Law & Economics of the Choice of Environmental Policy Instruments

SUMMARY

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INTRODUCTION

The project *Law & Economics of the Choice of Environmental Policy Instruments* is part of two sections of the research program *Levers of a Policy for Sustainable Development*: the section Policy *Instruments for sustainable development* and the section *Socio-economic consequences of a policy for sustainable development.*

The interdisciplinary approach Law & Economics has been crucial in determining the concept and realisation of the project. Two teams provided the legal contribution: a team from the Fondation Universitaire Luxembourgeoise (Arlon) and a team from the Institute of Administrative Law of the K.U.Leuven. The economic contribution was the responsibility of the research group Energy, Transport and Environment, which is part of the Centre for Economic Studies of the K.U.Leuven.

The collaboration between legal scholars and economists lead to a - more realistic - economic conceptual model, which served to evaluate social costs of different environmental policy instruments. The interdisciplinary approach was an added value in the design stage of the economic model (selection of instruments; identification and ordering of cost parameters) and in the implementation of the model (valuation of parameters).

Moreover the interdisciplinary approach has led to the inclusion of monitoring and enforcement while modelling the environmental policy instruments. Traditionally environmental economists mostly tended to ignore monitoring and enforcement aspects. Most models assumed that firms would perfectly implement environmental regulation. In recent years, however, a considerable strand of literature has been developed dedicated to the study of economic aspects associated with monitoring and enforcement (for an overview see Cohen

(2000)). However, for legal scholars it is self-evident that policy instruments, such as emission standards or environmental taxes, are only politically relevant if their compliance can be enforced. The core of enforcement consists of sanctioning instruments, such as fines, cessation orders or the withdrawal of licenses.

In order to model the monitoring and enforcement stage it was decided to use the concept of the regulatory chain. The notion 'regulatory chain' has a legal-technical basis. For an extended definition we refer to the doctoral research of C.M.Billiet[1]. It defines the successive stages in the lifecycle of policy instruments and consists of a rule-making stage, an implementation stage and an enforcement stage. Within this framework a functional analysis of the complementary relation between rule-making instruments (such as an obligation to use a particular abatement technology or to pay an emission tax) and enforcement instruments (such as fines or imprisonment) could be performed. In bringing together rule-making and enforcement instruments their matching potential was taken into account. A particular sanction can indeed be unsuitable to enforce one or more rule-making instruments.

OBJECTIVES

The project aims at the development of a methodology for the evaluation of social costs associated with different environmental policy instruments. Five aspects are particularly emphasised:

- The project aims at an interdisciplinary approach Law & Economics.
- The project takes the complete lifecycle of the policy instruments into account, including monitoring and enforcement.
- The project analyses a broad range of policy instruments.
- The project analyses policy instruments within an institutional framework.
- The project accounts for the whole of social costs (polluters, government and citizens).

We already elaborated on the first two points in the introduction. Here we focus on the other three aspects.

The selection of the rule-making instruments was limited to instruments that fulfil three conditions:

- Legally formalised instruments.

  Some instruments, such as environmental education, can be implemented without using specific legislation. Most of the environmental policy instruments, however, are formalised in legislation. These instruments were an obvious choice, due to the collaboration between law and economics. Their study valorises the legal know-how.
- Instruments that are implemented in Belgian environmental legislation.

[1] Billiet, C.M., The administrative enforcement of environmental protection law. Legal aspects (diss.), U.Gent – Centre for Environmental Law, in progress.

Therefore, the project only involves instruments that have been published in legislation in the 'Belgisch Staatsblad' (Belgian Law Gazette). This choice excludes some instruments; the most noticeable example being tradable emission permits, which legally do not exist in Belgian legislation. The selected instruments do, however, include decennia of legislative practice and therefore form a wide spectrum. The idea was to develop the legal knowledge base about the different environmental policy instruments. Further, in order to obtain insight into the cost structure of instruments, it was more realistic to work with instruments that were already generally applied and used.

- Instruments that are binding.

  Through this condition, instruments – or at least certain variations of instruments – that have a mere indicative value are excluded from the analysis. This constraint followed from the decision to model the monitoring and enforcement stage. The sanctioning instruments under study, are typically associated with rule-making instruments that oblige to something, that impose to do or not do some particular action.

Alongside the choice to work within the Belgian legislative practice, we also decided to pay specific attention to the institutional reality within which environmental legislators work. The incorporation of these institutional constraints makes the economic conceptual model more realistic. A legislator always operates within the framework of a constitution. He is also bound to respect supranational obligations, such as human right treaties and treaties for the protection of the liberty to trade. This framework excludes certain specifications of instruments. For example, it is useless to model a fine without developing a – admittedly expensive – procedure of appeal. The constitutional framework can also have a similar cost increasing impact. For example, the Belgian constitution obliges the legislator to legally formalise taxes through laws or decrees, and this increases the costs of environmental taxation in more than one respect.

Our research takes the whole of the social costs into account. Therefore, we model not only the costs for firms but also for government and citizens. All costs, including control and enforcement costs, associated with the regulation are accurately defined and valued for the three actors. Up until now, these costs were often neglected or very crudely estimated. Traditionally environmental economics focussed on abatement and production costs associated with environmental regulation. However, in recent years the informational, legal and administrative costs are becoming more pertinent.

RESEARCH RESULTS

Results are divided into three categories: the instruments used by the Belgian environmental legislators, a theoretical general equilibrium model and a case study, including the estimation of social costs, using a partial equilibrium model.

1. Instruments used by the Belgian environmental legislator

The instruments used by the Belgian (unitary and federal), Flemish, Walloon and Brussels' environmental legislators were identified and analysed by studying the environmental legislation since 1946 in the authentic texts. The result can be consulted in table 1.

Legal classification	**Economic classification**
I. Rule-making instruments 1. Primary rules 1.1. Management rules 1.2. Commercialisation rules 1.3. Ecolabelling systems and ecolabelling duties 1.4. Emission taxes 1.5. Emission rules 1.6. Factor taxes 1.7. Usage rules 1.8. Usage rights 1.9. Immission rules 1.10. Location rules 1.11. Installation rules 1.12. Import and export limitations 1.13. Authorising notification duties 1.14. Environmental quality rules 1.15. Environmental subsidies 1.16. Rules concerning the composition or construction and other technical product characteristics 1.17. Rules concerning the composition or construction and other technical packaging characteristics 1.18. Objective liability 1.19. Design and construction rules 1.20. Product taxes 1.21. Product approval systems and product approval duties 1.22. Production quota and production bans 1.23. Project approval systems and project approval duties 1.24. Restitution duties 1.25. Safety distances 1.26. Safety and emergency duties 1.27. License systems and license duties	**I. Standards** 1. Emissions (J.I.1.5) 2. Immissions (J.I.1.9) 3. Products (output) (J.I.1.16, 1.21 en 1.22) 4. Input (J.I.1.16) 5. Technology and infrastructure (J.I.1.11 en 1.19) **II. Taxes and subsidies** 1. Emissions (J.I.1.4) 2. Immissions 3. Products (output) (J.I.1.20) 4. Input (J.I.1.6) 5. Technology and infrastructure (J.I.1.8) **III. Tradable emission permits** **IV. Liability** (J.I.1.18) **V. Voluntary instruments /** 1. Publicity 2. Voluntary agreements **VI. Provision of information** (J.I.2.1, 2.4 en 2.7)

1.28. Sale and delivery rules 1.29. Transportation rules 1.30. Pollution bans 1.31. Removal and clean-up duties 1.32. Duties to take care 2. Secundary rules 2.1. Documentation duties 2.2. Record taxes 2.3. Recognition systems and duties 2.4. Notification duties 2.5. Inspection and maintenance duties 2.6. Some design and construction rules 2.7. Supervision duties 2.8. Duty to guarantee **II. Sanctions** 1. Plant closure 2. Administrative fine 3. Administrative coercion 4. Restoration to the original condition 5. Withdrawal ex tunc 6. Emergency sanctions 7. Withdrawal ex nunc 8. Criminal fine 9. Regularisation order 10. Suspension 11. Confiscation 12. Imprisonment 13. Change of authorising conditions	**VII. Penalties** 1. Fine (J.II.2 and 8) 2. Imprisonment (J.II.12) 3. Plant closure (J.II.1)

Table 1

Obviously this overview is open to further elaboration of knowledge and insights. The research material was very substantial and the analysis was often quite complex. However, this overview is without a doubt relatively complete and definite. It offers a reliable picture of the instruments used by the Belgian legislators since ARAB[2] 1946. This overview is, moreover, rather representative for the legislative practice in Western Europe. Other Western-European environmental regulators use similar rule-making instruments and associated sanctioning instruments.

2. General equilibrium model

General equilibrium models allow us to model and study the interactions between the polluting sector and the rest of the economy. The existing research in a general equilibrium

[2] Global regulation concerning the protection of labour conditions.

setting shows that, when enforcement costs are omitted and therefore perfect compliance is assumed, emission taxes and auctioned tradable permits are the most efficient instruments if their revenues were used to reduce existing labour taxes. Other environmental policy instruments did not have this important advantage.

In a general equilibrium model including enforcement costs we show that this ranking of instruments not necessarily holds true. Reasons behind this are the differences in enforcement costs between instruments and the fact that revenues from fines (associated with all instruments) can also be used to reduce existing labour taxes.

3. Case study in a partial equilibrium setting

In a partial equilibrium setting only the market of the polluting good is studied in the model. The rest of the economy is assumed to function normally[3] and not to interact with the market under investigation. Adding to this, that the production level of all firms on this market is fixed, we can concentrate fully on the study of environmental regulatory chains and their costs. The role of interactions with the rest of the economy we have already briefly discussed when describing the general equilibrium model.

A case study illustrates the partial equilibrium model. The case study involves the estimation of abatement costs by the textile industry situated by the Leie (a Flemish river). These costs depend, among others, on the environmental policy instruments in use and on the heterogeneity of the firms. Firms differ, after all, in location, history and production processes; this can lead to substantial differences in abatement costs. In the illustration we limit ourselves to the study of water pollution caused by BOD[4]-emissions of textile improvement firms and carpet producers.

3.1 Assumptions

Considering the inspection frequency we assume that every company is audited with a probability of ten percent by the environmental inspection agency. This value is based on a press release of the Ministry of the Flemish government on 11 June 2001. It states *'… that every class-I-firm is inspected thoroughly not even once every ten year'*. Moreover it is assumed that a firm in violation with the environmental regulation will have a higher probability of being inspected. This probability depends on the size of the violation. This variable part of the inspection frequency represents inspections conducted after complaints by neighbours, interest groups or civil servants other than environmental inspectors. The environmental inspection agency always reacts on such complaints (Milieuhandhavingsrapport, 2000).

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[3] A partial equilibrium model is a sufficiently correct representation of the economy when there are no important distortions present in the rest of the economy.

[4] Biological oxygen demand or BOD represents the amount of oxygen (mg/l waste water) certain bacteria use, in the course of five days at 20°C, in order to degrade the biological degradable material, more specifically for the oxidation of organic carbon to carbon dioxide.

In the model we take the different actors we distinguish in this project into account: firm, government and citizen. All possible costs associated with the environmental policy can be included in the total costs. These costs are discussed in detail and estimated in our research.

Firms have to take two decisions: firstly they decide to which degree they will comply with the environmental regulation and secondly they determine which technology will be used to comply. These decisions are taken in order to minimise the expected costs.

3.2 Instruments: profile and selection of regulatory chains

We work with a limited regulatory model. The instruments we combine within this model are:

- Rule-making instruments: emission taxes, emission standards, technology standards, authorising notification duties and license duties;
- Implementation instruments: documentation duties, notification duties and inspection and maintenance duties;
- Sanctioning instruments: criminal fine, administrative fine, transaction offer, suspension, cessation order, regularisation order and withdrawal ex nunc.

For each of these instruments we have developed a profile, based on an analysis of the legislative framework (human right treaties and the constitution) and of the legislative practice since 1946. This instrument profile was adapted to the regulatory and political background of the case study. The building blocks of the instrument were subject of a cost analysis. Next an example of such a profile for the emission standard is given.

> *Emission standards* determine the allowable emissions or introduction of pollutants by humans in water, atmosphere or soil. They can prohibit or limit emissions. Emission limitations can be limiting in location, timing or quantity.
>
> In light of the comparison we make between emission standards, emission taxes and technology standards only the emission limitations are relevant. We therefore do not discuss the emission prohibition.
>
> The regulator, who designs an emission limitation, has to determine several elements. If he opts for a quantitative emission limitation, he has to select a *parameter* and the *unit* in which it is expressed. He has to *value* each parameter in the selected unit. In principle, he also has to decide on the *measuring method* (method of sampling, analysis and interpretation of results). In order to implement and enforce the rule it is necessary that the point of emission is accessible and measurable. An obligation to install *measuring devices* and an *obligation to perform and register measurements* can be added. The legal formalisation of the whole should happen through a law or decree (mainly for its legal basis) and through executory decisions (technical aspects) (decision corpus and appendices). As will be clear later, it can, moreover, be necessary to systematically arrange certain aspects on the level of individual administrative decision.
>
> Emission limitation aimed at reducing water pollution use physical, chemical and microbiological *parameters*. In general physical parameters are expressed in specific *units*. Temperature and acidity of water, for example, are respectively expressed in degrees Celsius and pH. Chemical and microbiological parameters are mostly expressed as

concentrations (quantity per unit of volume). When emission limitations concern emissions in water, simple concentrations, such as microgram per litre, are since the eighties no longer in use; concentrations linked with a reference volume or exceptionally with the output quantity or production capacity are now in use. The objective of this approach is to make the policy more than a dilution policy. The combination with the reference volume or with production data immediately implies an effort level for the polluter to reduce emissions. This combination expects the determination of the allowable values on a regulatory scale (sectoral reference volume or sectoral coupling with production data) and the determination of the license itself. The determination of the license is a rescaling of the regulatory determination in light of the relevant firm data. We decide to model the chemical and microbiological parameters as concentrations combined with a sectoral reference volume, with rescaling based on the individual license.

The *values* chosen mostly are a combination of an immediate value and a calculated value based on the average value over a short time period, namely one day (24 hours). Obviously the immediate value is less stringent than the average value. We opt to model the combination of an immediate value with a value averaged over 24 hours. Moreover, the legislative practice only deals with emission limit values. The determination of measurement methods has recently become common practice; this greatly improves the knowability of the rule. We, therefore, only use emission limit values and presume that the measurement methods have been defined.

The *accessibility and measurability* of the effluent point is most efficiently organised by means of a general statement that dictates that this point and its access roads should always be easily and safely accessible and should safely allow measurements and sampling. This is, therefore, the way we assume this aspect to be handled in the remainder of our analysis.

The obligation to install *measurement equipment* and to *perform and register measurements* is often imposed. We choose to model the emission limitation both with and without obligation to install measurement equipment and to perform and register measurements.

The instruments were combined into regulatory chains for further research and are mentioned in table 2.

Chain	Rule making	Implementation	Enforcement
1.	Emission tax	Documentation duty Notification duty 2	a) Criminal fine b) Administrative fine c) Transaction offer
2.	Emission standard (1)	Inspection and maintenance duty	a) Criminal fine b) Administrative fine c) Transaction offer
3.	Emission standard (1) Authorising notification duty	Inspection and maintenance duty	a) Criminal fine b) Administrative fine c) Transaction offer

4.	Emission standard (1) License duty	Inspection and maintenance duty kennisgevingsplicht 2 Inspection and maintenance duty	a) Criminal fine b) Administrative fine c) Transaction offer
5.	Emission standard (2)	Documentation duty Notification duty 1	a) Criminal fine b) Administrative fine c) Transaction offer
6.	Emission standard (2) Authorising notification duty	Documentation duty Notification duty 1	a) Criminal fine b) Administrative fine c) Transaction offer
7.	Emission standard (2) License duty	Documentation duty Notification duty 1 Notification duty 2 Inspection and maintenance duty	a) Criminal fine b) Administrative fine c) Transaction offer
8.	Technology standard	Notification duty 1 Inspection and maintenance duty	a) Criminal fine b) Administrative fine c) Transaction offer
9.	Technology standard Authorising notification duty	Notification duty 1 Inspection and maintenance duty	a) Criminal fine b) Administrative fine c) Transaction offer
10.	Technology standard License duty	Notification duty 1 Notification duty 2 Inspection and maintenance duty Inspection and maintenance duty	a) Criminal fine b) Administrative fine c) Transaction offer

Table 2

3.3 Cost factors and cost analysis

We identify cost factors that result from the legal context and from the instrument itself. The cost factors resulting from the legal context are:

- guarantees required for civil rights;
- guarantees required for criminal pursuits;
- the possibility that an instrument is unavailable;
- uncertainty about the competency status of an instrument or a variation thereof;
- dysfunctional structure of the instrument due to limitations in the division of competencies;

- structural susceptibility of the instruments for violations of the equality principle or the discrimination injunction

The cost factors resulting from the instrument itself are:

- sustainability
- technical content (environmental and legal)
- knowability
- rules which require a procedure to be implemented
- legal formalisation
- time profile in the implementation stage
- rules which require an administration as implementation partner
- flexibility
- clustering (necessary versus advisable)

For each of these cost factors we have performed a relative valuation per instrument and taken into account the different stages of the regulatory chain as well as the information question.

For firms these costs consist, among others, of abatement costs, of expected fines when violating the environmental regulation and of costs associated with the extra administrative obligations. Managers, for example, have to stay on top of the different regulatory obligations and their consequences for the company. If necessary they have to request a license. They have to collect information about the different technological possibilities in order to comply with the regulation. Possibly employees will need extra training. The firm also incurs costs of the yearly tax assessment. Data have to be collected and filled in. Calculations have to be made. Moreover firms need to perform measurements in order to determine its actual emissions. Firms will also have to accompany the inspectors, when it is being inspected, and will have to perform a contra-analysis if necessary.

For the government costs are incurred, among others, during the legislative process (e.g. meetings with interest groups, with administrations and with experts; asking the advice of the Council of State; the publication in the Law Gazette…). Moreover there are also costs connected with the implementation of procedures (e.g. licensing procedures) and with the spreading of information about the new environmental policy. We also take the costs into account associated with the inspections on site and law suits.

Citizens, for example, incur costs when lobbying. Other costs are, e.g., associated with procedural rights (e.g. use the right to look into records, file an appeal concerning licences).

These costs (can) differ from instrument to instrument. The managerial costs associated with monitoring and enforcement will only be attributed to companies that are actually inspected.

3.4 Results

In order to be able to compare alternative regulatory chains, the total welfare costs that are necessary to reach one particular level of emissions, are calculated for different combinations of instruments. The choice of the regulatory chain determines how firms, government and citizens act and what the associated costs are. Total welfare curves (firms, government and citizens) of a regulatory chain are the most important output of this model. An example of our results for regulatory chains containing a transaction offer is found in figure 1.

The global welfare functions associated with each regulatory chain lead us to eight key observations.

1. Firstly we see that it only pays to pursue an environmental policy if the resulting emission reduction exceeds a minimum amount. The main reason behind this observation is that there are fixed costs linked with the environmental regulation. Only if the corresponding environmental benefits are high enough and exceed the fixed costs, it is worthwhile to implement an environmental policy.

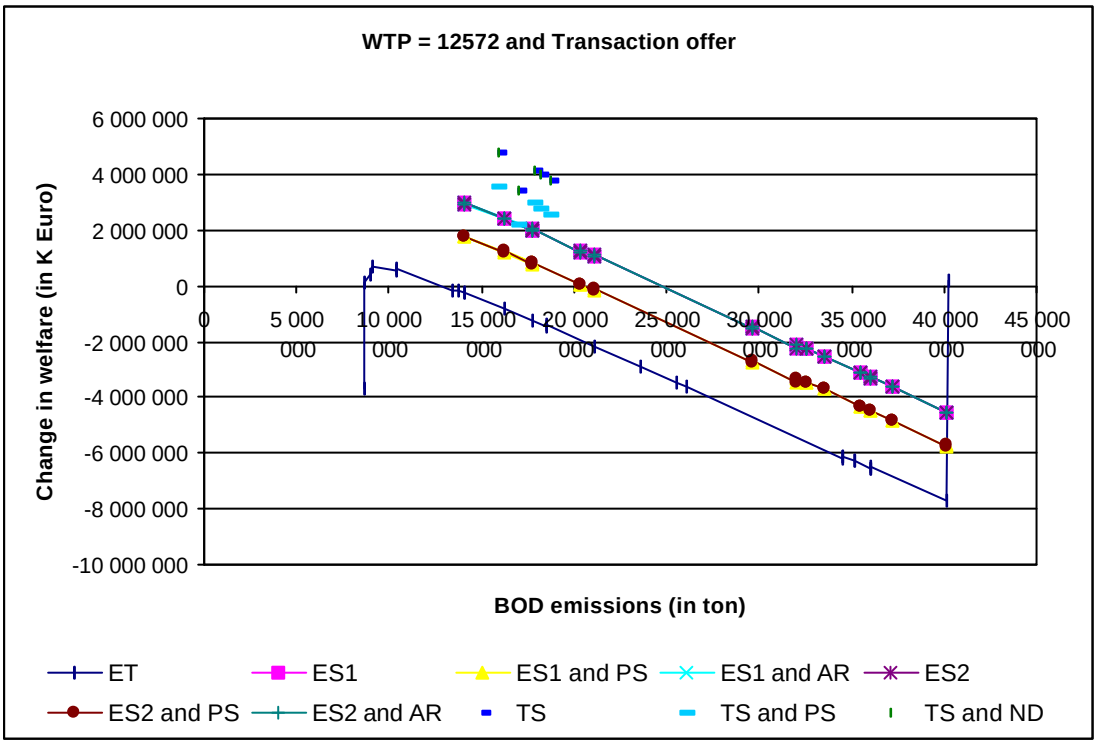

Figure 1[5]

2. Secondly, in order to obtain a given emission reduction, the emission tax turns out to be the most expensive instrument. Using a technology standard leads to the highest welfare level. However, the use of this instrument is extremely limited since it can only reach as many levels of emission reductions as there are abatement technologies. This result is highly sensitive to changes in monitoring and enforcement parameters and to the implementation procedure for emission taxes used in Belgian environmental law.
3. Thirdly we find that, given the currently assumed enforcement policy, an emission standard can only limit emissions to a certain extent. It is impossible to obtain the maximal possible emission reduction even if we set the standard equal to zero and thus allow for no emissions at all. The reason is that current enforcement is not stringent

[5] Abbreviations are: emission tax *(ET)*, emission standard version 1 or 2 *(ES 1/2)*, technology standard *(TS)*, authorising report *(AR)* and license system *(PS)*.

enough; so that it does not pay for the firms to invest in very costly abatement. They prefer to take the risk of getting inspected and caught.

4. Further we compare three different variations of the emission and technology standard. Adding an authorising notification duty to a standard only minimally increases the associated costs. Including the standard in a license system, on the contrary, markedly increases costs.
5. Costs associated with implementation instruments are generally low but the cumulative effect can cause costs to increase considerably.
6. The criminal fine is by far the most expensive instrument to use and, as could be expected, the transaction offer is the cheapest to use. However, in reality these three instruments are often used as complements. For minor violations, a transaction offer will often suffice. A criminal fine will be used for serious violations or extremely uncooperative firms. The administrative fine also has its specific use. Using an administrative fine avoids the social stigma associated with criminal fines. Therefore we cannot a priori choose one of the enforcement instruments as being 'the best'.
7. Sensitivity analysis shows that the results are – in certain aspects – highly sensitive to the differences in willingness to pay for water quality improvements. The higher the willingness to pay for the improvement in environmental quality, the more it pays to pursue an environmental policy even if emissions are only minimally reduced. Remarkably, the changes in willingness to pay do not influence the relative position of the different instruments. The emission tax remains the most expensive and the technology standard the cheapest.
8. Sensitivity analysis with respect to the enforcement parameters (fixed inspection probability, coefficient of variable inspection probability and the penalty coefficient) shows their immense importance. Choosing the optimal level of the parameters is crucial to the decision of the appropriateness of environmental regulation. Changing the level of the parameters can suddenly make a policy worthwhile pursuing.

In conclusion we can say that a detailed identification and estimation of information, monitoring and enforcement costs associated with an environmental policy, can greatly change traditional results with respect to the relative efficiency of instruments. Our numerical illustration proves this point by showing how an emission tax can be the most expensive instrument to use in order to obtain a particular level of environmental quality. This result holds even if we include heterogeneity of the industry into our model.

Moreover we have also shown that it is important to use a correct estimate of the willingness to pay for environmental improvements but that is even more important to formulate an appropriate monitoring and enforcement policy. The decision of whether or not to pursue an environmental policy depends on it.

PERSPECTIVES FOR APPLICATION

Firstly the project enlarges our knowledge of environmental policy instruments by developing criteria for a systematic assessment of the instruments' performance.

The instrument profiles we constructed for the analysis and definition of different environmental policy instruments, are, without doubt, useful for further legislative work.

The economic conceptual model we constructed, is an instrument to assess and order the relative cost efficiency of regulatory chains. It offers a methodology for further research of other instruments, such tradable emission permits. The systematic investigation of the cost efficiency of policy instruments, is, according to us, an indispensable step in pursuing an efficient and effective environmental policy.

This research also showed that the inclusion of all costs – or at the very least as much as possible – has in important impact on the relative efficiency of environmental policy instruments. Instruments, such as emission taxes, that are traditionally described by economists as being highly cost efficient, become much more expensive when all rule-making, implementation and enforcement costs for firms, government and citizens are included.

One of the most interesting conclusions we can draw from this project is, according to us, the importance of a well-developed monitoring and enforcement policy. Without a clear and effective enforcement policy the impact of the environmental regulation will be minimal. From the results we obtain, one can clearly see that an optimum can be reached when designing an enforcement policy. This optimum is somewhere between the total lack of enforcement and complete and full enforcement. It is, therefore, advisable to weigh benefits of enforcement and associated costs carefully.

This research project has built a framework for interdisciplinary collaboration on the field of Law & Economics concerning environmental policy. The cooperation between legal scholars and economists has provided both disciplines with important insights and clarifications. We will build on this cooperation when working on the PODO II- project ‘Law & Economics and the enforcement of environmental regulation’ (2001-2004).