberg, Thomas Nitzelius and Kristina Erikson, all at the Swedish Environmental Protection Agency, have also taken part in the work. The section on the design of the permit fee system is based on material from Dennis Collentine at the University of Gävle. Three preview groups have made valuable comments during the course of the work. The report was sent for opinion to a number of organisations in the autumn of 2008.[1] In September 2008 the Swedish Environmental Protection Agency also arranged a seminar for an exchange of experience with representatives of existing water quality trading systems in the United States and authors of proposals for a framework for a nutrient quota and credits system for the Baltic Sea as a whole.

The project group wishes to thank all the preview groups and others who have made valuable comments during the course of the work.

Stockholm, December 2008
Swedish Environmental Protection Agency

[1] Swedish Forest Agency, Swedish Forest Industries Federation, Swedish Board of Agriculture, Federation of Swedish Farmers, Swedish Association of Local Authorities and Regions, Swedish Water & Wastewater Association, Stockholm Water, the 5 competent authorities, WWF, Swedish Society for Nature Conservation, Swedish Board of Fisheries, National Maritime Administration, Swedish Energy Agency, Swedish Coast Guard, Swedish Meteorological and Hydrological Institute, Geological Survey of Sweden, Swedish Chemicals Agency and Swedish Armed Forces.

Contents

Summary

This report describes a cross sectorial fee system, with features of a permit trading system, designed to reduce the nitrogen and phosphorus load to the Baltic and the West Sea in a cost-effective way.

The load of nitrogen and phosphorus to the sea from Swedish sources has decreased over the last years, but the sea environment has not recovered at the same pace and further reductions are required. Sweden has signed an agreement, the Baltic Sea Action Plan, with other countries around the Baltic Sea to take further actions. Already there is a number of policy instruments geared toward emissions of nitrogen and phosphorus, but research shows that these instruments generate unnecessarily high costs. This can be explained by the fact that the majority of existing policy instruments are sector- or, in some cases, even measure specific and therefore limit the possibilities of low cost measures being implemented first. Most of these instruments do not consider the measures' impact on the actual recipient, but focus mainly on emissions at the source.

Policy makers are confronted with at least two challenges. First, the level of ambition must increase substantially in order for higher targets to be reached. Secondly, policy instruments must be shaped so that low cost measures are implemented first. This proposal embodies mechanisms that meet these challenges.

The permit fee system consists of three interconnected markets. By separating the system into these markets, each market can be shaped in order to fulfil a specific function.

As a first step, sources of discharges are regulated through caps in the *fee market.* The caps allow regulated sources to discharge a certain amount of nutrients without having to pay a fee. However, for any amount of discharge that exceeds the requirements, the emitters can choose between implementing measures to meet the regulations or paying a fee that gives them the right to emit a certain load to the recipient during a specific time period, a so called "right to load". The actors on the fee market are a regulating authority and regulated sources that, through fees paid to the authority, finance so called "compensatory measures". Compensatory measures are measures that compensate for the amount of discharges on the fee market that exceeds the sum of individual caps. They are contracted by the regulatory authority in the *measures market* and carried out by market agents that can achieve reductions in excess of their cap or by those who can mitigate emissions to the sea through unregulated activities that do not generate emissions, e.g. mussel farming and wetlands. The measures are financed by revenues obtained in the fee market. Compensations paid on the measures market therefore determine the fee level in the fee market.

When these two initial markets have been established, a *secondary-market* is created where rights to load can be traded. In this market rights to load are traded directly between different stakeholders. The purpose of this market is to enhance the cost-effectiveness and flexibility of the system.

The regulating authority is a key actor in the system and can be likened with a broker: it manages the contact with fee payers on the fee market and are responsible for using the revenues from these fees to finance compensatory measures. This role reduces the transaction costs that have been an obstacle when a traditional permit market have been used to reduce the load of nutrients from non-point sources as well as point sources.

Although the proposed permit fee system is expected to lead to decreased transaction costs compared with traditional trading systems, the transaction costs are likely to increase in comparison with existing policy instruments but, in return, the proposal is expected to generate benefits with regard to the following aspects: cost-effectiveness of measures, target fulfilment, dynamic efficiency as well as an increased potential to deal with uncertainties and distributional consequences.

It has not been possible to address all aspects of the permit fee system to such a degree that it is ready for implementation. Further analysis is needed in a number of areas. The Swedish Environmental Protection Agency (Naturvårdsverket) therefore proposes a continuation of this assignment to deepen the analysis (2009-10) and run a test in a pilot area (2010-12).

Terms and definitions

Administrative costs: Costs that arise as a result of administration of the policy instrument for both companies and households as an authority.
Basin: An area of land where the surface water flows via a series of watercourses to a single outlet into a lake or to the sea.
BSAP: The Baltic Sea Action Plan is the HELCOM action plan for the Baltic and the Kattegat
Fee: Differs from tax in that it is neutral in terms of public finances as the revenue from the fee is used to deal with the environmental problem concerned.
Coastal area: Area of land whose surface water runs straight out into the sea via small watercourses and which is not covered by the basin of a larger river.
Coastal zone: Geographically defined sea areas alongside land, for example the Stockholm archipelago.
Cost-effectiveness: A particular reduction target is reached at the lowest possible cost.
Distributional effects: Indicate who bears the economic costs generated by measures, dependent on policy instruments.
Dynamic efficiency: Incentives are created that lead to technological development of cost-effective measures.
HELCOM: The Helsinki Convention, or the Convention on the Protection of the Marine Environment of the Baltic Sea Area, is a cooperation between the various states around the Baltic Sea and the European Commission.
Hot spots: Geographical concentration of high discharge levels that lead to local environmental effects but also have an impact on larger areas.
Impact assessment: Identifies, quantifies and if possible assesses the costs and benefits of achieving a particular objective or of a particular target or measure.
Leaching: Leaking of substances from the soil to surface water or groundwater.
Load: The quantity of phosphorus/nitrogen from a particular source/region that reaches the receiving water body.
Main basin: Basins of the 118 largest watercourses that discharge into the sea in Sweden as well as the island of Öland.
Marginal cost: In this context, the cost of reducing inputs to the sea by one further unit.
Measures: A physical or behavioural change with the aim of reducing the nitrogen and phosphorus load on a receiving body of water. This may, for example, be growing catch crops, installing better treatment equipment in a sewage treatment plant or cultivating mussels.
Non-point sources: Discharges that cannot be traced a geographical point, e.g. soil leaching from agriculture and storm water from urban areas.
PLC5: A pollution load compilation for water and sea for 2006 complied by HELCOM. The Swedish data for PLC5 with regard to nitrogen and phosphorus are presented in Swedish Environmental Protection Agency report number 5815, 2008.
Point sources: Pollution that can be traced to a specific point such as a sewer or drain pipe.

Policy instrument: Policy instruments are central government tools to bring about implementation of measures. These can be broadly divided into normative instruments such as laws and regulations, economic instruments such as taxes and fees and information.
Policy instrument analysis: Evaluation of a policy instrument on the basis of certain criteria, such as target fulfilment, cost-effectiveness and dynamic efficiency.
Polluter pays: Means that the polluter has to bear the cost of the reduction in discharges, restoration of the environment and the cost of compensating the individuals affected by the environmental effects.
Receiving water body: In this context, the water body that is the object of a particular nitrogen and/or phosphorus load.
Regulation: Prescribing a particular reduction, behaviour, treatment technology or activity.
Retention: Collective term for all processes that mean that only a certain proportion of the total quantity of phosphorus or nitrogen discharged from a particular source reaches the final receiving water body due to denitrification, uptake in biota or sedimentation.
Sub-basin: A basin of a tributary within a basin. A hierarchical classification can be made into smaller and smaller tributaries.
Subsidy: Financial payment, financed through tax revenues, made to a company or private individual to create incentives for a particular measure to be implemented or to favour the production/consumption of a particular article/service.
Target fulfilment: Attaining the target of the policy instrument.
Transaction costs: In this context, all costs associated with the introduction and maintenance of a policy instrument not directly attributable to the cost of reduced discharges.
Wetlands: Damp and wet areas in which hydrophilic (water-loving) vegetation dominates, such as shallow, mainly smaller, lakes and ponds.

1 Introduction

1.1 Background

The nitrogen and phosphorus load on the sea from Swedish sources has decreased, but recovery in the environment has not been achieved as quickly, and further reductions are required (Swedish Environmental Protection Agency 2008a). During a ministerial meeting in November 2007, an agreement, the Baltic Sea Action Plan (BSAP) was signed between the countries around the Baltic Sea to further reduce the nutrient load (nitrogen and phosphorus) from all the countries (HELCOM 2007). From the Swedish point of view, the agreement signifies a recommendation to reduce phosphorus inputs to the sea by 34 per cent (290 tonnes/year) and nitrogen inputs by 29 per cent (20 780 tonnes/year) by 2021. Far-reaching measures will be required in most of the sectors that cause nutrient discharges if this target is to be met. For each country to meet the undertaking and do so at the lowest possible cost within the country concerned, action programmes have to be drawn up by 2010 and measures have to implemented by 2016 at the latest.

Today there are a vast number of **policy instruments** aimed at bringing about **measures** that reduce the nutrient load; see Annex 2 in the Swedish report for a more detailed description of a selection of these. Several studies have, however, found that present-day national policy instruments have led to unnecessary costly measures (see for example Elofsson and Gren 2004; Swedish Environmental Protection Agency 2008c). In other words, the reduction in load achieved could be obtained at lower cost, or a greater reduction in load could have been accomplished at the same cost. This can be partly explained by most existing policy instruments being sector-specific or even measure-specific, which means that the prospects of moving in the direction of measures that are notable for low costs are poor. Most existing policy instruments do not take account of the ultimate effect of the measure on the receiving water body either, and are instead based on discharge reductions at the source.

Policy thus faces at least two challenges. Firstly, the level of ambition must be raised substantially if the new targets for the Baltic are to be attained. Secondly, the policy instruments must be designed so that the cheapest measures are implemented first. These conditions are met when new policy instruments are designed that attain existing or future reduction targets at lower cost than is possible with existing policy instruments. It can generally be stated that systems based on emission trading[2] have been successful in reducing air pollution at the

Policy instruments means central government tools to bring about implementation of measures. These can be broadly divided into normative instruments such as laws and regulations, economic instruments such as taxes and fees and information as a policy instrument.

Measure means a physical or behavioural change with the aim of reducing nitrogen and phosphorus inputs to a receiving water body. This may for example be growing catch crops, installing better treatment equipment o reducing the supply of fertilisers.

[2] A limited number of emission allowances establish the total permitted emission (cap) and are allocated to a large number of sources that are permitted to transfer these between by trading. An emission source included in the system must have emission allowances that cover its estimated emissions. Each source chooses between using its emission allowances, and additionally being able to buy more if total emissions exceed the holding of emission allowances, or reducing emissions and selling. If the price of the emission allowances is higher than the costs of treatment at a particular source, it is cost-effective for the source to incur the treatment costs and sell emission allowances. If the cost of treatment is higher than the price, it is instead economically sensible to buy emission allowances and continue as previously. Each source itself choosing whether to buy or sell emission allowances thus means that the emission reductions are attained at the lowest cost, i.e. the system produces a cost-effective solution. In a world without transaction costs, emission trading systems thus offer a cost-effective way of reducing emissions. See also Annex 1 for a theoretical description of emission trading,

lowest possible cost (see for example Burtraw et al. 2005). If only point sources are included in a trading system for water quality, it could be designed according to the same model as is used for air. Attempts to apply the same model to nutrient load on water have not, however, turned out as well when non-point sources, such as agriculture, have been included. This problem is largely explained by the high costs related to the active trading between point sources and non-point discharge sources, as well as the difficulty of measuring discharges from non-point sources. But it is necessary to include the non-point sources as these account for a large proportion of Swedish nutrient load to the Baltic Sea and the West Sea, and also because the potential for relatively cheap treatment measures is high.

In view of this situation, a cross sectorial permit fee system is proposed in this report which creates incentives to attain a desired reduction in nitrogen and phosphorus load on the Baltic Sea and the West Sea at minimum cost.

1.2 Government assignment and implementation

The present report presents the results of Government assignment 24 in the Swedish Environmental Protection Agency's appropriation directions (2007):

> The Swedish Environmental Protection Agency shall draw up proposals for models for permit fee systems that can contribute **cost-effectively** to reducing eutrophication in the Baltic Sea and the West Sea. The possibility of having a permit fee system include trading of discharge credits for phosphorus and nitrogen shall be analysed. The Swedish Environmental Protection Agency shall calculate the costs of implementation of the proposals and analyse effects on the national economy and public finances of the proposals and consequences for operators. The assignment shall be implemented following consultation with the county administrative boards which are competent authorities in the water districts of the West Sea, the Southern Baltic and the Northern Baltic. The results of the assignment shall be presented no later than 31 December 2008[3].

Cost-effectiveness means that the target is achieved at the lowest possible cost. The term is explained more fully in section 2.1 and in Annex 1

Following agreement with the Ministry for the Environment in September 2007, it was decided that calculation of the cost of implementing the measures would not be included in the assignment but would be dealt with in a possible pilot study. The reason for this is that the costs depend on political decisions not yet taken on reduction targets and what sectors are to be included. It was also decided that the assignment should focus on one model for a fee system (rather than several models of fee systems) that can be designed in various ways. It has also been difficult to find any alternative fee system that has great potential for cost-effectiveness at the same time as the targets are fulfilled.

The work has been carried out by a working group at the Swedish Environmental Protection Agency with important contributions from consultants and following consultation with the water authorities for the North and South Baltic and the West Sea. An internal preview group and three external preview

[3] In the original formulation, the results of the assignment were to be presented on 31 October 2008, but the project was given a two-month extension.

groups, one scientific and one for authorities and other stakeholders, has assisted the project with valuable comments. Eva-Lotte Bernekorn-Sandin, Jonna Carlsson, Linda Eriksson, Anders Jonsson, Lars Klintvall, Kersti Linderholm, Mats Lindgren, Håkan Staaf, Katrin Zimmer and Elisabeth Öhman have taken part in the Swedish Environmental Protection Agency's internal preview group. The scientific preview group has consisted of Katarina Elofsson (Swedish University of Agricultural Sciences), Lena Gipperth (University of Gothenburg), Holger Jonsson (Swedish University of Agricultural Sciences) and Håkan Rosenqvist (consultant). Finally Lennart Gladh (WWF), Emelie Hansson (Swedish Society for the Conservation of Nature), Rune Hallgren and Markus Hoffman (Swedish Federation of Farmers), Bo Norell (Swedish National Board of Agriculture), Lars-Gunnar Reinius (Stockholm Water), Bo Rutberg (Swedish Association of Local Authorities and Regions) and Jenny Stendahl (Swedish Forest Agency) have taken part in the external preview group.

Opinions have additionally been gathered at several international conferences where the proposal for a permit fee system has been presented. In September 2008 a workshop for the exchange of experience was held with Douglas Hall (Manager, Program Development, Miami Conservancy District), Mark S. Keiser (Senior Scientist, Keiser & Associates, LLC and Acting Chair Environmental Trading Network) and Markku Ollikainen (Professor of Environmental and Resource Economics, University of Helsinki). In conjunction with the workshop a seminar was also held during which Mark Keiser presented the American experience of various economic policy instruments focused on water quality issues, Douglas Hall presented a water quality trading system launched in Ohio, which in many respects bears similarities to the permit fee system presented in this report, and Markku Ollikainen presented a proposal for a framework for a nutrient quota and credits system for all the Baltic Sea countries which has been financed by the Nordic Environment Finance Corporation (NEFCO).

1.3 Aim and limitations

1.3.1 Aim

The aim of this report is to describe how a cost-effective policy instrument in the form of a permit fee system, with the option of trading, for nutrients is to be designed to reduce eutrophication in the Baltic Sea and the West Sea. The policy instrument is to:

- Focus on both non-point and point sources.
- As far as possible be cross-sectoral.
- Be differentiated at appropriate geographical scales.

The project is to identify what constraints must be resolved for the policy instrument to have the desired effect. The report as far as possible sheds light on the economic effects generated by the proposed policy instrument in comparison with present-day policy instruments.

1.3.2 Limitations

The formulation of the Government assignment sets clear frameworks for the project.

- The project is limited to devising cost-effective policy instruments in the form of a fee system that includes the option of trading. Policy instruments not considered to fulfil the requirement of cost-effectiveness and policy instruments that cannot be defined as fee systems with the option of trading have thus been excluded. Separate instruments such as regulations, statutory requirements, taxes or information campaigns are not proposed. On the other hand, several of these policy instruments will be needed to complement the proposed fee system, and they are therefore described solely from this point of view.
- The report focuses on the design of the policy instrument nationally. The proposed policy instrument may, however, be expanded to cover other countries, but it is beyond the scope of the remit to discuss the optimum distribution of measures between different countries around the Baltic Sea.
- The total costs of the proposed fee system depends on the reduction target and how the reductions are to be implemented. How this cost is to be shared between different participants depends on which sectors are made to bear the cost of attaining the target. The proposal does not take up a definite position to appropriate reduction targets or who is to bear the costs of the measures, as this is essentially based on distribution policy considerations. This means that the impact the policy instrument may ultimately have for certain sectors cannot be assessed within the framework of this report. However, the case studies in Annex 7 in the Swedish report illustrate some of these aspects.
- The intention is that it should be possible for the report to be used as a springboard for a pilot study where the proposal is implemented in trials in a suitable area. A pilot study of this type includes a preparatory part in the form of an in-depth legal investigation of the proposal and other remaining issues that need to be addressed. A pilot study is directly necessary as it has often been found that the outcome obtained in reality does not always correspond to the outcome generated by an empirical case study. A pilot study can indicate what further legal aspects must be dealt with and provide better information on the **transaction costs** of the policy instruments and actual costs of measures.

Transaction costs means all costs involved in establishing a policy instrument that are not directly attributable to the cost of measure. Transaction costs are discussed in section 4.2 and Annex 7.

1.4 Structure of the report

The first chapter of the report discusses the principles adopted in the report in drawing up a proposal in accordance with the appropriation direction of wishes the government. This chapter describes the criteria used to assess a policy instrument, but also how existing policy instruments relate to these criteria. A description is then given in Chapter 3 of the design of the proposed permit fee system. Chapter 4 discusses the impact of the proposal in the form of increased transaction costs and the gains made on the basis of improved cost-effectiveness. In addition, it is analysed how the fee system relates to other criteria and what long-term effects this can be imagined to entail. The conclusions from the government assignment are presented in Chapter 5. A description of further needs for investigation is finally given in Chapter 6. In-depth discussion of each chapter is contained in annexes: 1. Assessment of policy instruments, 2. Description of existing policy instruments, 3. International experiences, 4. Design of the permit fee system, 5. Difference between discharge trading and permit fee systems, 6. Transaction costs and 7. Case studies. These annexes are, however, ***not*** translated into English and therefore not included in this report. They can be found, only in Swedish though, in the Swedish report: *Förslag till avgiftssystem för kväve och fosfor* (Naturvårdsverket 2008 Report 5913).

2 Principles underlying the government assignment

2.1 Criteria for design of policy instruments

Three principal criteria are generally used when assessing the effectiveness of policy instruments[4]:

- Target fulfilment
- Cost-effectiveness
- Dynamic efficiency

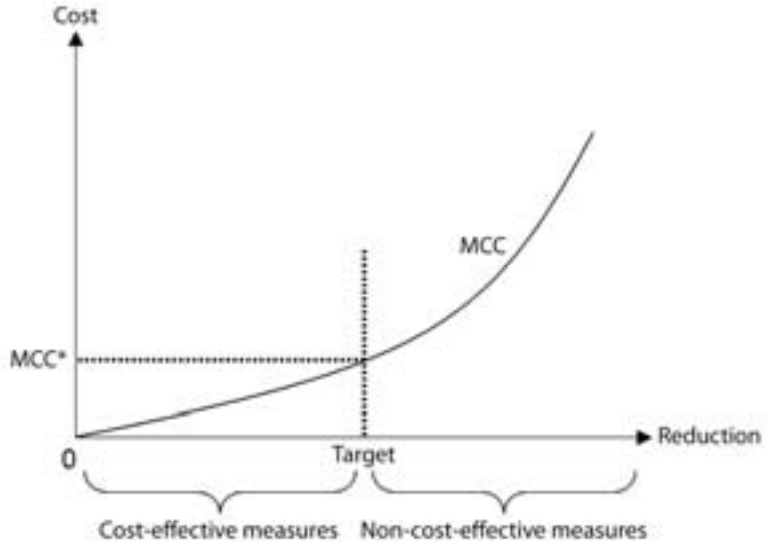
Other aspects to be considered include the handling of uncertainties in the policy instrument and its acceptance.

Target fulfilment quite simply means the potential of the policy instrument to attain the established objective, and this may differ sharply between different policy instruments. Normative policy instruments, in the form of different types of regulations, and emissions trading are generally considered to have greater potential for target fulfilment than other policy instruments (see Annex 1 in the Swedish report). In some cases, however, fulfilment of the objective by the policy instrument is explained by the degree of supervision rather than by the policy instrument in itself. Inadequate supervision can, for example, probably explain why regulations for individual wastewaters are only complied with up to about 60 per cent (Swedish Environmental Protection Agency 2004).

The *cost-effectiveness* of a policy instrument is defined as the target being fulfilled at the lowest possible economic cost (or the greatest possible reduction being achieved at a given cost) and depends on the ability of the policy instrument to create incentives for the implementation of the cheapest measures. Figure 2.1 illustrates whether an action is cost-effective or not.

[4] See Annex 1 for a more detailed discussion of these criteria and how different policy instruments relate to them.

Figure 2.1 Cost-effective measures



The vertical axis shows the cost, while the horizontal axis represents the total load reduction. The marginal cost curve (MCC) shows the cost to reduce the load by one more unit. This cost increases as it is initially possible to implement very cheap measures to bring about a reduction in load, while increasingly expensive measures have to be taken when the volume of reduction increases. It is necessary to establish a target to make it possible at all to decide whether a measure is cost-effective or not. Such a target is illustrated in Figure 2.1 by the dotted vertical line. On the basis of the marginal cost curve and the target it is possible to see that the measures to the left of the target are cost-effective, while those to the right are not. The total economic cost of a particular reduction is given by the area under the marginal cost curve. It is clear that to attain the target at minimum cost all measures whose marginal cost is less than MCC* must be implemented while those that exceed it are not implemented. Economic instruments are generally considered to have greatest potential with regard to cost-effectiveness (see example in Box 2.1 and detailed description in Annex 1 in the Swedish report).

Box 2.1 Cost-effectiveness of economic policy instruments

Tietenberg (2006) summarises the results of 14 different studies that show that the cost of attaining a particular target is 40 to 95 per cent lower with taxes/fees and transferable emission allowances than in the use of technological requirements or requirements for uniform reductions. The greater the differences in cost that prevail between different sources, the higher the cost gains to be obtained from economic instruments. The reason is that economic instruments give a price signal that means that each sources opts for the cheapest alternative in choosing between fee/tax and taking its own measures.

The assessment of the effectiveness of a policy instrument should also cover the incentives the policy instrument provides for the development of new and cheaper

measures over time, known as *dynamic efficiency*. Economic instruments generally mean high dynamic efficiency as they generally lead to there being financial incentives at all times to bring down discharges. This in turn leads to efforts to develop new water treatment technologies producing a higher yield than is the case with other types of policy instruments. As a result, the marginal cost of achieving the target can be reduced over time as cheaper measures are developed.

How the policy instrument relates to these three criteria indicates how well a policy instrument works, but the criteria can also be used as guidance in the choice or design of instruments. It is not possible to say what criterion is most important in general, as this depends on the specific environmental problem as well as the type of measures the policy instrument is aimed at. In general it is, however, possible to say that policy instruments that have high target fulfilment and are cost-effective are attractive from the economic point of view, but whether target fulfilment or cost-effectiveness should be prioritised depends on the environmental problem concerned. There may also be further aspects to be taken into account in the choice between policy instruments, some of which are described below.

Who ultimately bears the costs of fulfilling the objective has a great impact on the political prospects of gaining *acceptance* for a policy instrument. It is usually considered desirable from an economic point of view for those who pollute to pay for measures to be taken. It can be difficult to implement this politically, however, depending on which sectors cause the problems. Too heavy a financial burden on sectors that compete on an international world market can lead to the relocation of production to countries where these sectors are not subject to similar requirements despite creating the same environmental problems. This suggests the use of policy instruments that are less financially burdensome for the polluting sector.

It is also important to take account of how policy instruments can deal with different types of uncertainty and information problems in the choice of policy instruments (see Annex 1 in the Swedish report and Box 2.2). *Uncertainties* exist in a number of areas in the field of eutrophication and can be divided into three categories:

- Scientific (biological, chemical, physical) uncertainty for example on actual (as opposed to estimated) retention, the correlation between activity and load and between load and effect on eutrophication.
- Economic uncertainty on actual costs of measures and the benefit of a reduced nutrient load.
- Technological uncertainty on the treatment capacity of the various measures.

Box 2.2 Research on policy instruments under uncertainty

In order to deal with economic uncertainty, that is to say differences in information between an authority and the source-operator, policy instruments with self-selection are highlighted in research. Self-selection means that the source-operator can choose whether to implement its own measures on the basis of current levels of subsidies, fees, taxes or the price of a discharge credit. The point of such 'contract-based' systems is that they with certainty achieve a certain reduction in discharges to the receiving water body cost-effectively, as the contact differentiates treatment requirements and fees/subsidies between source-operator depending on their treatment effects (see Gren 2004; Bontemps et al. 2005). To deal with scientific uncertainty, a system is proposed based on attained water quality in the receiving water body where a fee is paid if the quality exceeds the limit value (which is measured at a maximum acceptable level) and subsidy is paid when the limit value is not reached (Segerson 2008; Horan et al. 1998. 2002). Incentives are thus obtained for the source-operators to increase knowledge of transport of pollutants in order to attain the lowest limit value possible. The choice between the two types of instruments that deal with either differences in information between authorities and source-operators or create incentives for gathering knowledge depend firstly on which type of uncertainty it is regarded as most essential to reduce and secondly on how many source-operators are affected. Policy instruments aimed at reducing the uncertainty in correlation between discharge and effect on receiving water body work well in the regulating of relatively few source-operators. Instruments that focus on reducing costs of differences in information between authorities and source-operators have an advantage when a relatively large number of source-operators are involved.

Chapter 4 of the report describes the potential the proposed permit fee system has to fulfil the criteria described above and how it relates to the other aspects described above.

2.2 Deficiencies in existing policy instruments

A substantial proportion of the nutrient inputs to Swedish seas come from non-point sources such as agriculture, forestry and private sewerage systems. It is therefore required, in addition to measures at point sources such as sewage treatment plants and industrial plants, that measures are implemented at non-point sources in order to attain the ambitious reduction targets. The difficulty with non-point sources is in measuring emissions at the source and establishing their effect on the receiving water body at reasonable cost. This has resulted for instance in the use of nitrogen fertiliser being taxed and not the nitrogen leaching itself. In addition, the non-point sources vary over time depending on weather conditions. Taken together, this means that a great deal of information is required to select the cheapest measures at non-point sources, information which in addition is often characterised by a high degree of uncertainty.

Box 2.3 Deficiencies in existing policy instruments

There are clear differences today in marginal costs between measures. For example, the marginal costs of nitrogen removal to the receiving water body differs between different sewage treatment plants. Existing policy instruments in the form of uniform regulations for nutrient emissions do not, however, provide sufficient incentives to take measures where they produce the greatest effect, as no comparisons of marginal costs are made today. There is thus potential to reduce nutrient emissions at lower cost than at present.

Marginal costs of measures also differ substantially between different sectors, which makes it desirable to have policy instruments that lead to the most cost-effective measures being implemented. The majority of existing policy instruments for reduced nutrient emissions are, however, at present generally aimed at a specific sector, which makes it difficult to share the resources between different sectors and in so doing be able to finance cheaper measures in another sector. There is, for example, no direct possibility today for sewage treatment plants instead of investing in expensive technologies to fund cheaper measures in agriculture. Policy instruments that are cross sectorial can provide better opportunities to redistribute the resources between the sectors and achieve cost-effectiveness.

In addition, the incentives for technical development are low as existing policy instruments are dominated by regulations and requirements. Current statutory requirements for private sewerage systems, for example, are not complied with to any great extent, due in part to inadequate supervision but also to the policy instrument not providing any economic incentives for individual property owners to implement measures. This suggests that the focus on non-point sources can be improved. It is, however, difficult to determine the effect on the receiving water body from non-point sources such as agriculture, forestry and private sewerage systems. Existing policy instruments are therefore focused on factors that can be observed instead, such as the nitrogen tax in Sweden. For a fuller description of existing policy instruments, see Annex 2 in the Swedish report.

Research and investigations have shown that the measures implemented against eutrophication from Swedish sources are not always the cheapest possible measures (Gren 1993; Gren and Zylicz 1993; Gren et al. 1997; Brady 2003; Elofsson 2003). In a study of the Stockholm archipelago it is found that a policy that takes account of the location of the measures can halve the costs of reducing nutrient inputs to the Stockholm archipelago in comparison with a policy that disregards where the measures are located (Scharin 2005). Another study shows that the total reduction in nitrogen load on the cost of around 12 per cent since 1995 has cost of around SEK 800 million. If the cheapest measures had been prioritised instead, the same result would have cost just under SEK 400 million. SEK 800 million alternatively could have provided a reduction in load of around 30 per cent on the coast and around 20 per cent in the Baltic Proper (Elofsson and Gren 2004).

The additional costs to which existing policy instruments give rise can be explained in particular by:

- most existing policy instruments not taking account of the fact that the environmental effects on the receiving water body of a particular discharge quantity varies depending on where the discharge takes place, and
- these instruments to a large extent are sector-specific, and comparisons are rarely made between costs of measures in different sectors.

There is thus great potential for cost gains through a different combination of measures than at present. For example, the policy instruments aimed at cost-effective (cheap) measures are changed to create stronger incentives, so that these measures are actually implemented.

2.3 Link to the Water Framework Directive

The principal purpose of this report is to develop a policy instrument proposal to reduce nitrogen and phosphorus load to the Baltic Sea and the West Sea, but there is a clear link to the EU's Water Framework Directive (2000/60/EC). The Directive strengthens the options for protecting water quality. Although the Directive only affects surface water and groundwater and coastal zones, measures in these water bodies will probably also signify improvements in the marine environment.[5] It is, however, unlikely that the measures implemented in the Water Framework Directive will be sufficient to attain the reductions in nitrogen and phosphorus load from Sweden recommended in the BSAP.

The Water Framework Directive emphasises the need to use price policy, safeguarding of the polluter-pays principle and the endeavours to achieve the targets cost-effectively. The report takes accounts of these aspects and can therefore also be regarded as a contribution to work under the Framework Directive.

[5] Under the EU's Marine Directive, the countries are building up institutions and structures for their implementation. This Directive will in future signify further pressure to bring about changes in the Baltic Sea and open up the possibility of more cooperation between different EU Member States.

3 Proposal for a permit fee system with option of trading

3.1 Introduction

This chapter presents the proposal for a permit fee system with the option of trading **load credits**. The purpose of the permit fee system is for future reduction targets for nitrogen and phosphorus in the receiving water body to be attained at the lowest possible cost, regardless of who actually pays for the measures that have to be implemented. A more detailed description of the proposal can be found in Annex 4 in the Swedish report.

Load credit means the right to load a receiving water body, in this case the Baltic Sea and the West Sea, with a particular quantity of nutrients during a particular period of time.

The proposal is based on Collentine (2005) and can be regarded as a combination of fee and emissions trading (see Annex 1 in the Swedish report for a description of such policy instruments and Annex 5 in the Swedish report for the difference between emissions trading and the fee system). A fee system with the following characteristics is created by combining these two policy instruments:

- The presence of a regulatory authority that firstly ensures that funds of fees are allocated effectively and secondly matches buyers (payers) with sellers (implementers of measures financed by the fee). The principal benefit of including such an authority is that the transaction costs are lower than with ordinary discharge trading for water quality where non-point source discharges are included, as buyers and those who carry out compensatory measures do not need to seek each other out. In addition, economic and scientific uncertainties and any ancillary effects of different measures are handled more easily. The authority additionally bears the risk of the actual outcome of measures not corresponding to their calculated effect.
- Creation of markets that have a special function and that provide the participants with price signals. This keeps the transaction costs down, supplies information on the costs of measures and provides increased cost-effectiveness and incentives for technological development.
- The system indirectly provides an emissions cap which consists of the sum of individual caps set at each regulated source. The advantage of the system is that the potential for target fulfilment, as in a trading system, is good, and that implementation can take place in stages through a lower emissions cap being set or the system covering more sources.
- The fee enables sources to choose between implementing their **own measures** or exceeding specified caps and paying a **fee** that funds **compensatory measures** with an equivalent effect at other sources. The advantage is in greater flexibility for

Own measures means measures implemented by the regulated sources to bring discharges below the cap.
Compensatory measures means the measures implemented somewhere else which correspond to the decrease that would have been attained if regulated sources had chosen not to exceed the cap.
.

Charge means a charge per kg of load to the receiving water body.

regulated sources and thus also increased potential for cost-effective solutions.

- The permit fee system in various ways can take account of upstream water bodies for which measures are required under the water administration. This can be done either via the auction procedure, through limitations in geographical scope or through restrictions on where compensatory measures are to be implemented.
- Depending on design, the system may require some government financial support in the initial stage but will then be neutral from the point of view of public finances. This reduces the need for tax revenues and means that distortions in other markets can be avoided. A fee may be less burdensome for certain sectors than a tax as revenue is returned to fund compensatory measures.

3.2 Structure of the permit fee system

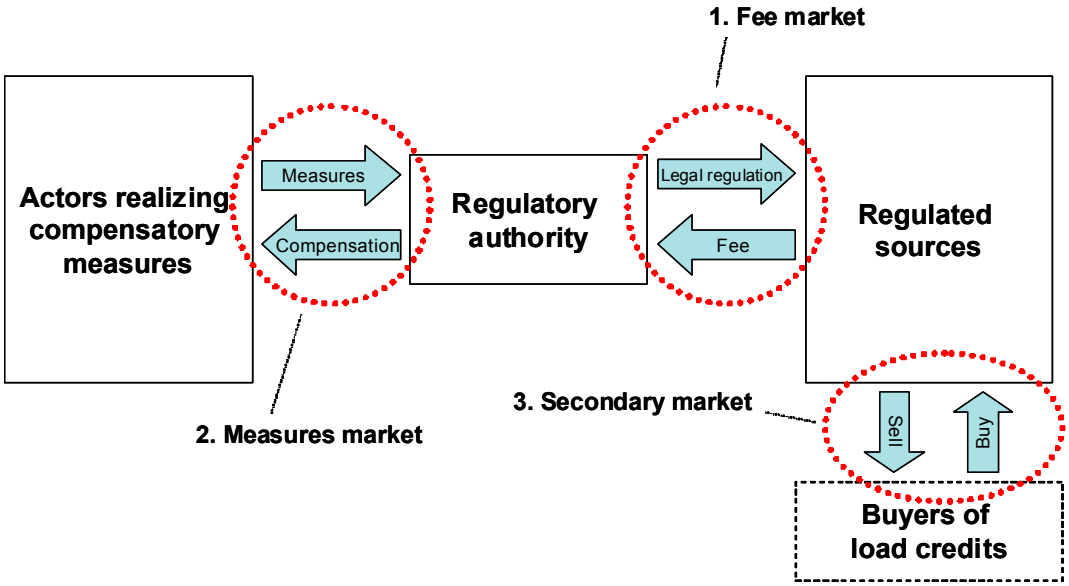
The permit fee system consists of three linked markets, see Figure 3.1. By dividing the system into different markets, each market can be designed to fulfil a specific function.

In a first stage of the *fee market*, emission sources are regulated through binding statutory requirements. The statutory requirements means that the regulated sources with a fee are allowed to emit a certain quantity of nutrients, established through an emissions cap. For any emissions that exceed the cap, the source can choose between either implementing its own measures to reduce the emissions or paying a fee that provides a right to load the receiving water body with a certain quantity over a particular period of time, known as a load credit. The actors in the fee market are a regulating authority and regulated emissions sources which can finance compensatory measures via the authority.

On the *measures market* the regulating authority signs contracts with those who carry out compensatory measures, i.e. measures that compensate for the portion of the discharges on the fee market that exceeds the individual caps. These measures are implemented by participants in return for a reimbursement which is subsequently funded by the fees on the fee market. The payments made on the measures market thus dictate the level of fee in the fee market.

When the first two markets have been established, a *secondary market* can additionally be set up for trading in load credits. Load credits can be bought and sold on this market between participants instead of the transactions taking place through the auspices of the authority. The aim of this market is to improve the cost-effectiveness and the flexibility.

Figure 3.1 Overview of permit fee system with option of trading



The regulating authority is a key participant in the system and can be equated to a broker: it maintains contact with fee payers in the fee market and ensures that paid fees fund compensatory measures. In this way the transaction costs that have been an obstacle when traditional emissions trading has been applied to reduce the nutrient load from point sources as well as non-point sources are reduced (see Box 3.1 and Annex 3 in the Swedish report) for a more detailed description of international experience).

Box 3.1 Transaction costs in Miami River Credit Trading Program (Ohio, USA)

One of the greatest obstacles that have hampered trading systems for water quality in the United States in which both point sources and non-point sources have been included has been the high transaction costs that arise when buyer and seller have to "find one another". In the water quality trading system on the Great Miami River in the state of Ohio (see Box 3.3) a function has therefore been introduced with a third party who acts as broker between buyer and seller. The transaction costs are consequently expected to decrease over time, and the cost-effectiveness of the system is expected to increase. See Annex 3 in the Swedish report for a more detailed description of previous experience from discharge trading in the United States.

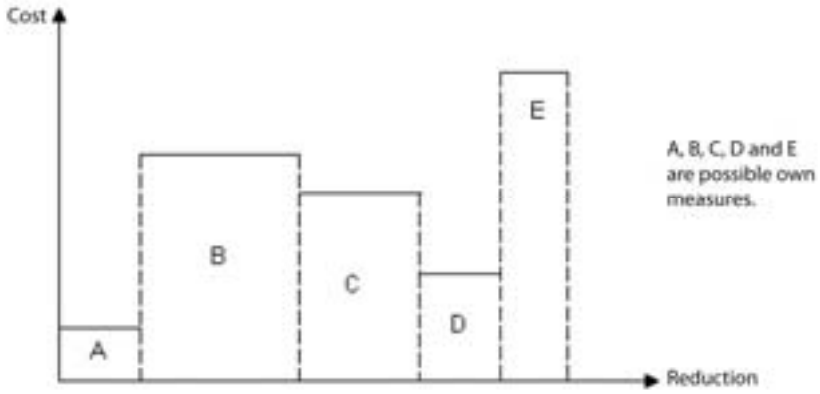
3.3 Function of the permit fee system

The ability of the permit fee system to strengthen the incentives to implement the cheapest measures is illustrated below. Different sources are allocated discharge caps. Depending on their investment opportunities and the actual load on the receiving water body, the cost per kilogram of reduction in load will probably vary between these sources.

Five different regulated sources that have different costs to reduce the load on the receiving water body in accordance with their individual caps can be seen

below. The requirements of the emissions cap for reduction are illustrated by the width of the relevant bar. Source A has the lowest cost and E the highest. Without the permit fee system these sources are responsible for complying with their discharge caps by taking their own measures.

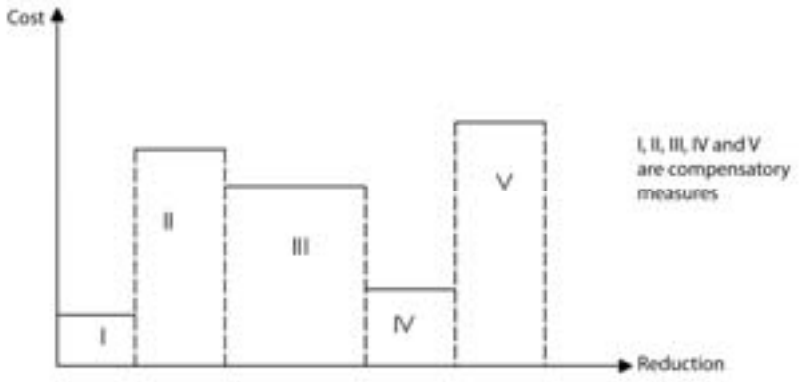
Figure 3.2 Fee market: Reduction requirements and costs of measures for different sources



The vertical axis in Figure 3.2 shows the cost and the horizontal axis shows the reduction in load. In calculating the cost of reducing the load on the receiving water body through a treatment measure at the source, account is taken of the retention between source and receiving water body. The cost of reducing the load to the Baltic Sea or the West Sea may therefore differ between different sources, although the cost is the same at the source, due to differences in retention. The total cost of the reduction in load is the sum of areas A, B, C, D and E.

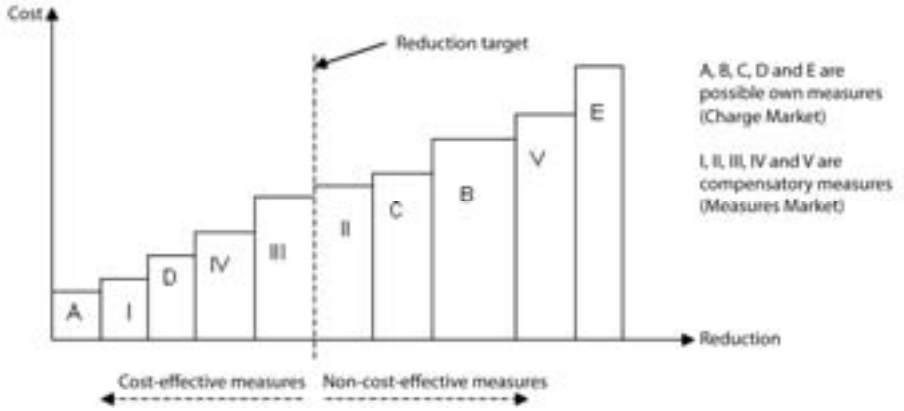
Reimbursements are paid to participants in the measures market to implement compensatory measures. The cost and effect of these measures (I-V) are illustrated in Figure 3.3 below. Note that these measures are not the same as those shown in Figure 3.2 (A-E).

Figure 3.3 The measures market: Costs of compensatory measures



By linking together the two markets in a permit fee system where incentives are given to implement the cheapest measures at all times, available measures in the two markets can be ranked from the cheapest to the mot expensive. In Figure 3.4 all the measures from Figures 3.2 and 3.3 are illustrated together and ranked from right to left based on cost of measure. Using the ranking, measures that are cost-effective or not for a given reduction target are identified. By making it possible for sources with non-cost-effective measures to finance cost-effective compensatory measures through the permit fee system, the costs of achieving different targets for load reduction can be minimised. The compensatory measures I, III and IV could thus be implemented against reimbursement via the measures market, and the sources that represent measures B, C and E would probably choose to pay a fee that fund these reimbursements.

Figure 3.4 Ranking of measures in the permit fee system based on cost of fee per kilogram of reduced load on the receiving water body



In comparison with Figure 3.2, where the total cost of the reduction in load is the sum of areas A, B, C, D and E, it is noted that in a permit fee system measures B, C and E would be replaced by cost-effective measures with an equivalent load reduction. The cost saving is made up of the difference between area B+C+E, that is to say the total cost of own measures, and area I+III+IV, that is to the say the cost of the compensatory measures. The cost of meeting a particular target for load reduction is thus minimised, regardless of who actually pays for the measures. This gain in effectiveness is confirmed in the case studies carried out under the government assignment, see Box 3.2 and Annex 7 in the Swedish report for a fuller description.

Box 3.2 Estimated effectiveness gains in the case studies

Four case studies have been carried out under the government assignment, in which the cost of nitrogen reduction through various policy instrument alternatives has been studied in three basins, those of the Helgeån, Gullmarn and Norrström rivers and in the three separate case-study areas taken together. The results show clearly that if a cross-sectoral permit fee system, which means that the cost-effective measures are implemented first, is used instead of uniform reduction requirements, in which each source in percentage terms reduces an equally large portion of the load, large effectiveness gains can be made. See the case studies in Annex 7 in the Swedish report for a fuller description.

When the permit fee system has been established, a secondary market for load credits can be introduced to further strengthen the incentive always to take the cheapest measures. A regulated discharge source that has paid the fee acquires a credit to load the sea with a particular amount of nutrients over a particular period and can sell this credit on during its period of validity. The source chooses to sell the credit on the secondary market only if the price on the market exceeds the cost of reducing the portion of the load that exceeds the cap through its own measures. In the longer term, when the market has matured, the regulatory authority renews the load credits by signing new measures contracts, but the fee in this later stage is principally determined by the price at which the load credits are traded on the secondary market and to a lesser extent by the cost of compensatory measures.

Box 3.3 Cost-effectiveness gains in the Miami River Credit Trading Program (Ohio, USA)

Several trading systems for water quality have been introduced in the United States, some having proved more successful than others. One of the latest trading systems to be introduced, and one of the largest, is that at the Great Miami River in the state of Ohio, where nutrient reductions are achieved through point sources (principally municipal wastewater treatment plants) in the basin having financed measures upstream in agriculture. This trading system started as a pilot program in 2006, but is now undergoing staged expansion, as very promising results have been obtained to date and clear acceptance and demand is being experienced from wastewater treatment plants, industrial plants and agricultural businesses to take part in the system. Some of the reasons for this acceptance appear to be very good communication between the authority and other actors, as well as the focus on predictable rules for buyers and sellers. To take an example, the value of a buyer's discharge credit is the same throughout the period for which the credit applies. Another strong driver is more stringent requirements anticipated for reduced discharges of nitrogen and phosphorus in the area. As a point source it is also advantageous to enter the system early as better trading conditions are given to earlier buyers, creating incentives to enter the market.

To date (October 2008) four auction rounds have been held and a fifth is in progress. The 50 or so projects in agriculture that have been granted funding to date have contributed to a reduction in nutrient load of 294 tonnes having been achieved at a cost of £923 069, which means a cost per kilogram of $3.14 (both nitrogen and phosphorus are counted). See Annex 3 in the Swedish report for a fuller description of experiences of discharge trading for water quality in the United States.

3.4 Establishment of the permit fee system markets

Special conditions must be created so that each market in the permit fee system will work. These conditions are discussed in brief below.

3.4.1 The fee market

3.4.1.1 DECISION ON DISCHARGE CAPS FOR SOURCES

The underlying principle is that the total load is to decrease so that the commitment according to a particular reduction target can be fulfilled. The reduction in load arises through the discharge caps for individual sources being lower than existing discharges. The authority sets the discharge caps so that the overall objective for load reduction is met, i.e. the target is met if no source exceeds its discharge cap. The system is founded on modelled discharges as a basis for decisions on discharge caps. The discharge caps are established for different types of sources and represent what responsible authorities judge to be reasonable for a particular type of source, for example private sewerage systems, agriculture or wastewater treatment plants. For this to signify an actual reduction, these discharge caps must entail measures that go beyond the reduction to which existing minimum requirements, established by directives and legislation. If the cost of compensatory measures is low in comparison with implementing one's own measures, the possibility of setting stricter discharge caps is also opened up, as these are not as financially burdensome as they would have been if the fee alternative had not existed.

How the costs are shared to attain the overall objective of the load reduction is determined by how and at what sources the discharge caps are set, i.e. the greater the reduction requirements the discharge cap signifies for a particular source, the larger a proportion of the total cost falls on the source. This report does not comment on the question of which sources and other actors are to be regulated or be entitled to seek reimbursement on the measures market as it is a distribution policy decision which therefore should not be taken by the Swedish Environmental Protection Agency.

There are, however, some aspects that should be taken into account when decisions on discharge caps are taken as they can influence the cost and effect of the policy instrument proposal:

- Firstly the cost of supervision varies between different sources and measures. It is generally cheaper to carry out supervision on point sources than on non-point sources as point sources generally have a large quantity of discharges per source and it is easier to check whether these sources exceed the discharge caps. As supervision is necessary at all regulated sources on the fee market but limited to contracted compensatory measures on the measures market, this suggests that the discharge caps should to a great extent be put on point sources while measures contracts are drawn up with non-point

sources. The need for supervision and enforcement can, however, be reduced by introducing financially stricter sanctions for breaches of contract.

- International competition aspects may also be of significance in assessing how the costs of the proposal are to be shared between different sectors. If excessive costs of measures are imposed on a single sector, for example agriculture or the forest industry, this may mean worsened competitive conditions, which in turn may mean reduced production, and thus load, from Swedish sources. This may appear positive at first glance, but it may unfortunately mean increased production/load from the same sectors in the other countries around the Baltic Sea (in the absence of equally strict requirements), which ultimate may mean that the reduction in load to the Baltic Sea fails to occur despite measures being implemented in Sweden. However, there is an insufficient basis at present to be able establish with certainty to what extent this is a possible effect. This aspect too suggests that discharge caps to a greater extent should be designed so that most of the costs are borne by sources that are not characterised by this competitive situation in relation to other countries around the Baltic Sea. It is not, however, possible on the basis of this argument to conclude that discharge caps for example should not be set for agriculture, as there may be many possible measures that have a marginal impact on the competitive advantages of agriculture if they are relatively cheap for the farmer to implement. As agriculture additionally accounts for such a significant proportion of the nutrient load to the sea, it is unlikely that discharge caps on point sources alone will be sufficient for ambitious reduction targets, such as the recommendations in BSAP, to be achievable (see Box 3.4).
- Thirdly, the type of measure or who carries it out is taken into account in the design of discharge caps. It may be politically difficult to require, for example, that mussel farms have to be established in certain coastal areas because these are not a source of nutrients but on the contrary contribute to a reduction in the concentration of nutrients. If it is desirable to encourage the construction of wetlands in areas of land not owned by farmers or other sources, this may be difficult to achieve with discharge caps. The implementation of such measures should be stimulated through opportunities for reimbursement on the measures market.

Box 3.4 The need for non-point sources to be covered by discharge caps

In the case studies that have been carried out, it is found that in the basins of the Helgeån and Gullmarn discharge caps have to be set for non-point sources if load reductions above 10 per cent are to be achievable. It should be pointed out, however, that only three sectors are included in the case studies (sewage treatment plants, agriculture and private sewerage systems). The range of measures is limited and certain assumptions and generalisations have been made with regard to the effect and potential of measures. Statutory requirements for point sources (sewage treatment plants) are easily sufficient in the basin of the Norrström river, and a 40 per cent reduction in nitrogen load is possible. The reason why this is so is that the majority of discharges come from sewage treatment plants in this area, which cannot, however, be regarded as representative of Sweden. When the three drainage basins are included in a joint permit fee system, statutory requirements for point sources only are sufficient for the total load to be reduced by 30 per cent. This cannot be regarded as representative of Sweden, as the reduction in the drainage basin of the Norrström is of great significance. For more detailed data see the case studies in Annex 7 in the Swedish report.

3.4.1.2 ESTABLISHMENT OF THE FEE

A discharge source must know the fee to be able to decide whether it is most advantageous to pay this or implement its own measures to meet the discharge cap. The market for measures contracts provides the authority with information on what different volumes of load reduction cost. The authority uses the information to determine the fee. Low retention means that the effect of the source on the receiving water body is great, calculated per unit of discharge, which in turn means that the fee per kilogram of discharge at the source is higher than if the effect on the receiving water body had been small. In this way the fee dictates which sources carry out treatment (those with low cost for a load reduction in relation to the fee) and which instead pay a fee (those with high cost for load reduction in relation to the fee). A cost-effective fee must therefore take account of the calculated load, which may differ between the discharge sources. Differentiated fees provide incentives to restructure sectors in the long term in such a way that certain activities, for example in agriculture, with high nutrient leaching are relocated to areas where they have less impact on the Baltic Sea and such high fees do not need to be paid, see Box 3.5.

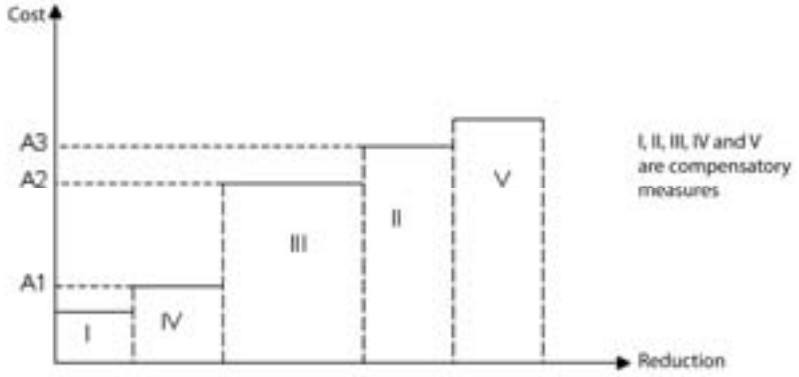
Box 3.5 The permit fee system creates incentives for re-allocation

In the last of the case studies the Helgeån, Gullmarn and Norrström drainage basis are merged and form part of a joint permit fee system to study how expansion of the geographical scale affects cost-effectiveness and sharing of reduction. It is found that a permit fee system with load fees leads to measures in agriculture primarily been implemented in areas where nitrogen leaching has a great impact on the receiving water body, which means coastal areas or adjacent areas. A measure in agriculture may be to choose activities with lower nitrogen leaching. See the case studies in Annex 7 in the Swedish report.

The vertical axis in Figure 3.5 shows the cost and the horizontal axis shows the total load reduction of measures I-V (the same measures as in Figure 3.3), with these ranked from cheapest to most expensive measure. The fee is based on how large a volume of compensatory measures the authority wishes to sign contracts with on the measures market. If the authority to begin with wishes to achieve a load reduction equivalent to measures I and IV, the fee on the fee market will be A1. If the authority in a next round wishes to achieve a further reduction equivalent to

measure III, this signifies a higher fee, A2. To further reduce the load, the compensatory measure II is implemented and the fee rises again to A3. A fee rising over time provides strong incentives for the cheapest measures to be implemented first.

Figure 3.5 Determination of the fee based on compensatory measure costs



3.4.2 The measures market

3.4.2.1 SELECTION OF MEASURES CONTRACTS

The reimbursements for compensatory measures can be paid as either **uniform** or **differentiated reimbursements**. For it to be possible to differentiate the reimbursement geographically, the regulatory authority must have information on the impact of the measure, which depends on local circumstances. With this information the cost-effectiveness can be increased through the application of differentiated contracts for compensatory measures.

Uniform reimbursement means that the reimbursement is the same for a measures regardless of who implements it, how much it costs and what effect it has on the receiving water body, while a **differentiated reimbursement** takes account of these aspects.

In the case of uniform reimbursement there may be implementers of measures that receive higher reimbursement than they actually require. In addition there are others who think that the reimbursement is too low and choose not to take part despite the fact that they may represent cost-effective measures. Under uniform payment the combination of measures that produces the lowest total cost of measures to meet a reduction target is therefore not implemented.

In the case of individual contracts some are able to content themselves with lower reimbursement, and these may then have higher costs for measures, for example farmers with more productive agricultural land are given higher reimbursement (provided they can compete with other measures in terms of the cost per unit of reduced load). One method of establishing the reimbursement for individual measures contracts is to use **reverse auctioning**. The purpose of a reverse auction is to make applications for compensatory measures compete with one another. The advantage in using reverse auction is that a larger load reduction can be achieved at a given cost. The auction may be designed so that the bidder who has the lowest cost of implementation also makes the lowest reimbursement claim, which results in a combination of measures that produces the lowest possible costs for a given reduction target. A reverse auction is primarily a way of permitting variations in costs of measures to emerge. In such a case a reverse auction additionally transfers economic gains from the land-owner to the authority,

In **reverse auctioning** actors make applications for reimbursement for measures. Reimbursement is paid for those measures that reduce the load at the lowest cost.
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which in turn releases funds for further load reduction. This is a common procedure in public procurement (public purchasing). This method has also started to be used on an increasing scale with regard to purchases of environmental services (Ferraro 2008). Auction methods have been used in the United States to set aside productive agricultural land in the Conservation Reserve Program (CRP) and in a pilot trial for measures to improve water quality (Conestoga Catchment Program). In Australia reverse auctions have been used to protect biodiversity (Bush Tender), to reduce nutrient losses and to reduce salt in groundwater (Ferraro 2008). Auctions produce lower transaction costs for example in comparison with negotiation (Bulow and Klemeper 1996).

Box 3.6 Reverse auction procedure in the trading system at the Miami River

A reverse auction procedure is used in the trading system for water quality in Ohio to determine which project proposals from farmers are most cost-effective and are thus eligible for reimbursement. When the Miami Conservancy District (MDC) have requested project proposals from farmers, individual farmers are assisted by local interest groups (soil and water conservation districts) to calculate reduced discharges the project proposals would generate and the cost per reduced unit. Project proposals which are judged to be cost-effective but do not receive funding in the current auction round are guaranteed funding in the next round. A surplus of credits is also created by there being a fund for discharge credits that can be used as security in case there is a risk of the measures in agriculture not leading to the calculated amount of reduction.

In choosing which measures are to be eligible for reimbursement, account can also be taken of synergy effects, the link between different measures, uncertainties and problems upstream. If there is a water body upstream that is affected by eutrophication and therefore requires measures under the water administration, it is simple to prioritise compensatory measures in the auction procedure that also have an effect on this water body and not just on the Baltic Sea or the West Sea. It can also be required that a certain proportion of the compensatory measures implemented take place upstream of the sources that fund these measures via the measures market. In choosing measures, account can also be taken of expected supervision and enforcement costs differing between different compensatory measures. It is important, however, that the authority is clear with which factors are being considered in the assessment so that those who apply have sufficient information to assess their chances of receiving reimbursement. If any differences in transaction costs are disregarded, the auction procedure is additionally the most cost-effective method of reimbursement. The present report therefore advocates this procedure to bring about compensatory measures.

3.4.2.2 FORMULATION OF MEASURES CONTRACTS

The duties the parties to the contact have are specified in each measures contract. The authority's contract is financial, and it has to be specified how large the reimbursement is, how often it is to be paid and how long the contract applies. For whoever is to carry out the measure, the contract specifies what services are to be implemented (conditions). These conditions must be specific to each type of

measure and may also contain how supervision is to take place and what happens if the conditions are not met. In addition, the contract must describe how it can be terminated. On the other hand, the contract need not specify expected effects on the receiving water body. Whoever carries out the measures is responsible for them being implemented in the agreed manner, while responsibility for the actual effects of the measures rests on the authority as this performs the model calculations (see Annex 4 in the Swedish report for a description of model calculations).

3.4.3 Secondary market for load credit trading

On the secondary market, the load credit acquired through a fee to the regulating authority can be sold on. As in the purchase of load credits direct from the authority, a purchase from another participant entitles the buyer to load the sea with a certain quantity of nutrients in a certain period of time. What is transferred is the right to load the receiving water body during the remaining period of validity. A regulated source that has paid a fee equivalent to a load on the Baltic Sea of 5 tonnes nitrogen/year for 5 years can be given as an example. The fee is equivalent to the cost on the measures market of reducing the nitrogen load to the Baltic Sea by 5 tonnes per year for 5 years. If the source discontinues its activity after two years, the right can be sold on for the remaining period of validity.

Buyers on this market are mainly regulated sources that need to pay a fee for their load. There are, however, potential buyers on the secondary market with purposes other than direct use of the load credit. These buyers can also be divided into two groups: those who wish permitted discharges to decrease, such as environmental organisations, and those that wish to sell the load credit in order to speculate.

The regulated sources thus have three alternatives to meet their discharge caps, paying a fee to the authority, taking their own measures or buying a load credit on the secondary market. The environmental effect is the same, however, regardless of the choice made. A source that wishes to sell on the secondary market must either implement measures so that it does not exceed its cap or stop the activity causing the load. If the price on the secondary market rises, so that it exceeds the cost for a particular source of taking its own measures, this source can invest in measures and sell the load credit on during the period of validity.

As the buyer can always choose to pay a fee to the authority, the price on the secondary market must be lower than this. Both these prices represent the marginal cost of reducing discharges. On the fee market it is the authority's cost for a reduction through measures contracts and on the secondary market it is the cost of measures for those who have already paid the fee. A regulated source therefore chooses the cheapest of these three alternatives. A higher degree of cost-effectiveness is obtained on the secondary market due to the reductions being made at the cheapest sources, regardless of whether these reductions are made by regulated sources or through compensatory measures.

3.4.4 Supervision

As for all policy instruments, the permit fee system requires supervision to be carried out in order to check compliance. Supervision must be carried out on the

fee market to check that the sources do not exceed their discharge caps or buy load credits via the fee or secondary markets. For measures contracts a check is required on compliance with the terms of the contract. These monitoring roles are most simply fulfilled by authorities that are already working on similar tasks. Costs of supervision may also be included in the fee because this is the only source of revenue in the permit fee system and has to cover all costs. Alternatively a "membership fee" can be imposed on those sources that wish to have the option of paying a fee instead of carrying out their own measures. But other alternatives for the funding of supervision are also possible.

3.5 Geographical scale of the permit fee system

There are several questions to take into account with regard to the scale of permit fee system: what scale is to apply to fees, measures contracts, trading on the secondary market and regulation? The answer is that the scale need not be the same and can vary between the different markets.

A fundamental rule is that the larger the geographical area, the greater the potential for efficiency gains. This applies on condition that a larger area offers more possible measures and therefore greater opportunities to utilise the cost differences between these measures. In this way a basin offers a greater amount of potential compensatory measures than a sub-basin. This improves the possibility of finding cost-effective measures, see Box 3.7. Factors that affect the size of the effectiveness gain include geographical location of discharge sources, the variation in retention coefficients (which has an impact on the cost of reduction at the receiving water body), access to compensatory measures and reduction targets (with low reduction targets the effectiveness gains are small). The advantage of smaller geographical areas is that there is a greater probability of affected water bodies upstream of the receiving water body also being improved.

Box 3.7 The significance of geographical scale for effectiveness gains

The results of the case studies indicate that there are greater effectiveness gains to be made when a differentiated fee system is used in larger geographical areas. As individual areas, the basins of the Gullmarn and Helgeån were too small and homogeneous for the variation that existed among the retention coefficients to have an impact and for a differentiated fee system to generate any efficiency gains in comparison with a uniform system. On the other hand, in the basin of the Norrström, which is a larger area with wide variations retention coefficients, the results show that a differentiated fee system signifies efficiency gains in comparison with a uniform fee system. When the three case-study areas are combined into a joint permit fee system, cost savings of up to 40 per cent can be made to achieve certain reduction levels, compared with reaching the same reduction by using separate fee systems in the basin concerned. See the case studies in Annex 7 in the Swedish report.

A permit fee system can be implemented both through a reduction target common to all the basins, where the Baltic Sea and the West Sea are counted as one receiving water body, or through reduction targets that vary between the basins, where the Baltic Sea and the West Sea are divided into different receiving water bodies. A difficulty in implementing the permit fee system with a common

reduction target and thus a common market for compensatory measures is that the policy instrument is aimed at several marine basins that have differing conditions and needs with regard to reduction in nutrient load. A compensatory measure with a bearing on the West Sea cannot be permitted to offset discharges that exceed a discharge cap for the Baltic Sea. A common basin can thus be thought of as a condition for implementation of the system with a common target, alternatively a target is set for each marine basin (in accordance with the division in BSAP). A further alternative is to divide the permit fee system into three of the five water districts that have been established for implementation of the EU's Water Framework Directive: Northern Baltic, Southern Baltic and the West Sea.

A fee system with the sea as receiving water body affects the cost-effective allocation of measures in the drainage basin of the receiving water body, but there may also be reduction targets for upstream receiving bodies. Under the EU's Water Framework Directive all water bodies have to attain established quality standards, and measures implemented, as part of a fee system must therefore in turn agree with these standards. There are two different ways of dealing with the problem. If there are water bodies that do not fulfil the quality standards, the system can be designed so that all compensatory measures must be implemented in the same basin where the fee is paid. In such a case the permit fee system makes it possible for the standards to be met. On the other hand, when a water body fulfils the standards, a compensatory measure can be implemented in a different basin than the one where the fee is paid. The water authorities have ultimate responsibility for assessing whether the standards are met and could therefore also be the authority that decides whether there is justification for introducing instructions into the permit fee system in order to control the measures so that the quality standards upstream are also met. Where the measures are implemented therefore need not be based solely on cost-effectiveness for the Baltic Sea or the West Sea but may also be limited by the scope that exists in affected water bodies. It should be emphasised, however, that most measures implemented with the aim of reducing the load to our seas will be land-based and will thus affect other water bodies upstream of the sea.

3.6 Dynamics of the permit fee system

In a fully developed market the load reduction will reach an equilibrium when the amount of reduction (made up of the sum of all reductions generated by the system on both the measures market and the fee market) amounts to the total reduction target for the system. The calculated cost per kilogram reduction for the last measure becomes the long-term fee for a load credit on the fee market. In the long term the costs of measures on all three markets will therefore gradually converge as cost-effectiveness gains decrease.

The size of the fee is based on what it costs to reduce the same emission through a compensatory measure. However, the cost increases as new compensatory measures are implemented (see for example Figures 2.1 and 3.5). This means that the fee is expected to rise over time. The proposal is based on the system being implemented in stages, which means that some sources will act earlier than others on the fee market. It may be considered unfair that some sectors

will have discharge caps imposed on them earlier than others, but being first in the permit fee system also results in the lowest fees, which signifies that there is an advantage in being involved from the outset. It is, however, proposed that the load credit to which the fee gives entitlement will be limited in time and this advantage therefore only applies until its permit expires and a new fee has to be paid.

If the reduction costs fall for regulated sources, this leads to an increased volume of load credits offered on the secondary market and lower demand for compensatory measures, that is to say regulated sources prefer to buy on the secondary market rather than paying the fee. The use of cheaper treatment technology signifies an advantage for those sources that already hold load credits, because they can sell those of their load credits that are no longer needed. For those sources that face the choice between implementing their own measures or buying load credits, it is also advantageous as the cost decreases in both cases.

Finally the system does not just offer flexible solutions for discharge sources with regard to choice of reduction measures but also gives authorities flexibility in establishing reduction targets. The discharge system can be modified over time depending on how other policy instruments work and what new information on measures and effects of sources on eutrophication emerge.

3.7 Funding of the permit fee system

In the long term the system is expected to be self-financing. Fees that are collected are used to fund compensatory measures that reduce the load to the same extent as the discharge caps signify. The fee funds must be sufficient to buy the same quantitative decrease in load through compensatory measures as would have been achieved if the regulated sources had chosen to reduce discharges below the caps by taking their own measures. There are three different methods, which are described in Annex 4 in the Swedish report, of linking the fee to the reimbursement for compensatory measures. The purpose of the permit fee system is to reduce the nitrogen and phosphorus load to the seas. The load target can theoretically be achieved without a single participant paying a fee, but some transaction costs would still remain. When a discharge cap has been established, the source on which this cap has been imposed has a choice between taking measures itself so that the discharges fall below the cap or pay a fee. In addition it must be checked that the discharge caps are not actually exceeded. That is to say, the authority has transaction costs in the form of costs to provide information on fee payment and costs to monitor discharge sources included in the system regardless of whether these pay a fee or not. How these costs are to be shared if a question that must be answered before the system is launched. If the transaction costs are covered by fee revenues this does not just mean that a source that has paid a fee has also paid the costs of supervision of other sources but also that the fee is higher. This leads to more choosing to bring their discharges down below the cap through their own measures, which in turn may mean reduced cost-effectiveness. To avoid the whole system being funded solely by fee revenue, an alternative may be for all sources that are regulated paying a particular fee. As not all discharge sources are included from the outset, this would mean an extra fee levied only on those sources on which a discharge cap is initially imposed in order to reduce their discharges. It is

thus possible to fund general administrative costs by all discharge sources paying a specific fee or the administrative tasks being included in the tax-funded assignment of the authorities.

4 Consequences of the proposal

4.1 Introduction

This section discusses the consequences of the proposed policy instrument. In the absence of a specific target it is not possible to quantify costs and benefits of the measures generated by a permit fee system. It should be emphasised that the impact assessment applies specifically to the policy instrument, and not the benefits and costs of reducing eutrophication of the Baltic Sea or the West Sea. For information on such costs and benefits, see Swedish Environmental Protection Agency 2008a, 2008c and 2008d. The potential efficiency gains entailed by the policy instrument and any additional costs in the form of transaction costs are described instead. These gains and additional costs are described in comparison with the reference scenario, that is to say existing policy instruments in the area. The permit fee system is also analysed on the basis of the criteria described in Chapter 2.

4.2 Transaction costs

Transaction costs relate to all costs associated with introducing and maintaining a policy instrument not directly attributed to the cost of reduced discharges (McCann et al. 1999). These costs can be divided into four main types: informative, administrative, legal and supervisory costs. These costs are generally shared by the legal system, authorities and related stakeholders..

It is the difference between the transaction costs of the present-day policy instruments and the permit fee system that is of interest as the present-day system also entails transaction costs. Regardless of policy instrument, the transaction costs depend on how far-reaching the requirements for load reduction are and how these are then shared between different sources. These are political decisions on which the present report does not comment. Only a broad comparison is therefore made here of the difference in level of transaction costs in the two different systems, i.e. the present-day system and the proposed system, to illustrate how the transaction costs in the proposal and cost-effectiveness gains relate to each other. The proposal is compared with three types of existing policy instrument in the present-day system – rules, grants and taxes.

Table 4.1 summarises the differences in transaction costs between the present-day and proposed systems, see Annex 6 in the Swedish report for a fuller description. The difference lies mainly in the introductory phase of a permit fee system, which does not exist under existing policy instruments. Initiation costs, for everything from information to new administration, exist for the proposed permit fee system just as they do for all other new systems. The costs of supervision and legal aspects in the proposed permit fee system ought to be roughly the same as for the existing system, although the differentiation of fee with respect to source may mean that supervision becomes more time-consuming.

With the right formulation, it ought to be possible to keep the transaction costs of the permit fee system down to a moderate level. It is crucial for this purpose that the system is not based on excessively extensive differentiation of the fee between different participants, that the procedure for the determination of levels of the fee is

accepted by stakeholders and that the system of sanctions is designed so that the need for supervision is not too burdensome. Although all these design requirements can be met, the transaction costs of the permit fee system are likely to be higher than the transaction costs of the prevailing system. Some of the present-day transaction costs may in the best case fall slightly with the permit fee system, but are unlikely to do so sufficiently to offset the extra costs of the permit fee system. The auction procedure may replace many of the present-day reimbursement systems in the area, and in the longer term the auction procedure may additionally provide knowledge that brings down the information costs. If a secondary market for paid fees is introduced which gives entitlement to a particular quantity of discharge over a period of time, there are additional costs for this: information costs, administrative costs and supervisory costs to ensure that contracts entered into are adhered to, and in cases in which disagreement and improper action arise, legal costs. The gains from the secondary market consist in the option that arises for sources that can purchase a load credit, because this is more economically beneficial than paying the fee. For sellers of the load credit to which the fee gives entitlement it is instead the possibility of some form of cheaper measure that has opened up, which makes it economically beneficial to implement that measure and consequently be able to sell a load credit they no longer need.

For the comparison between the present-day and proposed systems to be fair, however, it is emphasised that if further reductions in nutrient load have to take place under the present-day system the administrative and supervisory costs within this system will also increase.

Table 4.1 Transaction costs that be expected to differ between the present-day system and the new proposal of fee system

Type of transaction costs	Policy instruments used at present	New proposal of fee system
Information costs	Smaller portion today	Higher initially
Administrative costs	High cost today	Depends on design
Supervisory costs	Quite high costs today	Depends on design
Legal costs	Difficult to determine today	Difficult to decide

4.3 Target fulfilment

The possibility of the proposed permit fee system fulfilling its objective is the same as for regulation, that is to say 100 per cent provided the sectors concerned fulfil statutory requirements. This depends on a discharge cap being set at a level corresponding to the desired load. The cap is consequently the force driving the whole permit fee system. Supervision of compliance is, however, a decisive factor to guarantee that the desired load reduction is achieved, and if it does not work the possibility of good target fulfilment is reduced irrespective of policy instrument. There is, however, some uncertainty with regard to target fulfilment which is due to the built-in uncertainty in certain measures. If, for example, a sewage treatment plant instead of reducing discharges to below the cap pays a fee, which in turn funds a number of compensatory measures for instance in the form of wetlands, there is greater uncertainty with regard to the ability of the wetlands to reduce the load of nitrogen, for example, than if the sewage treatment plant itself had

implemented this decrease. This uncertainty can be dealt with to some extent by designing the policy instrument so that the estimated decrease in load from the compensatory measures surpasses the exceeding of the discharge cap caused by the sewage treatment plant.

As well as attaining the targets set for the Baltic Sea, there may additionally be upstream water bodies for which a reduction in nutrient load is required in implementation of the water administration. The permit fee system can also be designed in order to achieve these targets. If the geographical area is relatively small in which sources subject to discharge caps fund compensatory measures, the problem of eutrophication will probably be solved in most upstream water bodies. How great the likelihood of this actually happening is depends, however, on the load target the geographical distribution of sectors included in the system. If, on the other hand, the geographical area is large and there is also a wish to solve upstream problems, it can set as a requirement that a certain proportion of the compensatory measures take place upstream of the source that pays the fee. It is also possible in the auction procedure to favour the compensatory measures that have an effect on upstream water bodies affected by eutrophication. All these measures affect the cost-effectiveness of achieving the reduction in load to the Baltic Sea and the West Sea, but can nevertheless improve the cost-effectiveness of achieving targets in more receiving water bodies.

Box 4.1 Dealing with hot spots in the trading system at the Great Miami River

There is no problem with hot spots in the trading system for water quality in Ohio, which can be partly explained by the reduction targets being set for the water bodies and not the sea. In certain cases there are requirements for compensatory measures in agriculture to take place upstream of the sewage treatment plant that pays the fee. If sufficient measures are not proposed in the general auction round to attain desired decreases in the receiving water body, there are also options to hold "sub-auctions", i.e. smaller auctions aimed at measures in certain prioritised basins.

4.4 Cost-effectiveness

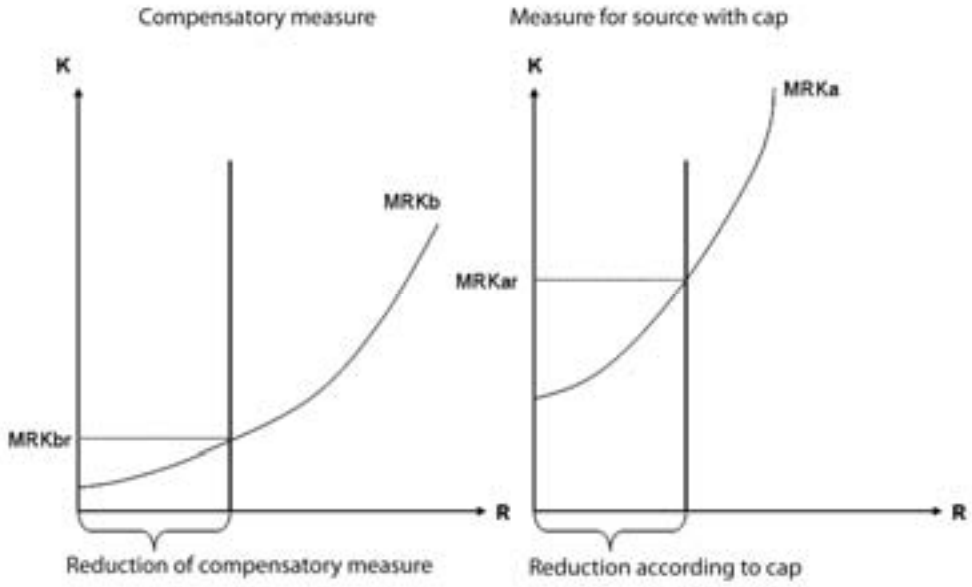
In comparison with existing policy instruments, a permit fee system provides the possibility of reducing the nitrogen and phosphorus load to the sea at substantially lower costs of measures, see Box 4.2.

Box 4.2 Example of cost-effectiveness gains with a permit fee system

Gren and Scharin (2006) compare cost calculations in Swedish studies of different systems aimed at reducing eutrophication in seas. The studies point to efficiency losses of uniform systems compared with different permit fee systems. Uniform permit fee systems signify a cost increase of between 10 and 55 per cent and uniform treatment requirements entail additional costs of between 5 and 230 per cent compared with a cost-effective solution. But the results also show that the effectiveness losses of uniform systems decrease when the treatment reaches a certain level and more treatment measures are put into effect.

The potential for increased cost-effectiveness in the proposed permit fee system is explained by the two markets opening up the possibility of making use of differences in costs between different measures. On the fee market sources will prefer to pay a fee instead of taking their own measures as long as cheaper compensatory measures exist. On the measures market the authority will be able to enter into contracts with those participants who can implement measures that offer a load reduction at the lowest cost. This is illustrated in Figure 4.1 below, in which the marginal cost of achieving a certain reduction in load is described for a company with a possible compensatory measure (MCCb) as well as for a company that is subject to a particular discharge requirement (MCCa). As previously, the vertical axis illustrates the cost (C) and the horizontal axis reduction in load (R) to the receiving water body. The figure shows a case where the marginal cost to the company of not exceeding the discharge cap is higher than the marginal cost of achieving a corresponding reduction through the compensatory measure (MCCar>MCCbr). The company on the fee market will prefer the fee rather than implementing its own measures provided the fee is lower than its own marginal cost (MCCar). The company with a potential measure will implement it provided the reimbursement exceeds the marginal cost (MCCbr). As there is a difference in marginal cost in this case between these measures, the permit fee system creates incentives so that the most cost-effective measure is implemented, and financial funds will be transferred from the fee market to fund compensatory measures on the measures market.

Figure 4.1 Illustration of cost-effectiveness gains in the permit fee system



When the level of ambition in reduction targets for the Baltic Sea and the West Sea is raised, for example through BSAP, the economic costs will probably be substantially higher if this reduction has to be achieved through existing policy instruments as they do not provide incentives for cost-effective solutions. The scope for obtaining effectiveness gains from the policy instrument proposal depends to a large extent on the geographical scale at which compensatory measures are permitted. Is the fee to fund compensatory measures within a main basin, basin or merely in the same sub-basin, or is it sufficient that it is done within Sweden. The smaller the area, the less scope there is for efficiency gains as the cost differences between different measures become smaller the smaller the area is. There may, however, be justification for making certain geographical demarcations so that the measures that will be required under the EU's Water Framework Directive can be handled.

4.5 Dynamic efficiency

The constantly present price signals on all three markets in the permit fee system provide a strong basis for the development of new cost-effective measures (dynamic efficiency) as there are economic incentives at all times to develop better and cheaper proposals for measures. These incentives are strengthened over time as the fee is equivalent to the cost of the most recently implemented measure on the measures market, which increases over time, and applies for a limited time. New and better technology will be spread rapidly as there are economic incentives the whole time for regulated sources to implement these and sell the load credit on the secondary market, or avoid paying a fee. The same force drives participants who can implement compensatory measures and obtain reimbursement for these. New technology leads to rising profits for whoever has developed it and therefore

encourages the development of cheap reduction technology. This dynamic effect is possible for society because the economic cost to society of achieving the environmental objective decreases. The potential for dynamic efficiency is thus high for the permit fee system in comparison with other policy instruments.

4.6 Handling of uncertainties

The system takes account of economic uncertainty by giving discharge sources the flexibility to weigh their own cost assessment of alternative measures into the decision, which means that the authorities do not need to commit resources to estimating costs of measures either for compensatory measures or measures at regulated sources. Information to the authority on actual marginal costs is obtained on the measures market through reverse auctioning and on the fee market through the decisions that regulated sources make with regard to paying a fee or reducing discharges below the cap. The system handles the uncertainty regarding effects of measures by transferring responsibility from the implementer of measures to the regulating authority. The effect of scientific uncertainty decreases through models based on scientific data being used both for the selection of measures and for decisions on fees. The authority is responsible for the model and handles the scientific uncertainty equally for all actors in the permit fee system. At the same time there are limitations in using such models. The model used to calculate the effect of measures/sources on the load can be upgraded over time as new information on these effects is obtained. The scientific uncertainty can thus decrease over time.

4.7 Distributional effects

The policy instrument is well suited through the design of discharge caps to taking account of distributional effects if this were to be desirable on the basis of a distribution-policy aspect. If it considered, for example, that a particular source should be protected from bearing the cost of measures, it can be given the possibility of reimbursement for its measures through the auctioning procedure. This reimbursement must, however, be funded through a lower discharge cap for another source. In that way distributional effects can be regarded at the same time as offering high potential for cost-effectiveness to be achieved, which is difficult by regulation. It is therefore possible to establish discharge caps for sources whose measures are not cost-effective as these may choose to pay a fee that funds cost-effective compensatory measures at other sources. The authorities therefore do not need to think about whether to demand cost-effective measures or not and only have to ensure that the sum of these meets the targets, cost-effectiveness being achieved through the flexibility in the permit fee system. The proposed system can thus deal with distribution-policy aspects without compromising on cost-effectiveness, which is an improvement in comparison with the majority of present-day policy instruments for which cost-effectiveness has sometimes had to cede to distributional effects and vice-versa.

Which sources are made subject to discharge caps and the level of these also determines whether the polluter-pays principle is fulfilled. The principle barely

applies if sources obtain reimbursement to reduce the load they cause. Although the sources fund the load reduction themselves, through a fee or their own measures, the principle only prevails if the load the sources cause does not generate any environmental effects, which ultimately depends on the load target set. If environmental effects remain, it is required that the sources also pay a fee for remaining discharges so that the principle prevails (see Annex 1 in the Swedish report for a fuller description of the principle).

4.8 Summary

Table 4.2 summarises the consequences of the proposal in comparison with the present-day system. The proposed permit fee system is expected to entail an increase in transaction costs relative to existing policy instruments, but the proposal otherwise entails improvements for all criteria. The principal advantages of the permit fee system in comparison with present-day policy instruments are in the possibility of attaining the target at minimum cost (cost-effectiveness) and the ability to create economic incentives for the development of cheaper measures in the area (dynamic efficiency).

Table 4.2 Comparison between present-day system and proposed permit fee system

Criteria	Present-day system	Proposed permit fee system
Transaction costs	--	---
Cost-effectiveness	+	+++
Degree of target fulfilment	++	+++
Dynamic efficiency	+	+++
Possibility of dealing with uncertainties	++	+++
Possibility of handling distributional effects	++	+++

Note: *Positive* criteria: (+) Low; (++) Medium; (+++) High. *Negative* criteria: (-) Low; (--) Medium; (---) High.

5 Conclusions

The proposed permit fee system has advantages compared with other policy instruments that aim to reduce nitrogen and phosphorus load to the sea.

The fee system creates economic incentives to find the cost-effective alternatives of measures to achieve a given reduction in load, which in turn means that the fees are low. The fee system gives regulated sources economic flexibility in that they are given the option of either paying a fee or taking their own measures to bring discharges below the cap. As described in Chapter 4, the fee system has high potential with regard to:

- target fulfilment,
- cost-effectiveness,
- dynamic efficiency.

Economic and scientific uncertainty can be handled to a greater degree than with existing policy instruments. The fee system also makes it possible to take account of distributional effects without needing to compromise on cost-effectiveness. The fee system can also take account of expected and unexpected distributional effects as implementation is done in stages. In comparison with traditional discharge trading for water quality in which diffuse sources are included, the principal advantage of this fee system is that it lowers the high transaction costs that arise when sellers and buyers have to find one another.

The proposal in this report is described at national level, but it may be of interest to think about possible effects and ways of implementing it jointly for all the countries around the Baltic Sea, for example under BSAP. Although the policy instrument is only implemented in Sweden, it would be possible for the auction procedure to be opened up for measures within other countries around the Baltic Sea. For this to be justified from the Swedish point of view, it is required that effects of measures funded by Swedish actors in other countries are allowed to be included in Sweden's undertaking, for which there is no scope in the present-day agreement. Such a possibility would mean increased cost-effectiveness to attain the total reduction targets for the Baltic Sea and the West Sea. In addition it could put pressure on other countries to take measures to achieve reduction targets as Sweden's funding, through the auctioning procedure in other countries, would mean that we can credit ourselves with the effect of cost-effective measures which this country would miss out on in such a case. Competition thus arises on cost-effective measures that favour those countries which open up to the possibility of funding measures in other countries at as early a stage as possible. It may, however, become even more important in such a case to introduce restrictions so that reduction targets for water bodies upstream are also dealt with.

6 Further needs for investigation

6.1 Background and aim

An overall proposal for a permit fee system has been presented in earlier chapters. It has not been possible in ongoing work to deal with all the aspects surrounding the proposal at such a level of detail that the proposal is ready to be launched. There are further needs for investigation in a number of areas. The Swedish Environmental Protection Agency therefore proposes a continuation of this Government assignment in the form of, firstly, an in-depth analysis (Phase 1) and secondly practical application/testing in a pilot area (Phase 2). The aim is to draw up a proposal that is so detailed that it can be used in the political process.

6.2 Proposal for implementation

6.2.1 Phase 1 – Start of 2009 to mid-2010

The issues that remain to be investigated in the in-depth analysis can be addressed in parallel but in several sub-studies as follows:

1) **Economic analysis,** shows among other things total costs and distribution of costs between sectors depending on size and distribution of discharge cap
2) **Legal analysis**, investigates among other things how the proposal fits in with existing legislation and what adjustments may be needed
3) **Environmental analysis**, examines among other things how measures are to be defined and how the effect of these measures is to be established
4) **Data needs**, describes among other things what data is needed for different sectors and what geographical scale is required for this data
5) **General analysis**, deals with issues concerned with all the areas mentioned above

The results of this work are used as a first stage in making a detailed formulation of the policy instrument proposal. The proposal is then tested on a hypothetical market in 6) an **economic experiment**. Experience from this test is fed as a second stage into the formulation of the proposal which is then ready to be implemented on a limited scale in a test area.

A general and non-exhaustive description is given below of the issues that should be addressed in each sub-study in the in-depth analysis.

6.2.1.1 ECONOMIC ANALYSIS

The economic sub-study should address the following issues:

- An economic analysis is performed with the aim of calculating potential effectiveness gains from the system (for an example of such an analysis see Keiser & Associates 2004). The case-studies in

Annex 7 in the Swedish report represent simplified economic analyses which, with greater and more precise material, can be developed into a complete analysis.

- The analysis shows how different sectors would be affected depending on how the discharge cap is distributed and how ambitious the reduction target is.
    - Simulations of measures should be made here for different sectors and with different reduction requirements, either on the basis of guidelines from Swedish Government Offices or more freely to investigate different alternatives.
    - Compared with case studies performed, further sectors (e.g. forest industry and forestry), measures and measures-related data of various kinds should be included.
    - The design of the system with an auction procedure means that it is sufficient for the authority to have limited access to data on measures. But there is a need for close collaboration with those involved in the pilot study to make it possible to see what reduction potential there is and what costs this would entail in total and broken down into different sectors.
- An assessment of how large the market may become with respect to number of actors and load credits.
- The analysis should show how the fee levels should be formulated: differentiated or uniform.
- An in-depth analysis should seek to improve the assessment of the size of the transaction costs, although this is not easy to do.

6.2.1.2 LEGAL ANALYSIS

The following questions should be answered in the legal analysis:

- How the policy instrument fits into the Environmental Code, and what possible changes are required in the proposal or the Code, as well as how the proposal may interact with existing, specific legislation on water, nitrogen and phosphorus, for example the Water Administration Act, the Water Ordinance, the Water Services Act, the Water and Wastewater Act, tax on commercial fertilisers and the LBU (rural development) programme.
    - Can the decisions on the individual discharge caps be incorporated into the permit process?
    - Opportunities for the individual actor to appeal decisions on permitted discharges?
- How sectors that have already implemented ambitious reductions are dealt with – the aspect of fairness.

- What principles are to apply in the distribution of the individual discharge caps – the principle of reasonableness?
- How account can be taken of different natural conditions in different geographical areas.
- What options does an authority have to set requirements for various activities, what is required for example for the environmental quality standards to be sued to specify discharge caps for individual activities?
- What is required to make flexibility possible in how statutory requirements are met, i.e. through a fee or own measures?
- A clear definition of the meaning of the concept of measures that clarifies which measures may lead to financial compensation.
- An analysis of how the auctioning procedure can be formulated in Swedish legislation.
- A proposal for formulation of contract between regulating authority and those who carry out compensatory measures.

6.2.1.3 ENVIRONMENTAL ANALYSIS

The issues that should be addressed in the environmental analysis include the following:

- What method and model are to be used to calculate and certify the effects of measures, both ex-ante and ex-post.
- What principles are to apply in distribution of the discharge cap with respect to natural conditions, present-day activities (discharges and any countermeasures) and type of sectors (conditions differ markedly, for example, for agriculture and the activities of sewage treatment plants).
- A discussion on the concept of measures from a scientific perspective that clarifies what measures can be reimbursed on the measures market. An example that illustrates the importance of this is that discharges from agriculture depend on pure countermeasures as well as what crops are grown (also a legal question).
- An analysis of the principle that is to apply to the selection of measures so that account can be taken of local conditions (also a legal question).
- An analysis of possibilities for environmental monitoring and supervision for different types of sources.

6.2.1.4 DATA NEEDS

The case studies are largely based on data produced by Svenska Miljöemissionsdata (SMED) for Sweden's reporting to HELCOM of the pollution load on the Baltic Sea (Swedish Environmental Protection Agency 2008b), known as PLC5 data.[6] For it to be possible for these to be used as a basis for a live permit

[6] Pollution Load Compilation, reporting round 5

fee system, there is a need for certain aspects to be studied more closely, in particular the geographical division, soil type data, run-off and retention data and need for further primary data (SLU 2008), see Annex 7 in the Swedish report for a fuller description.

6.2.1.5 GENERAL QUESTIONS

In addition there are a number of general questions that must be answered:

- Principles of distribution of the discharge cap, what aspects should be taken into consideration?
- Proposal for which participants are to be responsible for implementation of the system, including regulating authority, certification of effects of measures.
- How the targets are to be formulated, in absolute or relative terms.
- At what geographical scale the system is to be implemented with respect to target formulation, trading, administration etc.
- What period of time is to apply to measures contracts. Cereals and oil prices differ sharply, for example which means that there may be a fear among those who carry out compensatory measures of being locked into long contracts.
- How phosphorus and nitrogen are to be dealt with in the same system.

6.2.1.6 ECONOMIC EXPERIMENT

When preliminary replies have been drawn up for the questions above, it is advocated that an economic experiment is conducted in which the functions of the permit fee system are developed and a main proposal for formulation is specified more precisely. If there is a given area, a given reduction target, a decision on what sectors are to be subject to a discharge cap and which can apply for reimbursement for compensatory measures, such an experiment can be conducted. The experiment consists in affected participants taking part in simulated actions of a permit fee system. Some will act on the fee market while others act on the auction market. Based on given circumstances with regard to their own fees, they have decide whether they wish to fulfil the discharge caps through their own measures or pay a particular fee. On the measures market the participants have to choose whether they wish to submit a proposal for a compensatory measure on the measures market. A design that works poorly in an experiment market will probably not work either in an actual market situation. The fact that a design works well in an experimental situation does not, however, guarantee that it will work in a real situation. An experimental evaluation of different designs can nevertheless provide a rough sifting and ranking as a basis for the next stage of the pilot study. The experiment should be carried out by experts in the area and with experience of such economic experiments.

6.2.2 Phase 2 – 2010 to 2012

In Phase 2 the further depth is given to the proposal for design of the system by implementation in a defined area. Before the actual introduction it is important that the policy instrument is endorsed by those participants who can in some way imagine to be affected by the instrument. The system should be as transparent as possible for the actors, which can be facilitated by various means such as information campaigns, websites and training. It is important to evaluate the permit fee system at regular intervals with regard to what has worked and what has not worked. The fee system must be allowed to work for a number of years before it can be judged with certainty whether it has produced the desired results.

6.3 Organisation and resources

We propose that the Swedish Environmental Protection Agency be responsible for the in-depth study, i.e. Phase 1. A scientific preview group and preview groups consisting of affected authorities and representatives of the market participants who may be included in the permit fee system should also be attached to the work.

We estimate that a total of 4-5 person-years will be required during Phase 1, of which around half is provided by the Swedish Environmental Protection Agency and the remainder by experts from outside the Agency. The financial need for the latter is estimated to total around SEK 2 million.

6.4 Timetable and checkpoints

Final reporting of Phase 1 will take place in mid-2010, when Phase 2 will begin. The latter phase should, however, be formulated in a new Government assignment from Swedish Government Offices to the appropriate organisation proposed in Phase 1.

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Proposal for a Permit Fee System for Nitrogen and Phosphorus

REPORT 5968

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This report presents a proposal for a permit fee system to make it cheaper for society to reduce nitrogen and phosphorus discharges to the Baltic and the West Sea. The proposal entails setting a cap for discharges for example from agriculture, sewage treatment plants and industrial plants. Anyone wishing to discharge more than the cap has to pay a fee which funds an equivalent reduction in discharges elsewhere. It can also be possible to sell and buy discharge credits.

Eutrophication continues to be one of the most serious environmental problems in our seas. There are already many policy instruments in Sweden aimed at reducing nitrogen and phosphorus discharges to the seas, but research results show that they have led to unnecessarily expensive measures.

Society thus faces at least two challenges. Firstly the level of aspiration has to be raised substantially so that the new objectives for the Baltic and other sea areas can be attained. Secondly the policy instruments must be designed so that the cheapest measures are implemented first. This proposal for a permit fee system addresses both these challenges.

The report is the English translation of a Swedish Government assignment reported in December 2008. The project was carried out by the Swedish Environmental Protection Agency.

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