Water Emissions Trading in Europe – a literature overview and discussion of opportunities

By Michiel H.A. Wind

Eco-consult Environmental Economics
www.eco-consult.nl

Version 11-5-2012

Contents

Foreword

Water quality trading or water emissions trading provide an important instrument for improving the state of inland waters and sea water. For Europe, the trading of nutrient loads is especially important. Research suggests that trading is extremely well suited to healing the most polluted sea in the world, the Baltic Sea. This observation applies to the North Sea as well, suggesting that this instrument could play a significant role in improving the state of the big European rivers such as the Rhine and the Danube. When Europe takes a serious initiative to improve the quality of water in these cross-national rivers, trading programs in nutrients designed to river basins provide a feasible solution to use.

Trading in nutrients has two good properties: the outcome of trading is cost-efficient, and we know for certain that trading implements the wanted reduction in nutrient loads. For point sources, trading in nutrient works in a similar fashion as for climate emissions; nonpoint sources provide a challenge, but it can be handled, as experience in the US shows. I have demonstrated that by trading in nutrients between waste water treatment plants, the littoral countries of the Baltic Sea can achieve surprisingly cheaply 70% of the phosphorus target and 63% of the nitrogen target of the Baltic Sea Action Plan.

Unlike Europe, the United States has much experience in many types of water quality trading programs, including programs designed for nutrients. Europe needs to study the experience from existing programs. Furthermore, much new research is needed to explore fully the potential that water quality trading programs can provide to European waters.

The publication at hand by Michiel Wind is strategically very important. It provides the long needed information on the features of water quality trading for practitioners and policy makers. Wind covers not only the background of trading programs but also provides a useful account of studies and suggestions made for policy makers, among others, the detailed proposal by the Nordic Environment Finance Cooperation (NEFCO) on organizing a voluntary trading program for the Baltic Sea.

I hope this report will reach a wide audience.

Markku Ollikainen

Professor of Environmental and Resource Economics
Department of Economics and Management
University of Helsinki

Summary

In several European countries there is an interest in WET, as illustrated by around 14 studies summarized in this report.

Main conclusion is that present EU directives limit room for WET, and that EC-guidance and leadership, legal accommodation, and support is necessary in order to harvest the benefits of WET: mainly cost savings and earlier achievement of better water quality. But even today WET should be possible in Europe. The Swedish and Baltic Sea plans show this, and have developed a clever way to deal with potential problems of including non-point sources.

Many studies mention (perceived) juridical conflicts with (but also support in) present EU directives, mainly IPPC, Nitrates Directive and WFD. Mainly the Belgian, some of the Dutch and the Scandinavian studies discuss these conflicts in detail. Conclusion is that even with present legislation WET is possible, though present legislation limits the number of discharge permits that an emitter can buy and use. These limits may prevent achieving to the full all benefits of WET, but they may also help preventing one of the main potential problems with WET: hot spots in emissions due to emitters using too many permits locally.

Some suggestions are given for possible watersheds where WET might be used, and some other pollutants than eutrophication that is most commonly tackled with WET.

Finally, specific recommendations are given:

The EC:
- Provide facilitation with financial support and guidance, similar to EPA's water trading policy of 2003 (US EPA, 2003);
- Use legal room already available for pilots;
- Study opportunities for WET applied to new environmental problems and areas;
- Commission research into WET in Europe.

National member state governments:
- Lobby the EC for WET-facilitation;
- Use legal room already available: phases 1 and 2 of the Baltic Sea trading plan can be implemented today in any European country or water body: reversed auction and an investment fund financed by point source dischargers, both voluntary;
- Study opportunities for WET applied to new environmental problems and in specific catchment areas (river basins);
- Explore using existing institutions for implementing WET, for example the Dutch emission trading authority ('Nederlandse Emissiehandelsautoriteit', NEa) or similar in other countries, or other suitable water authorities, such as water boards.

Other authorities such as water boards and municipalities:
- Use legal room already available for pilots and experiments;

Propose detailed plans to the EC and ask for support and facilitation.

Introduction

This report is about Water Emissions Trading (WET or Water Quality Trading) in Europe. The goal is to inform about the basic principles, provide an overview of studies done in Europe, and suggest some future opportunities for WET in Europe.

The principle of cap and trade emissions trading is simple: authorities place a cap on the use of a scarce resource, allocate the rights to the resource (also called permits, credits or allowances) to users, and thereafter free trade keeps the rights allocated in an optimal way. Practice is more complex than this, but the principle has been shown to work. The EU-ETS for greenhouse gases is a well-known and successful application of emissions trading, but little is known in Europe about application to water quality. Yet, there is ample experience with WET, amongst others in the USA, New Zealand, and Australia.

In Europe, there has only been limited interest in this market based policy instrument. The EU are funding research into economic instruments for water management through the 7th Framework Programme, but trading is ignored in this research project. While on the EU-level WET is still overlooked, on a member state level there has been a number of studies. There are detailed proposals for Sweden and for the Baltic Sea. Furthermore, there are several studies on water emissions trading in several European member states.

These studies and proposals are discussed in this report, and conclusions and recommendations from them are summarized.

I need to thank for their indispensable support and valuable comments:
- Bob Pengel (independent consultant water management, flood management and ICT/GIS),
- Linda Karlsson (environmental economist in Swedish Environmental Protection Agency),
- Markku Ollikainen (Professor Environmental and Resource Economics, University of Helsinki),
- Reinder Torenbeek (freelance consultant in the field of water quality and aquatic ecology),
- Sean Blacklocke (consultant on economic, policy and scientific matters related to water resources).

1. What is Water Emissions Trading - general principles

The aim of many environmental policy instruments is to limit polluting emissions to an acceptable or sustainable level. The only instrument that does just this while otherwise leaving actors free and minimizes overall costs is emissions trading according to the principle of cap and trade. Changes in market conditions will not affect the result for the environment, as opposed to environmental levies. Emissions trading has been applied to a wide variety of environmental problems. The European Emission Trading Scheme for greenhouse gases is the most well-known emissions trading system, and is generally considered a success. Less well-known, at least in Europe, is the use of emissions trading for control of water pollution.

How does it work? Within a watershed the total allowable discharge is defined, taking into account the (ecological) water quality goals. All dischargers receive tradable permits, giving them the right to discharge a fixed quantity of pollution. They can then buy or sell permits from one another as they like, as long as overall water quality objectives will still be met.

Dischargers' decisions to trade will depend on what is attractive and cheaper for them: paying for their own emission reduction measures, or buying permits from others. Sellers can use part of the money to reduce their own emissions more cost effectively, and keep the rest as a profit. In this way reduction measures will collectively be undertaken with improved overall cost-effectiveness, which in turn will speed up the process of achieving water quality objectives.

If necessary, the total allowable discharge (emission cap) can gradually be lowered over the years in order to raise water quality. With a relatively high initial cap, the initial economic impact will be lower and hence acceptance of such measures higher. Furthermore, overall societal cost may be lower because there is more time for actors to implement and develop (innovative) measures and fit them into regular investment cycles. Therefore too, this gradual lowering of the cap would preferably have to be announced to the market long time in advance.

On the other hand, if trading partners anticipate that the improved cost effectiveness in their collective clean-up is going to be used as a justification for government lowering the cap (raise the water quality standard), they may not use this instrument – they may continue lobbying and litigating against higher standards.

A way around this is to let environmental NGOs and other water users like angling clubs in on the market. Then they can buy permits and retire them to improve water quality standards beyond the cap. Also, as these NGO's are expected to have a high willingness to pay for clean water, they may contribute to reaching the socially optimal level of water quality.

Advantages of WET:

1. It is compliant with the 'polluter pays principle' (Article 9, Water Framework Directive, WFD),
2. More cost-effective sets of measures can be taken, alleviating problems of disproportional costs. Quantifying and addressing the magnitude (cost effectiveness) and distribution (cost disproportionality) of compliance costs are

explicit requirements of the WFD (Articles 3-b, 4-a-ii, 5, 5-a, 7-d, 16-6).
3. It stimulates innovation towards more cost effective water pollution control technology, because innovators can earn money on selling their innovations and emission permits generated.
4. Discharge targets are reached in less time and at lower costs.
5. Trading systems are cost-effective irrespective of the initial allocation, so that it can be used to cope with equity issues. For example, most cost-effective measures may be found in the agricultural sector, but still agriculture may not be able to bear the costs of taking these measures. If agriculture is allocated relatively generously with permits, the sector can sell the permits to other sectors, and pay for the cheap reduction measures in agriculture.
6. Letting NGO's in on the market will elicit true willingness to pay (WTP), as opposed to the contingent valuation method, which uses hypothetical markets to assess WTP. Also it may help reaching better water quality faster.

1.1 Different types of WET

In practice, WET will only rarely be a pure cap and trade system as described in textbooks. In the book 'Water-Quality Trading', by Jones, Bacon, Kieser and Sheridan (2006, WERF) four types of WET are distinguished. These categories are similar to the WRI-classification (Selman, 2009). See Table 1.

WERF	WRI	Example	Pros	Cons
Centrally managed trading	clearinghouse	Long Island Sound	resembles traditional regulation and a discharge levy	less local freedom, less market allocation, less cost-effective, bureaucratic
Trading associations	bilateral trades	Tar-Pamlico Trading Association (founded 1989)	legally simple (if pilot-project status granted)	limited cost-saving trades in the market?
Market-like trading	exchange market	Lower Boise River	lowest costs, liquid market	technically and legally complicated?
Small-scale offset programs	sole-source offsets	Rahr Malting Company	small-scale, simple	no liquid market, risk of market power

Table 1 Overview of four categories of water emissions trading systems from the WERF-book 'Water-Quality Trading', by Jones, Bacon, Kieser and Sheridan (2006) and the WRI-classification (Selman, 2009). The pros and cons are M. Wind's judgment.

Another distinction in types of WET is between international and domestic trading programs: the former require more (legal) coordination and agreement between nations. The Chesapeake Bay trading program suffers from the lack of coordination between the participating states (personal communication professor Markku Ollikainen, e-mail from July 18, 2011). A good reference on this matter is Baumol and Oates, 1988.

1.2 Trading under an absolute cap versus trading relative to a baseline

In general, the cap and trade type of WET is difficult to apply to diffuse or non-point sources, such as agriculture, run-off and long-term leaching from water bottoms and groundwater. These sources are difficult to measure and model, and responsible actors and polluters may be hard to identify and hold accountable. Therefore, in the case of non-point sources, we may have to resort to rules of thumb, best available technologies, and so-called baseline and credit-based trading (also called performance standards based trading).

Credit-based trading means that a baseline needs to be set by authorities. In practice, this means that if you operate according to a defined generally accepted manner, you need not buy credits. If you operate in a worse manner, you need to buy credits. On the other hand, by taking certain additional measures (often called Best Management Practices, BMP's), credits are generated. These credits can be sold to other polluters emitting *more* than the set baseline because they did not take the required minimum, baseline measures.

In some literature, in the case of cap and trade, the tradable units are described as *allowances*, while in the case of credit-based trading, one speaks of *credits*. In the case of cap and trade, total emissions are known and can be allocated to responsible entities. In the case of credit-based trading, total emissions are *not* known, but only changes in emissions relative to the set baseline are known.

Cap and trade is seen as the theoretically best type of trading, because than for *all* emissions permits are required, and hence (opportunity) costs are born by the emitter. This holds true, even if permits are grandfathered (for free), because when using permits, revenues from selling them are forgone. In baseline and credit-based trading however, emissions up to the baseline are free of costs to the emitter, but not to society: a market failure. This means there are external costs leading to sub-optimal decisions by the polluter. Another way to put it: a new nonpoint source gets to emit up to the baseline for free, and a nonpoint source contemplating to stop its activity altogether is not stimulated to do so by revenues from selling its no longer needed permits.

More on the theory of emissions trading, see Tietenberg (2006). For the differences between trading under an absolute cap versus trading relative to a baseline, see Nentjes and Woerdman (2012).

1.3 Trading ratio's

Emissions of pollutants do not always harm the environment equally: damage may vary with location and time. In most water quality trading systems, the problem of differences in environmental impact due to location (or time) is solved by applying 'trading ratios': in order to be allowed to emit one unit over here, one has to reduce a different number of units over there (Hung and Shaw, 2005).

Furthermore, a trading ratio different from 1:1 may be applied in order to account for risk and uncertainty, to make sure water quality does not suffer from a trade but rather improves. Especially at non-point sources (mainly agriculture, but also urban

runoff), it may be uncertain if and when a measure results in an emission reduction or water quality improvement, and monitoring is difficult.[1]

According to Professor Markku Ollikainen (personal communication, e-mail July 18, 2011), we can distinguish between two trading systems: emissions trading and ambient trading systems. The former is for uniformly mixed emissions (such as GHG gases) while the latter is for regional, only non-uniformly emissions (water pollutants, SO_2, NO_x). In the former, permits are traded in a 1:1 ratio, but in the latter in the ratio the polluters load to the chosen receptor points. (Note, e.g. the US Acid Rain program is for non-uniformly mixed pollutants, but applied on a 1:1 basis, because this is easier for trading.) In both cases, the trading system can be created using either the cap-and-trade principle or the baseline and credit system.

[1] Another way of dealing with this risk is to bank the credit generated (keep it in store), and wait to observe the positive result of the cleanup measure, before the credit takes on value and can be sold. This may be referred to as ‘mitigation banking’.

2. Water quality trading in the US and elsewhere

Mainly in the USA (and in Australia and New Zealand, and expected to increase in Canada and China (Stanton, 2010), there is ample experience and research available on Water Quality Trading or Water Emissions Trading (WET). In Europe however, there is hardly any experience. This is quite surprising, as conditions and problems in European water management sector have many similarities to those in the USA.

In the USA, WET has been used primarily for eutrophication problems (emissions of phosphorus and nitrogen), but also for discharges of cooling water, toxic substances and salts. A useful and short overview can be found in World Resources Institute (WRI, 2009). The WRI inventory identified 57 water quality trading programs worldwide. Of these, 27 are active, 21 are under consideration or development, and 10 are inactive or are completed pilots. All but six trading programs are located in the USA: four in Australia, one in New Zealand and one in Canada.

Furthermore, the WRI identified five key factors that stakeholders and experts should note as important for the successful implementation of trading programs:

1. Strict regulation, a cap or other drivers that create a demand for credits.
2. Small liability risks: when you buy or sell a credit, you should feel secure that the authorities support and acknowledge the trade legally.
3. Robust, consistent and standardized methods to determine emission quantities.
4. Standardized tools, transparent processes, and online registries to minimize transaction costs, and make trading easy (such as www.nutrientnet.org).
5. Early stakeholder involvement and support, and a participatory process for developing and implementing a trading program.

Apart from this WRI overview, the book Water-Quality Trading by Jones *et al.* (2006) is recommendable. Furthermore, there are numerous papers and other publications available on theory and the US experience with water quality trading.

Another interesting overview is in Stanton, 2010, p. 51 – 69, chapter reviewed by US WQT expert Mark Kieser. Citation:

Many projects may also generate co-benefits such as biodiversity conservation, air quality improvements, job creation, and even building community. Such benefits are not always captured in the price per pound calculation. For example, stakeholders noted that one of the greatest benefits of the Alpine Cheese Company/Sugar Creek Trading Program in Ohio is that it brought all sides to the table to negotiate a solution to the falling water quality in the sub watershed. Regardless of the long-term viability of the trading scheme, there has been significant improvement in the tenor of the conversation about water quality in the sub-watershed among the parties. A similar "benefit" to developing a trading program was cited by PWS (Payments for Watershed Services, MW) project developers in China and Africa as the "intangibles"—non-quantifiable benefits to pursuing trading as a tool to address water quality.

When US experience with WET is discussed in Europe, often skeptics point at low trading activity in existing US trading programs. Stanton (2010) writes (citation):

Program inactivity occurs for several reasons and does not necessarily signify a failure to meet environmental, policy, or market objectives. Key reasons for inactive programs include: meeting permit requirements, lack of adequate regulatory drivers, and insufficient economies of scale.

While the achievement of water quality requirements explains the lack of transaction activity in a few cases, the overwhelming influence on inactive programs comes from insufficient demand because of nonexistent or not sufficient regulation. Several programs were developed in anticipation of regulatory drivers that are not yet in place. For example, trading in the Virginia Nutrient Trading Program was created with the expectation of more stringent guidelines and is entirely contingent on the implementation of a TMDL for nitrogen and phosphorus. While the program has yet to experience any monetary transactions, its trading platform has issued binding agreements to 105 facilities, committing US$3.1 million for nitrogen and phosphorus reductions.

It's worth noting that in most cases and for most permitted facilities, the standards were met easily and relatively cheaply suggesting that compliance in the future will become more costly as water quality standards become more stringent. As this happens, the demand for nutrient credits may increase and the overall attractiveness of nutrient trading tools will also increase. This development will bode well for the regions that have invested in the development of trading policies, tools, and platforms in anticipation of this eventual demand.

The benefits of water quality trading may increase sharply as more restrictive wastewater discharge permit limits are adopted. In addition, nitrogen discharges to surface waters from coal-fired power plants could increase as new air emission controls are installed; some of which use nitrogen-based reagents to capture pollutants in flue gas. Purchasing offset credits is likely to be less expensive than investment in on-site treatment facilities, particularly since an ample supply of low-cost credits from agriculture appears achievable. Eventually, the EPRI-led project is expected to serve as a model for developing other interstate water quality trading initiatives. In addition, reduced surface water nitrogen and phosphorous discharges into the Ohio River Basin may help reduce nutrient loading in downstream waterways as far away as the Gulf of Mexico.

3. Status in Europe

In Europe there has only been a limited number of studies into WET: a handful of studies in the Netherlands, a Ph.D. study in Germany, a study into legal possibilities in Flanders/Belgium, and a study in Italy. The most interesting and elaborate studies however have been done for Sweden and for the Baltic Sea. All of these studies (apart from the Italian one), are discussed briefly underneath.

In a report from the IUCN (Greiber, 2009) on the economic value of groundwater and biodiversity in European forests (http://ec.europa.eu/environment/forests/pdf/grounwater_report.pdf) it reads (p.11): “Water quality trading has developed in the US, providing an innovative approach to meeting requirements under the Clean Water Act, and is an approach that has been largely overlooked in Europe so far.”.

3.1 Swedish Model

Based on publications and proposals by Professor Dennis Collentine (Collentine, 2006 and 2007), the Swedish EPA (Environmental Protection Agency) has elaborated a 'fee-system with trading possibilities' for nitrogen and phosphorus. In short, this system functions as follows:

- Regulated point sources are allocated a discharge cap (‘legal regulation’), and for emissions over that cap, they pay a fee.
- Regulating authorities use that fee to pay for compensating reduction measures in other, non-regulated sources, such as agriculture (‘Centrally managed trading’ or ‘Clearing-house’ -system).
- These compensating measures (‘contracts’) are chosen by means of a reverse auction: actors are invited to offer reduction measures, and the authorities chose the measures with best cost-effectiveness.
- Finally, in the so-called secondary permit market, regulated point sources can trade permits amongst themselves.

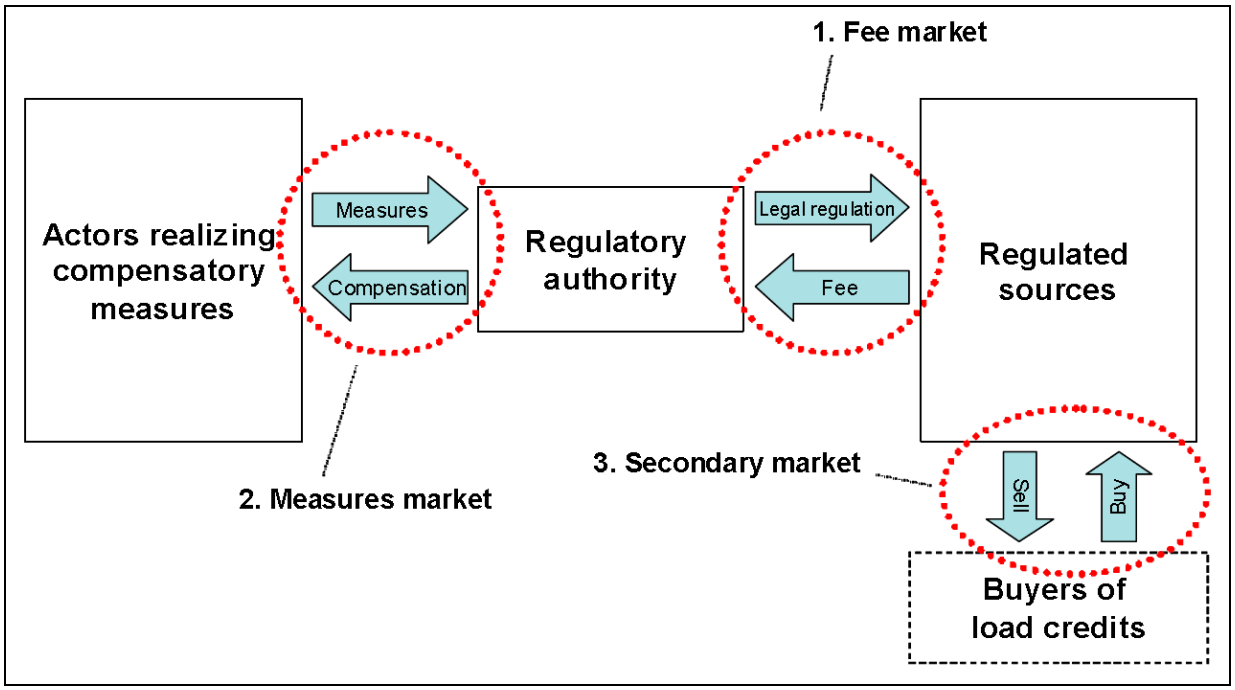

Figure 1. The Swedish model. Source: Swedish EPA, 2009

Although some people see the Swedish system as a variant of reversed auction, it fits well under the WET category of 'Centrally Managed Trading', as described in Water-Quality Trading (Jones, 2005, p 14.), or the 'Clearing House'- type of the WRI, 2009, p. 11 (see 1.1 Different types of WET). The level of the fee is determined by authorities, based on the costs of the most expensive compensating measure necessary to precisely compensate all surplus emissions of the regulated point sources. Furthermore, permit trading in the secondary market is of course true 'Market-like Trading' in the same categorization in WERF, 2007 (or 'Exchange Market' in WRI, 2009, p. 11). The system is called a 'fee system with trading possibilities' by the Swedes, but the level of the fee is based on market forces, so this is rather a permit trading system than a fee system.

The system is a combination of a 'cap and trade' and a 'baseline and credit' system: the regulated point sources are allocated an absolute cap ('cap and trade'), but the non-regulated sources can create credits by reducing their emissions beyond a set baseline (a sort of 'business as usual'). The regulated sources are mainly wastewater treatment plants and forest operations (paper and saw mills), while non-regulated sources are mainly agriculture and smaller wastewater treatment plants. The regulating authority may be the regional government or water board.

By this combination of two trading systems, the best of both worlds is achieved: the regulating authority acts as a broker or bank, and trading partners avoid the risk of failing compensating measures. Furthermore, the traded commodity is made uniform and homogeneous: trading partners do not have to worry about trading ratios and uncertainty. The regulating authority makes it easy for all pollution sources to take part in the system:

- regulated sources simply pay the fee or buy permits from other regulated sources if they emit more than their allocated cap, and
- non-regulated sources get paid for reduction measures by the authority as if it were a regular state subsidy.
- *All* sources are stimulated to look for innovative clean technologies because they

can earn money by selling generated permits or reductions credits.

Regulated sources can choose between paying the fee, and buying credits from other regulated sources, so fee and credit prices will tend to be equal. Furthermore, the price that the authority pays for compensating measures, will equal the fee they charge to regulated sources.

In order to account for retention of nutrients and other causes of differences in environmental damage, a zone system is used to determine the level of the fee. In most water quality trading systems, the problem of differences in environmental impact due to the location is solved by applying trading ratios: in order to be allowed to emit one unit over here, one has to reduce a different number of units over there. But in the Swedish system, one unit of emissions in a place with high environmental impact simply pays a higher fee.

Research has shown (p. 123, Swedish EPA, 2010) that if measures with best cost-effectiveness would have been chosen in Swedish past reduction efforts, a 50% cost-reduction would have been possible. A fee-trading system would be able to elect the most cost-effective measures. Much of the administrative and enforcement costs would remain the same as with traditional regulation, though monitoring, setting up the system and (other) transaction costs may require extra resources (p.130 -131, Swedish EPA, 2010).

The Swedish model uses the experience from (mainly US) water quality trading programs. Many of these existing trading programs suffer from low trading activity (though they still may be profitable!). This is attributed partly to high transaction costs in the form of liability risks of failure, and bureaucracy. Another cause of low trading activity in the US is lack of (sufficiently low) caps on total emissions, resulting in little need for trading. This is may change in the future.

The Swedish fee system is designed to in due time be integrated in a possible trading system for the whole of the Baltic Sea (see Chapter 3.2).

The proposals by the Swedish EPA have been well met by the Swedish government. However, Swedish EPA has concluded that in the long run the fee system cannot be combined with present national and EU regulation. Government has now asked the EPA to investigate introduction of the fee-trading system for only point-sources, which may be a first step to introducing a larger scale system.

Furthermore, the Swedish EPA hopes that other EU member states support and adopt the concept of WET, in order to speed up the process of accommodating the European legal framework to WET.

3.2 The Helcom proposal for the Baltic Sea

This thorough study of some 100 pages (Green Stream Network, 2008) describes a ‘Framework for a Nutrient Quota and Credits Trading System for the Contracting Parties of Helcom in Order to Reduce Eutrophication of the Baltic Sea’. Helcom is an acronym for Helsinki Convention, which adopted the Baltic Sea Action Plan to clean up the Baltic Sea. The Nordic Environment Finance Corporation (Nefco) financed the study. It is expected that current legislation and measures will not be sufficient to

reach the target of a clean and healthy Baltic Sea, especially regarding eutrophication. Furthermore, there are large differences in agricultural practices and other measures already taken, resulting in large differences in cost-effectiveness. Therefore trading could be beneficial: three studies cited in the report, indicate cost reductions of about 50%, or 3 to 10 billion euro per year.

However, there are a number of challenges to introducing trading. Firstly, there are no annual monitoring data available for point or for non-point sources. Secondly, there are legal barriers. On the other hand, there are also legal elements that support the use of flexible policy instruments such as nutrient trading. The report says in the Summary for Policymakers:
'It is clear from the international, EU and national legal frameworks that there is strong support for the continued development of flexible policy tools to address the issue of eutrophication in the Baltic Sea. The authors suggest that complex and overlapping sources of law do not inherently prohibit the implementation of nutrient trading, and particularly in relation to Best Environmental Practices, for non-point sources, there is a legal niche for nutrient trading.'

Respecting this background, the report describes a plan to gradually introduce a trading system in four phases. Over time, and with the experience of the earlier phases, the two challenges mentioned can be met. The report proposes to base the first two phases on voluntary trading, while the last two phases would be non-voluntary with respect to being integrated into the trading system. The first two phases would entail ‘baseline and credit trading’ (credits related to certain activities, see 1.2 Trading under an absolute cap versus trading relative to a baseline). The baseline would be current Emission Limit Values (ELV's) and Best Available Technologies (BAT's). In phase 3 and 4, when monitoring and reporting procedures are harmonized, more sources can be transferred to a cap-and-trade scheme linked to the initial baseline-and-credit scheme.

Key features of this plan include:
- As the plan addresses eutrophication, both nitrogen and phosphorus can be traded interchangeably across the whole of the Baltic Sea. The unit trade is 'equivalent kilogram of nitrogen'. The ratio between N (Nitrogen) and P (Phosphorus) is fixed by the Redfield ratio: 1 kg of N equals 0.14 kg of P.
- In order to prevent new hot spots due to regional sources buying too many credits from other regions, no source is allowed to increase its discharges above existing permitted levels. New sources and existing sources increasing their capacities, are allowed to emit only normally permitted quantities (according to present regulation).

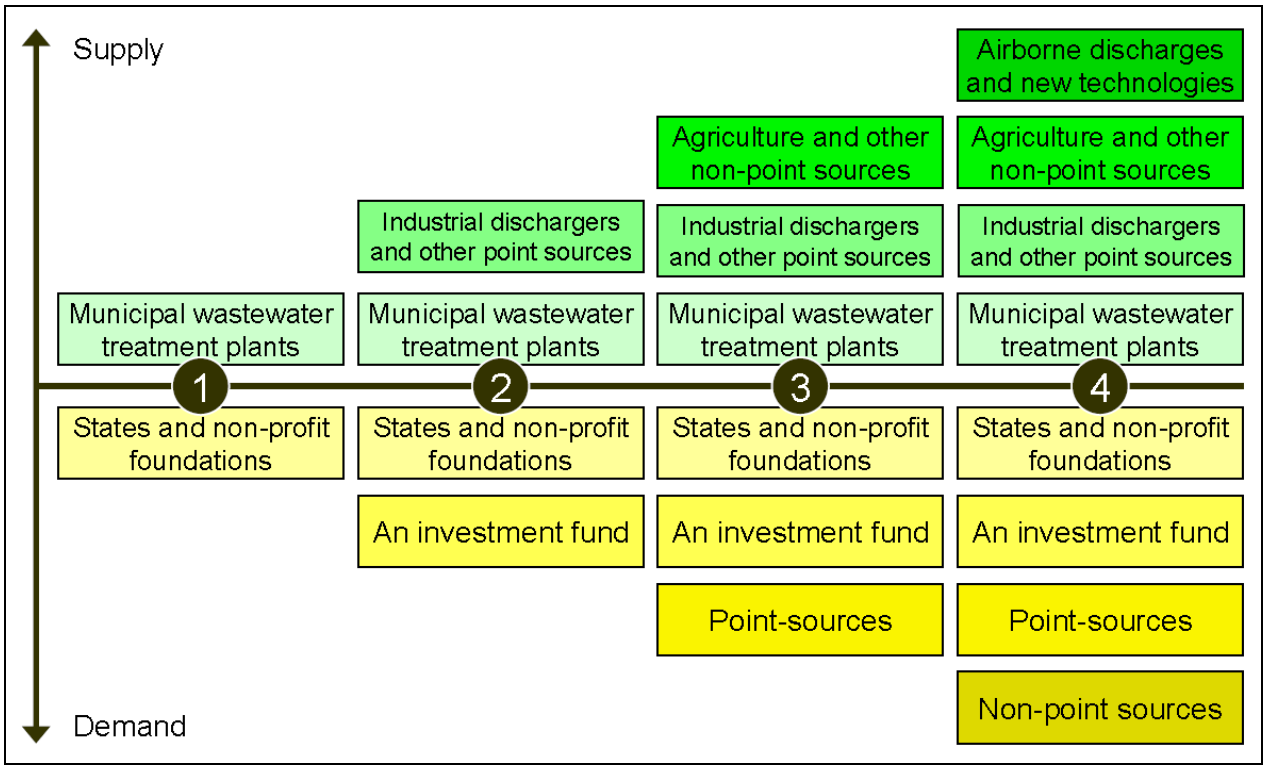

Figure 2. The coverage of the scheme increases gradually. Phases 1 and 2 are based on voluntary demand whereas Phases 3 and 4 are based on compliance demand. (Source: Green Stream Network, 2008).

The four phases are explained in more detail in Table 2 underneath. Note that even if not all phases are executed, efforts to improve monitoring and other preparations for later phases will be useful in making alternative eutrophication policy plans. Furthermore, also the early phases alone will improve cost-effectiveness and save money.

	Phase 1	Phase 2	Phase 3	Phase 4
Supply of credits	MWWTPs[1] whose efficiency can be improved, amongst others, in Russia, the Baltic States and Poland	In addition to MWWTPs, all other point sources, mainly industrial discharges and fish farms	In addition to point-sources, agriculture and animal husbandry, through e.g. conversion of agricultural land into grassland	In addition to point and non-point sources, airborne discharges and new technologies for reducing the internal load of the Baltic Sea, if proven effective
Demand for credits	Littoral states, non-profit foundations (e.g. John Nurminen Foundation) and private companies (e.g. Cargotec) on a voluntary basis	In addition to direct investments, an investment fund that pools voluntary investments and purchases nutrient credits for least cost, through e.g. tendering twice a year[3]	In addition to voluntary demand, MWWTPs and other point-sources that face more strict ELVs and BAT requirements	Point and non-point sources in addition to voluntary demand
Objectives	Move from ex-ante to ex-post funding of abatement efforts by introducing the concept of nutrient credits[2] Harmonisation of monitoring and reporting procedures, and the establishment of a register for nutrient discharges and projects aimed at reducing them	Establishment of an investment fund that purchases nutrient credits through tendering and, thus, improves cost-efficiency Quantification of abatement costs, through information provided by winning and non-winning tenders	Expansion of the voluntary demand, by allowing point-sources the flexibility of using nutrient credits for compliance Inclusion of agriculture in the scheme as a supplier of nutrient credits[4]	Creation of a liquid market for nutrient credits
Legislative issues	Because of its voluntary nature, Phase 1 avoids many of the legal issues that arise from existing international, EU and domestic regulation. However, EU state aid rules apply even if the scheme is voluntary	Inherently the same as in Phase 1. The tender process will be subject to the public procurement directives	Integration of the legal foundation of the scheme with the existing body of law that applies to the discharge of nutrients	The legal issues are substantially similar to Phase 3, although the design of legal instruments is undoubtedly complicated by the broader nature of Phase 4.

[1] Municipal wastewater treatment plants

[2] To make sure that investment fund is fully operational in Phase 2, the development of it should be initiated in Phase 1. If it turns out that the demand for nutrient credits in Phase 1 is low, the fund can be utilised to a limited extent already in Phase 1 to boost demand.

[3] The inclusion of agriculture in the scheme is likely to require more detailed information about the leaching of nutrients than is available today. Thus, the development of monitoring practices of agricultural sources should be initiated in Phase 1 to ensure that agriculture can be included in the scheme in Phase 3 as a supplier of nutrient credits

[4] Verification of nutrient discharges is included in the scheme from start. However, in Phase 1 verification is voluntary. Thus, the buyer of nutrient discharges decides whether it is required or not. From Phase 2 onwards, verification of monitoring reports is compulsory.

Table 2. Details of the four phases (source: Green Stream Network, 2008)

Although various words and expressions are used, many elements of this plan are similar to the Swedish concept and plans considered in other countries. For example, the investment fund which is filled with money from amongst others levies on point

sources not participating in the scheme, is also found in the Swedish plan and in the Dutch concept of a 'compensation fund' (KPMG, 2008). In Ireland WET has been considered for the catchment of Lough Melvin, but ‘reverse auction’ was chosen to elaborate[2].

The trading potential for the whole of the Baltic Sea drainage area is estimated to 1.1 billion kg of nitrogen equivalents, the current anthropogenic waterborne load to the Baltic Sea. Of this load, 49% originates from agriculture and forestry, and 35% from municipal wastewater treatment plants or the lack of them.

Conclusions and recommendations:
- Nutrient trading may provide a cost-effective way to combat eutrophication.
- Because accurate monitoring and understanding of the system by the polluters is required, a gradual introduction of the system is recommended.

A SWOT analysis of the proposed system is given in the report, and is shown underneath in Table 3.

In a study by Hautakangas and Ollikainen (2011) it is demonstrated how trading can help the BSAP work out more equitable and cheap, and therefore faster. As the BSAP is now, major part of the reduction effort and costs come down on Poland and other former East-bloc countries, while benefits of a cleaner sea come to all littoral countries. When permits are allocated relatively generously to big emitters with cheap measures (such as Poland), they can sell these to finance their huge reduction efforts.

In general: any sector or group of emitters unable to pay for their cheap and needed reductions can be allocated relatively many permits. This does not respect the polluter pays principle on a group level, but it does so on an individual level.

[2] In a reverse auction, the sellers instead of the byers compete to obtain business from the buyer. Prices will typically decrease as the sellers undercut each other. Personal communication, e-mail Dr Claire Cockerill, Environmental Economics, Gibson Institute for Land, Food and Environment, Queens University Belfast, January 11, 2008.

Strengths	Weaknesses
Reduces the cost for improving water quality in the Baltic Sea Creates an economic incentive for dischargers to go beyond minimum pollution reduction Harmonises monitoring and reporting procedures and, thus, improves the quality of monitoring data Contributes to not only to capacity building regarding monitoring procedures but also to abatement technologies Encourages dialogue among stakeholders Do not dictate the choice of abatement technology, and thus provides incentives for innovations in pollution reduction technology	The non-global nature of nutrient discharges complicates scheme design It is not possible to proceed directly to full-scale nutrient trading, due to lack of harmonised monitoring practises and monitoring data The emergence of new hot-spots, i.e. highly degraded areas, if polluters are allowed to increase their discharges as a result of trading (in Phase 4)
Opportunities	**Threats**
A solid infrastructure and solid knowledge base with room for future expansion of the trading scheme The investment fund (from Phase 2 onwards) attracts new investors as a result improving the transparency of abatement investments Reveals abatement costs	The costs of the scheme outweighs the benefits gained through better cost-efficiency Lack of political support for nutrient trading The existence legal barriers that must be overcome before nutrient credits can be used for compliance (from Phase 3 onwards) Contracting Parties do not seek more ambitious reduction goals accompanied with the possibility of using nutrient credits for compliance If the scheme fails, for some reason or another, the nutrient load may increase and new hot-spots may emerge

Table 3 Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis of the Baltic Sea trading plan.

3.3 Finland: Trading simulation for Finnish river

In this article (Lankoski et al. 2008) a simulation is made of effluent trading between point and nonpoint sources in a river basin in Finland, Kymi River Valley, to improve water quality in the Gulf of Finland.

Measures for nonpoint sources to reduce effluents (nitrogen and phosphorus) are to establish buffer strips to stop runoff from fields, and change to crops requiring less nitrogen fertilization. Reducing the quantity of fertilizer is in itself not a valid measure to generate credits because it is hard to enforce (‘moral hazard’). Point sources are waste water treatment plants, which have technological abatement possibilities. Trading is made according to the ratio reflecting the transportation of nutrients to the

Gulf of Finland from each location. Aims are to find whether the chosen measures in agriculture can provide considerable reductions in nutrient loads, and what are the incentives of farmers to participate in the trading program.

Reduction potential in agriculture is found great and farmers are the greatest suppliers of credits, but their gains from trading vary substantially. Some farmers may become net buyers of permits and thus net losers from regulation. The benefits of effluent trading are distributed unevenly among point sources as well. A generous initial allocation may be needed to strengthen the incentives of farmers to participate in the program and gain support for the trading program.

3.4 Belgium: legal possibilities for WET in Europe

In Dutch, an exploratory study into the legal possibilities and design issues of tradable discharge rights or reductions for dischargers, as an innovative policy instrument in the Flemish County (Peter de Smedt, 2007, 257 pages).

In this study the question is addressed whether or not the EU Water Framework Directive (and related directives) is a suitable legal framework for WET. The WFD requires identification of cost-effective programs measures, and allows for the use of market-based instruments, respecting the polluter pays principle. This suggests that WET fits well within the WFD. Other relevant directives are: IPPC-directive (Integrated Pollution Prevention and Control), Habitats and Birds Directive, Environmental Impact Analysis Directive, and Urban Wastewater Directive.

None of these directives prohibit use of WET, but they can limit the scope and applicability. For examples, the 'Habitat-test' and the Environmental Impact Analysis may hamper trading of emissions, for example by prohibiting the geographical reallocation of emissions. The main problem however, lies with the IPPC directive which is oriented towards individual installations instead of water bodies, and requires Best Available Technology (BAT). The IPPC directive would preferably be changed on this point if WET is implemented, as has been done to facilitate emissions trading for greenhouse gases (EU-ETS). If WET is to be combined with the present IPPC, baseline-and-credit types of WET are more compatible with the installation oriented IPPC then the cap-and-trade type.

In the WFD, articles 11.3g combined with article 10, 2 sections 40 and 41 indicate that an installation-based approach is chosen instead of a river basin approach. The WFD does however have a possibility to replace installation-based permits by 'other forms of regulation', that is possibly WET.

So, even with present IPPC and WFD directives, trading is possible within the minimum requirements of these directives, as is illustrated in
Figure 3.

Formal lists of sector-based BAT's include relatively generalized and fixed cost considerations, so more cost effective and innovative measures can be applied by individual dischargers in order to generate tradable discharge permits that can be sold.

When focusing on point sources and more specifically wastewater treatment plants, the Urban Wastewater Directive opens up for WET in article 5.4, where the emphasis is laid on *overall* reductions. Because, arguably, this directive is more specific and 'stronger' than the WFD (‘lex specialis’), this possibility can be used regardless of what the WFD says. In other words: legally WET is easier to establish between (urban) points sources than between non-point sources.

An important legal principle is that the polluter should pay for his pollution. This principle may be respected by WETs, but grandfathering (initial allocation of free permits, based on historical emissions) can be seen to conflict with this principle, even if polluting always has been for free in the past. Auctioning the permits or collecting a fee could resolve this legal issue.

Another legal principle is the precautionary principle. A number of techniques are available to make sure that the environment remains at least as healthy as before emissions trading was introduced. These techniques include flexible or dynamic emission caps, trading ratios with margins of safety, and additional or existing regulation. Prevention of hot spots needs to be ensured in regulation, e.g. by additional regulation in the individual permits, otherwise there may be a conflict with existing rules.

An important condition for successful implementation of WET is establishing requirements for detailed monitoring of emissions and receiving water quality. The Australian Hunter River Salinity Trading Scheme (HRSTS) is considered an international prototype in this respect. In the EU this condition is generally met, amongst others, by the WFD.

The use of pilot projects in order to test and refine any WET system is generally recommended in international literature, but article 11.3 of the WFD (requiring ‘basic measures’) may be a problem in this respect.

It is recommended that WET systems be designed by a multidisciplinary team, consisting of at least environmental economists, legal scholars, and scientists such as engineers, biologists and hydrologists.

The so-called paradox of geographical scales implies that for reasons of economic efficiency a WET system should be as large as possible, but for preventing hot spots a small scale system is preferable. This dilemma can be solved by using a Trading Ratio System (TRS, Hung and Shaw, 2005) in a river basin or catchment: one unit of emissions reduced in one zone, must be traded against a different number of units in another zone, depending on the ecological value and - damage. Zones are designed according to distance to discharge into the sea or lake, the function of the water (such as drinking water, shipping or recreation) and occurrence of protected nature areas. Hot spots, in general, can be prevented by capping ambient water concentrating levels in mixing zones (Personal communication from Sean Blacklocke, e-mail July 9, 2011).

The River Basin Management Plans (RBMP's) of the WFD are an important basis for development and implementation of a WET system. The Programs of Measures (POM’s) are obligatory, and therefore are a good legal basis for emissions trading programs. Article 11 of the WFD can act as a legal basis for online trading.

WET requires strong monitoring and measuring protocols, verified by accredited auditors. Enforcement is given ample attention in this Flemish study, and does not seem to be a legal problem. In alternative policy instruments, enforcement is important too.

Setting the cap (or in the case of 'credit and baseline trading': the baseline) for emissions trading should in principle take reference in the environmental quality to be attained. Important in this respect is the obligation mentioned in the WFD to adjust ambient quality norms when the desired Good Ecological Status or Good Ecological Potential is not attained. This means that the cap may have to be reconsidered periodically, or even be defined as a dynamic cap depending on certain parameters such as location of the emissions, water level, and season. For example, in times of drought, the cap could be lowered because dilution is less.[3] Furthermore, use of trading ratios and limiting the period in which a permit can be used ('banking') can help preventing hot spots.

Additional legal mechanisms have been used to prevent hot spots: review or withdrawal of individual permits, and imposition of a general obligation to ensure local water quality. All of these mechanisms to prevent hot spots require that all transactions of permits are known to the authorities. Therefore a reporting system for transactions is recommended, coupled to sanctions, as in the Australian HRSTS-program.

General practice in the USA in traditional permit systems that get combined with trading systems, is that the pollutants that are traded are taken out of individual permits. In traditional permits, technologies that influence the traded emissions remain regulated. Another approach that has been practiced is to establish a new common permit for a group of emitters, the Watershed General Permit, allowing the group to freely trade reduction measures amongst themselves. However, in Europe this legal construction to accommodate trading seems to be impossible at the moment due to the IPPC directive. Emitters that are not subject to the IPPC directive can more easily be incorporated in trading systems by regulations on a national level.

In water quality trading in the USA, individual traditional permits may contain the rule that emissions should be covered by sufficient tradable permits. Traditional permits simply are modified by an additional paragraph regulating WET. Furthermore, individual permits remain important for preventing hot spots, by means of additional requirements such as that tradable emission permits can only be used to the extent that local ambient water quality remains within set norms. Finally, traditional permits remain important within a WET for monitoring and enforcement stipulations.

A strong and well-established authority covering the whole trading area or river basin, such as the EPA in the USA, and for smaller national water bodies, water boards as in the Netherlands, has shown to be an important factor for success in establishing a WET system. In Europe, we still lack such cross-border authorities, but the river basin based WFD-structures may develop into such authorities.

---

[3] Personal communication from Sean Blacklocke, e-mail July 9, 2011: The cap on allowable emissions is back-calculated based on the amount of pollutant that can go to the stream without exceeding Good Ecological Status. If the initial calculation of the cap is wrong, the cap should be reexamined, but variable discharge allowances based on season or stream flow may not be administratively manageable. In the US we generally set the caps based on worst conditions, like the seven-day, ten-year low-flow event for rivers prone to drought with mostly point-source dischargers along it.

Main conclusions of the study are:
- The option of WET needs more attention on a European level. Especially the IPPC directive needs to be adapted to facilitate WET.
- Generally, the installation-based approach (aimed at individual installations and companies instead of general environmental targets) is a problem to any WET, which by nature is targeted at the overall emission level relevant to the environmental target.
- The WFD with its river basin based structure is in principle well suited for enabling WET, and even with the present legal situation in Europe, there are possibilities for WET. Especially the policy in the WFD for physic-chemical substances and specific pollutants, and wastewater treatment plants regulated by the Urban Wastewater Directive, have a clear legal potential for WET.
- Development of a pilot project is recommended, under clear legal, environmental economical, and enforcement conditions - conditions that are equally important to any other, more traditional policy instrument.

3.5 The Netherlands

A number of studies have been carried out around WET, but most reports are in Dutch language. There seems to be a special interest in the subject in the Netherlands, but perceived European legal hurdles scare national and local authorities, and water boards away from experimenting with WET.

3.5.1 Dutch government exploration of trading for quality and quantity

This study is in Dutch, with a short summary in English, which is sited below (Klooster, 2007, 84 pages). It is titled ‘Tradable water rights – exploration of a new instrument in integrated water management’.

A general introduction to WET is given in this report, and the policy instrument has been compared to most relevant alternative instruments: command and control (such as traditional permits, and prescription of specific techniques), subsidies, levies, taxes and covenants (voluntary agreements). The advantages and disadvantages of trading depend on e.g. management goals, design and specific circumstances. In general, however, most important advantages of trading are cost effectiveness (costs savings), continuous incentive for innovation (dynamic efficiency), precise achievement of the emission target (provided there is adequate monitoring and enforcement) and flexibility for emitters.

In the USA it is federal policy to support the development of trading projects, and the in last decades many projects have been initiated. Expected cost savings vary from 40 to 80% compared to strict command and control type policies. Yet, it is too early to conclude that water quality trading is a definite success in the USA, in many cases because the total maximum daily loads (the emissions caps) have not yet been established, or are still relatively large/high. However, the US Environmental Protection Agency (EPA) is actively promoting trading, including financial support. The large amount of available reports and other literature from the USA should be useful for the study and implementation of water quality trading in Europe.

The design of a well-functioning trading system requires special attention for the

following issues:

- In most cases, initial distribution of permits is the most controversial part. Although auctioning theoretically in many ways is the best option, the permits are usually distributed for free, mainly in order to get stakeholder support for implementing a new system. Also, todays water users often have historic rights to use the water.
- Compared to air pollution, the location of the discharge is important for water pollution. Therefore, special care should be taken to prevent problematic concentrations of discharges: hot spots. Several ways to prevent hot spots in a water quality trading system are described.
- To assure that transfer of permits from seller to buyer does not result in a net increase in environmental damage, correction factors or trading ratios are often used. Correction factors are intended to compensate for differences in environmental damage caused by discharges on different locations, for example due to ecological or other location specific circumstances.
- Transactions should be hindered as little as possible by so-called transactions costs, such as government duties to be paid, bureaucracy, regulation and (perceived) risks.
- To create sufficient support, all stakeholders should be involved in an early stage during the development of a trading system.

Unlike e.g. the global trading system for greenhouse gasses, specific local circumstances can and should be taken into consideration while developing the usually small-scale water quality trading systems. Compared to national or European regulation, this may increase support from local stakeholders.

The study explains with a figure how WET could contribute to cheaper additional measures, while respecting existing regulation:
Figure 3.

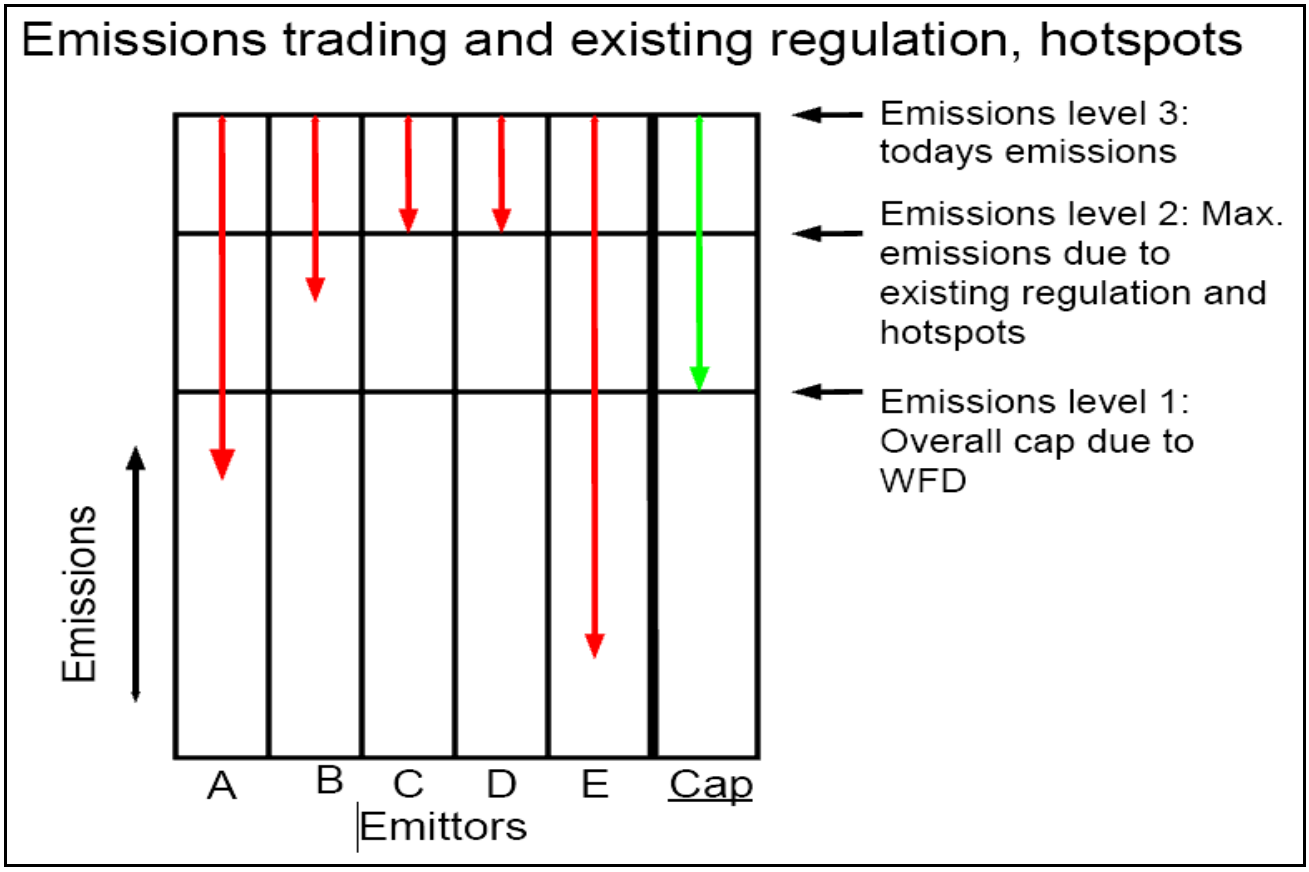

Figure 3. How WET fits into and supplements existing regulation (such as IPPC -, Nitrates - and Urban Wastewater directives). Existing regulation is not sufficient to reach set ambient ecological targets. WET ensures that overall total reductions end up under the cap. Sources that can only reduce at high costs (such as C and D) do so only to level 2, while buying credits from sources that can reduce cheaply to lower than required levels (A, B and E). Overall result is that the cap is reached precisely and at lowest possible costs.

It is noted in the report that, in order to get support from sectors unable to pay for their cheap reductions (possibly agriculture), it is possible to allocate them relatively many permits, which they can than sell for financing their abatement efforts. This strategy is not compliant with the polluter pays principle at a sector level, but it is at an individual emitter's level.

Conclusion of this exploratory study is that, taking into account the huge challenges water policymakers face and the increasingly high associated costs, this promising policy instrument deserves more thorough study and attention in Europe. Further research should focus on:

- transfer of American knowledge and experience,
- different types of water rights trading (cap and trade, credit trading and hybrid systems),
- ways to include non-point sources such as agriculture,
- the legal and policy context of introducing water rights trading in the Netherlands and Europe,
- quantifying differences in the cost-effectiveness and potential cost savings,
- public support and cultural issues.

3.5.2 Master-thesis: WET in Dutch Water Management

Full title of this thesis is: Emissions trading in Dutch water quality management – Feasibility study into emissions trading as a new policy instrument (Kamphuis, 2008). In this MSc thesis at the Delft University of Technology (68 pages in Dutch, 1 page English abstract), the author concludes that water emissions trading is feasible in theory, but he points at the present BAT requirements in IPPC and WFD. In two case studies he concludes:

Nutrient trading in the Zuidpolder in Delfland, the Netherlands, is not suitable because the greenhouses that are main polluters will shortly be connected to wastewater treatment plants. The remaining emitters, farms and wastewater treatment plants themselves, could potentially trade profitably, but uncertainty about effects of measures (in particular riparian buffer zones) and problematic monitoring and accountability of emissions, will probably make WET difficult.

The other case study is on trading cooling water discharges on the river Rhine. During hot and dry summers, water temperatures of the Rhine are above norm with increasing frequency. Emissions trading in the German part of the river is a good and profitable policy instrument for controlling discharges of cooling water. In the German part there are enough emitters and thus potential for trading is good. Emissions trading could save €3.75 million (not clear from the study, but probably per year). In the Dutch part of the river however, there are too few emitters and a too low a volume of cooling water to make WET worthwhile. The thesis does not consider joining the Dutch and German market, which seems a natural step because it concerns the same water body.

3.5.3 Legal implications of economic instruments in water policy

This is a legally oriented Master's thesis by Anita Jolink at the Centre for Environmental Law and Policy, Utrecht University (2010, in English, 104 pages). Main conclusion is that the instrument of tradable water pollution rights (WET) is legally possible, but limited by current European laws. More specifically, emission limits may not be exceeded when for example one polluter buys emission rights from a polluter that reduces more than he is obliged. However, wherever additional reductions of emissions are needed to attain water quality targets (such as the good ecological status mentioned in the WFD), there should be room, both legally and economically, for mutually beneficial trading (refer to figure 3).

Regarding eutrophication, the Nitrates Directive states that the maximum amount of nitrogen fertilizer that can be applied per hectare is 170 kg. The Netherlands have been allowed to use up to 250 kg per hectare due to a derogation granted by the EC. A trade system could for example be designed with a cap of 170 kg/ha, while allowing farmers to buy emission rights (or 'fertilizer rights') up to 250 kg/ha. Jolink assumes that farmers would not favour this design because they would have to take extra reduction measures, but at the same time she writes (p.84) that this system could be in line with the 'Van der Vlies'-motion passed by Dutch parliament stating that the financial burden of extra environmental measures on farmers should not be allowed to increase. In fact, farmers could earn extra money with the system when they take cheap reduction measures and sell the allowances to other farmers or other sectors such as wastewater treatment plants. Also Jolink thinks that introducing these caps might endanger the derogation the Dutch have presently, because the system

might show to the EC that the 170 kg/ha limit is achievable after all.

Jolink concludes that a new monitoring authority would have to be established to administer and monitor trading, and that the costs associated with this should be balanced against societal benefits of the system.

Jolink states that a WET system would be more interesting for countries that have not yet reached their goals, while the Dutch already have attained their goals. However, it may be true that Dutch agriculture have attained their fertilizer application targets (in kg/hectare), but the overall ambient water quality targets (concentration targets as defined in the WBMP's) have generally *not* yet been met, so additional measures are necessary. It would be most cost-effective and thus compliant with the WFD, to let market forces choose these additional measures within a WET-framework, and thereby stimulate the necessary innovation.

Jolink writes that a WET system in the Netherlands could be introduced alongside existing legislation, similar to the CO_2 emission trading scheme (ETS), and similar to the way water quality trading is being implemented in the USA. The idea is to change as little as possible to existing legislation and permits. The only thing that changes is that the emission limits mentioned in the permits are made flexible and dependent upon the number of allowances a polluter has.

Introducing WET in this way does not seem to be contrary to existing Dutch water legislation. However, there is a ruling from the European Court of Justice, case C-322/00 regarding the Nitrates Directive, that states that emission limits have to be respected at any time. Therefore, the Dutch MINAS system that calculated the net loss of nutrients instead of the directive's plain input restriction of 170 kg/ha, was not allowed and discarded. This limits trading opportunity within a WET for nitrates. For other pollutants the same problem exists regarding the Integrated Pollution Prevention and Control (IPPC) Directive: a polluter cannot buy unlimited discharge rights. However, he can indeed *sell* rights when he reduces his emissions beyond what is required, to buyers that are not reducing their emissions sufficiently. Refer to Figure 3, page 25.

3.5.4 Dutch government: how to allocate emissions permits?

This study (by KPMG Sustainability, 2008, in Dutch, 112 pages) is sceptical about a large scale trading system like the EU ETS for water, but optimistic about a fund similar to the Swedish model: fees charged per kg of nutrient emitted fill the fund, which in turn pays for reduction measures (p. 92). However, the legal obligation to use Best Available Techniques (BATs) is limiting room for trading (see Figure 3, page 25.). Therefore it is recommended that this problem is dealt with at a European level.

For thermic discharges on a local scale, the study is recommending an offsetting system, legally founded in a covenant (private agreement), and that the government starts a pilot on cooling water discharges in the municipality of Moerdijk, The Netherlands (p. 102). However, this pilot has not been started yet.

3.5.5 Free University reports by Oosterhuis

This section discusses two short reports by Frans Oosterhuis, titled 'Opportunities for the use of tradable permits in Dutch water quality policy' (2006, in English, 16 pages), and ‘Experience with tradable permits in water quality management in the USA’ (2006, in Dutch, 15 pages). The instrument of WET is discussed for the Dutch situation, and the experience with water quality trading in the USA is summarized.

Main conclusion is that: taking into account presents EU directives, WET seems especially suitable to fill the gap between what can be achieved with source related requirements by the WFD, and the eventual ambient water quality that is also required by the WFD and other legislation (see
Figure 3, page 25).

In other words, and as is concluded in many other publications discussed here, specific pollution control measure requirements, such as BAT and emission or input limits (such as the 250 kg/ha rule by the Nitrate Directive), often are insufficient to reach ambient water quality targets of Good Ecological Status or Potential.

The current prescriptive measure requirements limit the likelihood of a discharger buying a lot of emission rights, which will limit the applicability of a WET system. But on the other hand, WET as a supplemental policy instrument to BAT and other prescriptive measures, does still enable the achievement of cleaner waters where these measures are inadequate. And in less time and at a lower cost, while respecting cost-effectiveness and flexibility for the participating actors. In the future though, if the EC were to actively promote and facilitate Water Emissions Trading by modifying directives such as the WFD, Nitrates Directive and the IPPC, scope for WET and its advantages could be broadened, thereby increasing opportunities for cleaner waters faster and cheaper.

Oosterhuis emphasizes that emissions trading not only provides static efficiency by allowing flexibility for those measures to be taken with best cost-effectiveness. Emissions trading also provides dynamic efficiency: it stimulates development and spreading of innovative and even more cost-effective reduction measures and techniques.

Furthermore, a number of general recommendations and design issues are discussed in this paper, describing and introducing the instrument of WET in a condensed way.

In the second paper by Frans Oosterhuis, together with Rob van der Veeren (in Dutch, 2006), an overview and evaluation is given of experience with water quality trading (WET) in the USA. It is concluded that there is ample experience in the USA, and that there are a lot of different forms of trading being practiced.

In practice, the number of transactions in many trading programs have often been low. There is a number of reasons for this:

- A WET system can only cover a limited area because WET is more prone to hot spots than air pollution trading systems. This results in a lower number of potential traders, and thus fewer potential transactions.
- Also because of the danger of hot spots, additional limitations to trades are necessary, such as trading ratios and individual official approval of every trade.

This as opposed to the greenhouse gas trading systems, where it is irrelevant wherever in the world emissions take place, and trading can be free and with very low transaction costs.
- Sources often discover cheap reduction measures within their own facilities after the trading system is in place. When they start investigating compliance strategies, trading may appear to be unnecessary.

Oosterhuis also points out the differences between the USA and Europe. In the USA emissions from agriculture have had little regulation until now, whereas in Europe there are for examples the Nitrates Directive and regulation related to the Common Agricultural Policy. This means that in the EU, emissions trading is legally more complicated than in the USA, and also that a number of the most cost-effective measures ('low hanging fruit') already are compulsory.

3.5.6 WET for drinking water companies

This short report by KIWA Water Research (2006, 31 pages) rejects WET as an instrument suitable for obtaining WFD targets for the drinking water sector, though it recognizes that not all questions have been answered yet.

An interesting suggestion that can be derived from this study (see page 9) is using the so-called environmental measurement system (in Dutch: www.milieumeetlat.nl) as a basis for trading. This measurement system quantifies environmental impact from various crop protection chemicals in uniform environmental impact units. If for examples a water board sets a target for a maximum number of environmental impact units for a certain area, and distributes these units amongst users, a cap and trade system would virtually be in place. This idea deserves further exploration.

3.6 German Ph. D. thesis

The Ph. D. thesis *Water Quality Trading Systems: An Integrated Economic Analysis of Theoretical and Practical Approaches*, by Marianne Keudel at the University of Cologne (2007, in English, 206 pages), is an assessment of the theoretical background of water quality trading systems, including design options and practical approaches. The thesis recommends a thorough analysis of river specific ecological and economic criteria and dimensions before designing a WET. One practical approach followed in a WET in Australia is especially interesting, according to this study. The criteria developed in this study can also be used to analyse ill designed or ill functioning WET systems, in order to improve them. Opportunities for successful and beneficial WET systems are expected to be greatest in countries with a stable institutional framework and limited existing prescriptive regulations for water quality.

3.7 United Kingdom

In a report from the UK Forestry Commission (Coull, 2008) WET is discussed. WET is seen as a form of Payment for Ecosystem Services (PES). Some key citations:

"Water quality trading has developed in the US, representing an innovative approach to meeting requirements under the Clean Water Act. This approach has been largely overlooked in Europe so far."

“4: Water Quality Trading
Summary
- The Clean Water Act in the USA and the Water Framework Directive in the UK are instrumental pieces of legislation in water quality. Both allow for the use of trading as a tool to meeting regulatory goals.
- Whilst the UK has so far opted for more traditional instruments such as rules and licensing, the USA has several water trading schemes which are used to meet regulations.”

“…Water Quality trading has not been considered to be a viable option, due to the perceived administrative costs.
... Water quality trading offers several advantages to policymakers. Where it is appropriately utilized, it can offer economic benefits in reduced administration costs. Arguably it may achieve environmental standards quickly and encourage innovation in meeting these.”

“Tackling non-point pollution (i.e. pollution from agricultural and urban runoff) is more difficult, but there are examples of trading systems where these sources have been included.”

“Overall, water quality trading is considered favourably as a tool in the USA, and the use of forestry, through measures such as riparian planting, is seen to be part of this solution.”

“The scope of water quality trading should be explored further as a means to meeting requirements under the Water Framework Directive.”

3.8 Poland

Already in 2007 Poland explored WET, as reported in ‘The Concept of a Trading System of Mandatory Reductions of Pollutants Discharged to Surface Waters’ (Ostojski and Wilk, 2007, 19 pages, in English), by the Polish Institute of Meteorology and Water Management.
In this report the concept of WET is introduced, in relation to the obligations Poland has resulting from the WFD and other water related EU-directives. The authors of the report expect that WET-systems can generate financial revenues for authorities to pay for the implementation of the WFD. These revenues are expected to come from auctioning the permits, and from taxes on trades.
Recently there is new interest in the topic, according to Wilk Pawel of the Polish Institute of Meteorology and Water Management (personal communication, e-mail November, 16, 2011). His dissertation research on nutrient absorption capacity is also intended as a basis for WET.

3.9 Italy

In Italy an exploration of WET similar to explorations in other EU countries has been done by Simone Borghesi in an article in Rivista Internazionale di Scienze Sociali (2008, 22 pages, in Italian). In the English abstract she concludes: “Despite the potential benefits of tradable permits and the success reported in some contexts, from the present case study analysis it turns out that several factors, including lack of sufficient market competition, may sometimes hinder their functioning in practice.”

Furthermore, part of the PhD. thesis of Greti Lucaroni of 2011 is about WET. She applied WET to Trasimeno Lake, a lake of central Italy, where she simulated an auction for the initial allocation of permits.

4 Opportunities in Europe

In this chapter we discuss some possible areas where application of the instrument of WET seems promising.

4.1 WFD

As De Smedt (2007) and others points out, WET fits well within the WFD, for a number of reasons:

1. It respects the Polluter Pays Principle, and demands cost recovery
2. The WFD calls for the achievement of good ecological status, and departs from there, just as the cap and trade principle starts from fixed ecologically sustainable boundaries, and requires the market (economy) to sort out the rest. This as opposed to discharge levies, that start from a fixed levy, and leaves it to the environment to sort out the rest (in other words: the environmental outcome is uncertain).
3. The WFD takes care of the monitoring and enforcement, necessary for trading.
4. The WFD is organized based upon natural units for water management: watersheds, river basins and water bodies, which also are logical trading zones for WET-programs.

The EC could facilitate use of this instrument to the member states by providing the legal framework and practical guidance for implementing different sorts of trading possibilities. Financial support is also needed, just as the US Environmental Protection Agency has done with its 2003 Water Quality Trading Policy (US EPA, 2003). Wherever directives would need to be changed, the EU could provide exemptions from these directives for making pilot projects possible, and in due time with knowledge gained from these pilots, actually amend the directives.

Areas where WET would be interesting in the WFD are primarily eutrophication (nitrogen and phosphorus), but also cooling water discharges, and the priority substances. Introducing market forces connected to WET could speed up the achievement of the ecological targets by stimulating innovative techniques, and save money by improving cost efficiency.

4.2 North Sea

The North Sea has several environmental problems. Eutrophication is one of them, that could be handled with a WET system, similar to the plan developed for the Baltic Sea (Green Stream Network, 2008). The North Sea has some similarities to the Baltic Sea:

- Eutrophication is a problem
- It is a relatively sheltered sea with limited run through of clean water
- Likely there are differences in marginal pollutant control costs between emitters because a large number of actors can participate.

Photo 1. Foam on North Sea beach, caused by algae resulting from eutrophication (photo by R. Torenbeek, 2011)

Also, this would be a good time to consider WET for the North Sea because the Marine Strategy Directive (MSD) is now being implemented.

In this context the question arises how a WET for nutrient discharges into the North Sea would interact with the WFD measures already taken in the countries around the North Sea. A possible answer is that the WFD measures would not be affected by a North Sea WET, but the North Sea WET could lead to additional measures. Present measures would simply remain necessary to comply with the WFD, but in order to guarantee achievement of MSD emission targets for the North Sea, additional measures could be necessary. Instead of taking these additional measures, a country could buy extra emission rights from other countries if that would be more attractive or cheaper. In this way, each environmental problem, for each area, would have its own cap, in compliance with the so-called 'Tinbergen rule'.

The Tinbergen Rule states that for each and every policy target there must be at least one policy tool. If there are fewer tools than targets, then some policy goals will not be achieved.

Another environmental problem, or at least a scarcity problem, is overfishing in certain areas and on certain species of fish. This problem too can be dealt with by using tradable permits, but that is beyond the scope of this study. A useful reference for this topic is Anderson (1999).

4.3 Cooling water discharges

There is less experience with tradable emission rights for cooling water then there is with eutrophication, but several projects and studies (Kamphuis, 2008 and KPMG Sustainability, 2008) conclude that it is indeed an interesting environmental problem to tackle with WET.

In an advanced version, emission rights could be defined as a percentage of the total discharge space. This space would then be defined and vary depending upon several ecological factors, such as water temperature, water quantity (relevant because of dilution) and season. A model calculating maximum space for discharging heat would be necessary. Ideally, an Internet-based trading platform would show allowable discharge space on a daily basis. Discharges of participating sources could also be monitored permanently by automated on-line measuring of temperature and water quantity.

There are a number of rivers and watersheds in Europe where high temperatures are an ecological problem, for examples the Rhine, Elbe, Danube and the Rhone.

4.4 Other water related problems

There are a number of other environmental problems related to water where tradable permits could be considered. In principle, if there is a measurable norm or cap to any discharge and identifiable sources, trading is an option.

In the USA trading has been mainly applied to eutrophication, but also to micro-polluters such as heavy metals (Cu, Zn, Pb and Sn), salination (salts), cooling water (temperature) and organic matter (Dissolvable Organic Carbon, DOC). According to Blacklocke (Personal communication, e-mail July 9, 2011) also total suspended sediments and faecal coliform have been considered for trading.

Furthermore, one could think of trading applied to the relatively new source of water pollution by medical drugs, such as hormones and antibiotics (penicillin). Allowances could be assigned to for example hospitals, medicine companies and/or drug stores. This could speed up implementation of innovative measures such as Pharmafilter (www.pharmafilter.nl).

The use of pesticides could be controlled with a WET, using the interchangeability system for different chemicals mentioned in the Dutch Environmental Measurement instrument (‘Milieumeetlat’, in Dutch, www.milieumeetlat.nl). There may be other systems already developed to quantify different sorts of (water) pollution in one unit, that might qualify for trading.

Conclusions and recommendations

There is agreement in discussed studies that the EC directives IPPC and Nitrates are limiting WET in Europe. Countries interested in WET, such as the Netherlands, Finland and Sweden, could work jointly and lobby towards accommodation of WET by the EC.

However, even in today's legal environment WET is possible and offer opportunities. Many of the studies on European water quality trading conclude that existing EC directives limit room for trading, but mainly in the sense that polluters cannot emit *more* than existing regulation allows. But WET can be useful in reducing emissions utterly, beyond those minimum levels dictated by technology standards such as BAT, and in a cost-effective and flexible way. This is necessary in order to reach the targets for healthy water ecosystems as required by the WFD.

In other words, existing directives and regulations provide a minimum of measures that all emitters have to take, but for reaching still outstanding environmental targets, WET can help to identify existing *and develop innovative* cost-effective measures that bring us the necessary *additional* improvements. Actually, existing regulation may be helpful for implementing WET, because it helps prevent hot spots, which are one of the main risks of WET.

Definitions seem to cause confusion. Some people associate the word emissions trading with large-scale systems like EU ETS for greenhouse gasses and the SO_2-trading in the USA. Others use emissions trading also down to small-scale projects where two sources make a single trade. The former group of people rather refers to these small-scale projects as offsetting systems or funds. In this study we use WET for both small and larger scale trading systems.

The Swedish model is an interesting solution to the problem of measuring and accounting for emissions from non-point sources, often used as a reason to reject WET. Cap and trade is the theoretically optimal system of trading, but in practice it is only possible for point source trading. Credit-trading (with a relative cap) is the easiest trading system for non-points sources such as agriculture. The Swedish system has found a way to combine these two into a coherent and optimal system. The system deserves to be studied and experimented with.

An interesting suggestion that can be derived from the KIWA study (p.9) (see chapter 3.4.6) is using the so-called environmental measurement system (www.milieumeetlat.nl) as a basis for trading. This measurement system quantifies environmental impact from various crop protection chemicals in one uniform unit. If for examples a water board sets a target for a maximum number of environmental impact units for a certain area, and distributes these units as permits amongst users, a cap and trade system would virtually be in place. This idea deserves further exploration.

Any sector or group of emitters unable to pay for their cheap and needed reductions can be allocated relatively many permits. This does not respect the polluter pays principle on a group level, but it does so on an individual level.

Specific recommendations to:

The EC:
- Provide facilitation with financial support and guidance, similar to EPA's water trading policy of 2003 (US EPA, 2003);
- Use legal room already available for pilots;
- Study opportunities for WET applied to new environmental problems and areas;
- Commission research into WET in Europe.

National member state governments:
- Lobby the EC for WET-facilitation;
- Use legal room already available: phases 1 and 2 of the Baltic Sea trading plan can be implemented *today* in any European country or water body: reverse auction[4] and an investment fund financed by point source dischargers, both voluntary;
- Study opportunities for WET applied to new environmental problems and in specific catchment areas (river basins);
- Explore using existing institutions for implementing WET, for example the Dutch emission trading authority ('Nederlandse Emissiehandelsautoriteit', NEa) or similar in other countries, or other suitable water authorities, such as water boards.

Other authorities such as water boards and municipalities:
- Use legal room already available for pilots and experiments;
- Propose detailed plans to the EC and ask for support and facilitation.

[4] Actors are invited to offer reduction measures, and the authorities choose measures with best cost-effectiveness.

References

Anderson, Lee G. (1999): ITQs in Share System Fisheries? Implications for Efficiency/Distribution, Arnason, Ragnar and Hannes H. Gissurarson (eds.): Individual Transferable Quotas in Theory and Practice, Reykjavik: University of Iceland Press, pp. 169-184.

Baumol, W. and Oates, W. (1988). The Theory of Environmental Policy. Cambridge, Cambridge University Press, p. 299

Borghesi. S. (2008), IL SISTEMA DEI PERMESSI NEGOZIABILI PER LA GESTIONE DELL'ACQUA: UN'ANALISI DEI PRINCIPALI CASI DI STUDIO. Rivista Internazionale di Scienze Sociali, n.2: 137 – 158. (www.unisi.it/gofolwww/joomla/iscrizione/materiali/16135/bozze.pdf)

Collentine, D. (2006). Composite market design for a Transferable Discharge Permit (TDP) system, Journal of Environmental Planning & Management 49(6), 929-946

Collentine, D. (2007) One Step at a Time: Incremental implementation of a water quality permit program. Submission to Conference on the Science and Education of Land Use: A transatlantic, multidisciplinary and comparative approach, September 24-26, 2007 Washington DC
http://nercrd.psu.edu/taluc/Papers/CollentineOneStep.pdf

Coull J., Valatin, G., (2008), Payments for Ecosystems Services - Findings and Perceptions from the USA - Policy Summary. Forestry Commission/Forest Research, Farnham, Surrey GU10 4LH, UK, EU.
www.forestresearch.gov.uk/pdf/PES_policy_summary_Jan08.pdf/$FILE/PES_policy_summary_Jan08.pdf

Green Stream Network (2008), Framework for a Nutrient Quota and Credits' Trading System for the Contracting Parties of HELCOM in order to reduce Eutrophication of the Baltic Sea.
www.nefco.org/files/Nefco_BS%20NTS_GSN_Final%20Report_20080229.pdf
or
www.nefco.org/news/nefco_initiates_discussion_on_nutrient_credits_trading_system

Greiber, T., and others, (2009), Final report study on the Economic value of groundwater and biodiversity in European forests 070307/2007/486510, IUCN Regional Office for Europe (IUCN ROfE), Brussels, EU.
http://ec.europa.eu/environment/forests/pdf/grounwater_report.pdf

Hautakangas, S. and Ollikainen, M. (2011), Making the Baltic Sea Action Plan workable: a Nutrient Trading Scheme. Julkaisussa "Governing the blue-green Baltic Sea". Pihlajamäki, M. & Tynkkynen, N. (toim.). Ulkopoliittinen instituutti s. 112-121. (FIIA Report 31).

Hung, M-F., and D. Shaw (2005). A Trading-Ratio System for Trading Water Pollution Discharge Permits. Journal of Environmental Economics and Management, 49: 83-102.

Jolink, A. (2010) Legal Implications of Introducing Economic Instruments in the field of European and Dutch Water Management. www.helpdeskwater.nl/publish/pages/26880/legal_implications_of_introducing_economic_instruments_in_the_field_of_european_and_dutch_water_management.pdf

Jones, C.J., Bacon, L., Kieser, M., Sheridan, D., (2005) Water-Quality Trading; A Guide for the Wastewater Community, McGraw-Hill, www.mcgraw-hill.co.uk/html/0071464182.html

Kamphuis, C., (2008), Emissiehandel in het Nederlandse Waterkwaliteitsbeheer - Haalbaarheidsstudie naar emissiehandel als alternatief beleidsinstrument (in Dutch). MSc Thesis at Delft University of Technology, The Netherlands.

Keudel, M. (2007) Water Quality Trading Systems: An Integrated Economic Analysis of Theoretical and Practical Approaches. PhD thesis, University of Cologne, Germany. http://kups.ub.uni-koeln.de/2049/2/KUPS_Water_Qualty_Trading.pdf

KIWA Water Research, (2006), Verhandelbare emissierechten als KRW instrument voor de waterbedrijven in Nederland – Wat kan de sector hebben aan het instrument? (in Dutch), Kiwa N.V., Nieuwegein, The Netherlands.

Klooster, J., Torenbeek, De Vries, and Wind, M.H.A., (2007) Verhandelbare waterrechten - Verkenning van een nieuw instrument in het integraal waterbeheer (in Dutch), CE Delft, report no. 07.7263.09. http://eco-consult.nl/publicaties/7263_Eindrapport_JK.pdf

KPMG Sustainability, Hofland Milieu Consultancy, Sterk Consulting (2008), Verdeling emissies – Verkennende studie naar de mogelijke instrumenten voor alternatieve verdeling van emissies naar water, (in Dutch).

Lankoski, J., Lichtenberg, E., Ollikainen, M. (2008), Point/Nonpoint Effluent Trading with Spatial Heterogeneity. American Journal of Agricultural Economics: 90, 1044-1058.

Nentjes, A. and Woerdman, E., (2012) Tradable Permits versus Tradable Credits: A Survey and Analysis, International Review of Environmental and Resource Economics, 6: 1–78.

Oosterhuis, F., Van der Veeren, R., (2006), Ervaringen met verhandelbare rechten in het waterkwaliteitsbeleid van de Verenigde Staten – Notitie in het kader van het BSIK-project ‘De watereconomie van Nederland’ (in Dutch), Free University, Amsterdam.

Oosterhuis, F., (2006), Opportunities for the use of tradable permits in Dutch water quality policy - Discussion paper in the framework of the project ‘De watereconomie van Nederland’, Free University, Amsterdam. www.ivm.vu.nl/en/Images/WempaWP2b-0FBB8875-9824-6D5B-79960DE4C6F5421C_tcm53-104004.pdf

Ostojski and Wilk, 2007, ‘The Concept of a Trading System of Mandatory Reductions of Pollutants Discharged to Surface Waters’, Institute of Meteorology and Water

Management, Warsaw.

Selman, M.; Greenhalgh, S.; Branosky, E.; Jones, C. and Guiling, J. (2009) Water Quality Trading Programs: An International Overview. World Resources Institute, Washington.
www.wri.org/publication/water-quality-trading-programs-international-overview

Smedt, de, P., (2007), Naar een markt voor verhandelbare lozingsrechten. (in Dutch) Universiteit Gent, Faculteit Rechtsgeleerdheid, Maritiem Instituut, Gent, Belgium.
www.maritieminstituut.be/uploads/b266.pdf

Stanton, Tracy; Echavarria, Marta; Hamilton, Katherine; and Ott, Caroline. 2010. State of Watershed Payments: An Emerging Marketplace. Ecosystem Marketplace. Available online: http://www.foresttrends.org/documents/files/doc_2438.pdf

Swedish EPA (2009). Proposal for a Permit Fee System for Nitrogen and Phosphorus. Swedish Environmental Protection Agency, Report 5968, June 2009.
www.naturvardsverket.se/Documents/publikationer/978-91-620-5968-2.pdf
and presentation by Linda Karlsson, Swedish EPA on Fee-trading system in Paris, 2010:
www.onema.fr/IMG/EV/EV/plus/2-Karlsson-testingnewapproachestopollutionmnagement_permitfeesysteminSweden.pdf

Swedish EPA (2010). Vidareutveckling av förslag till avgiftssystem för minskade utsläpp av kväve och fosfor, rapport 6345, mars 2010 (in Swedish),
www.naturvardsverket.se/Documents/publikationer/978-91-620-6345-0.pdf

Swedish EPA (2010). Vidareutveckling av förslag till avgiftssystem för minskade utsläpp av kväve och fosfor - Underlagsrapport, rapport 6346, mars 2010, (backgroundreport in Swedish)
www.naturvardsverket.se/Documents/publikationer/978-91-620-6346-7.pdf

Tietenberg, T., (2006) Emissions Trading – Principles and Practice, Resources for the Future, Washington, USA.

US EPA (United States Environmental Protection Agency, Office of Water), (January 13, 2003), Water Quality Trading Policy, Washington, D.C.
http://water.epa.gov/type/watersheds/trading/tradingpolicy.cfm and
www.epa.gov/owow/watershed/trading/finalpolicy2003.pdf

Abbreviations

BSAP	Baltic Sea Action Plan
EU-ETS	European Union Emissions Trading Scheme
WET	Water Emissions Trading
WFD	Water Framework Directive
WRI	World Resources Institute
EPA	Environmental Protection Agency
BAT	Best Available Techniques
IPPC	Integrated Pollution Prevention and Control
HRSTS	Hunter River Salinity Trading Scheme (in Australia)
TRS	Trading Ratio System
RBMP	River Basin Management Plan (for the WFD)
POM	Programme Of Measures
MSD	Marine Strategy Directive
WERF	Water Environment Federation
LBS (Pound)	Libra Pound or English pound = around 0.45 kilogram.