Statistiska centralbyrån
Statistics Sweden

eurostat

Environmental Protection Expenditure Accounts in Sweden – a pilot application and analysis

Final report to Eurostat

Maja Cederlund, Mats Eberhardson, Fredrik Kanlén and Nancy Steinbach
Statistics Sweden 2009

Preface

This report has been prepared on commission and with financial support from Eurostat (EU Grant Agreement 71401.2007.014-2007.474), which assists and coordinates the development of environmental statistics in the EU Member States. Maja Cederlund, Mats Eberhardson, Fredrik Kanlén and Nancy Steinbach have carried out the work and are responsible for the contents of the report. The authors would like to thank following persons for their valuable assistance and input to this work: Viveka Palm, Anders Wadeskog and Gunnel Wahlstedt from the department of Regions and Environment, Mattias Björling, Anders Jäder and Birgitta Magnusson from the department of National Accounts and Mikael Molén from the department of population and welfare at Statistics Sweden, Hans Liedholm from the Swedish Forest Agency, Björn Åsgård from the Swedish Board of Fisheries, Guy Vandille from the Belgian Federal Planning Bureau, Federico Falcitelli from the National Statistical Office of Italy and Danguole Krepstuliene from Statistics Lithuania.

In 1993, Statistics Sweden, the National Institute of Economic Research and the Swedish Environmental Protection Agency were instructed by the Government to prepare a study covering the physical links between the economy, the environment and natural resources, the monetary reflection of these relations and the state of the environment. The aim of the work on environmental accounts at Statistics Sweden is to develop and maintain a system of physical accounts that are linked to the production and consumption activities described in the National Accounts. In practice, this means developing and maintaining a system of environmental and natural resource statistics linked to the industry, product and sector categories used in the National Accounts, thus forming a satellite system of accounts around the National Accounts.

According to the UN, a system of environmental accounts should in principle cover[1]:

- Flows of materials through the economy, e.g. energy and chemicals, together with the emissions and waste to which these flows give rise. Within the EU, many countries have opted to use the NAMEA system[2] to describe these flows.
- Economic variables that are already included in the National Accounts but are of obvious environmental interest, such as investments and expenditure in the area of environmental protection, environment-related taxes and subsidies and environmental classification of activities and the employment associated with them.
- Natural resources: Environmental accounts should make it possible to describe stocks and changes in stocks of selected finite or renewable resources. Environmental accounts should deal both with questions related to the monetary valuation of this natural capital and qualitative aspects that do not have any market or other defined monetary value, e.g. the value of outdoor life and biodiversity.

Statistics Sweden, February 2009

[1] The SEEA handbook can be downloaded at http://unstats.un.org/unsd/envAccounting/seea2003.pdf

[2] NAMEA stands for National Accounting Matrix including Environmental Accounts. In principle this is a Social Accounting Matrix (SAM) supplemented by environmental accounts data on, e.g., emissions to air and waste, linked to the Use and Supply Matrices that a SAM is constructed around. Just as a SAM is a way of presenting National Accounts data, NAMEA is a way of presenting environmental accounts data.

Summary

In this project the aim has primarily been to collect and compile environmental protection expenditure accounts (EPEA) for Sweden. This has involved evaluations of earlier work done in Sweden as well as describing data gaps in the EPEA and the attempt to close them if possible.

The intention was to let the 16 Swedish environmental objectives provide a lead in covering the EPEA tables with a full picture of the actions in relation to environmental protection. The complexity of the objectives showed that a lot of the objectives cross into several actors and they do not provide a clear guidance on who should deal with them. So this project could mainly make assumptions on where there might be actions taken on the basis of the goals of the objectives.

Problems of filling out the tables aroused as main economic statistics do not separately identify transactions related to the environment. Statistics Sweden built on the Belgian experiences as these provided a thorough methodology for estimating most data with the help of the national accounts' input/output tables. In the case of governmental activities and transfers, data from National accounts and Environmental accounts were used. The data on transfers differed between the COFOG and the Environmental Accounts which meant that the production table (Table B) and the Expenditure table (Table A) did not match up properly (as well as for the financing table, Table C).

The experiences of the project show that it takes a considerable amount of time to compile these kind of data as well as understanding the results from the tables. The conclusion is that the EPEA tables are a solid base to those who understand national accounts and should be maintained as such. With the large amount of estimations, data gaps and unexplained statistics in the Swedish EPEA the simpler indicators are to be recommended until better knowledge of the statistics are available.

In the project there were also a subordinate purpose interlinking the monetary aspects of EPEA with physical entities such as energy use and emissions at a micro level. This included collection of data from a number of different sources to construct a data set to be analysed. This part of the project turned out to be difficult due to the quality of data. Instead of performing analysis only at the micro level the decision was taken to also include industry level analysis. Unfortunately, none of the attempts succeeded in producing solid results but the efforts made were fruitful in so much as they illustrated the possibilities and methodologies to be used in analysing. Moreover, first steps are taken towards the understanding and knowledge of the kind of data sets and quality needed for these types of analysis.

Table of Contents

1. Introduction

1.1 Background

In 1996 Statistics Sweden published a first evaluation of the possibilities to compile Environmental Protection Expenditure Accounts (EPEA) in accordance to SERIEE[3] published in 1994 by Eurostat (SCB 1996). The EPEA is a set of tables containing a number of environmental economic variables that provides information consistently with the National Accounts. The EPEA captures not only the economic contribution but also the financing side of environmental protection for the entire economy. The 1996 study identified a number of weaknesses for the Swedish case of EPEA. For example, the coverage of economic sectors was not good, there was a lack of information on connected and adapted products related to the environment and existing data were not broken down into environmental domains such as for example air, waste or water. On top of that, information on consumption of fixed capital, compensation of employees and intermediate consumption was missing. At Statistics Sweden today, statistics measuring environmental protection expenditure (EPE) for industry and government are readily available. Separate studies have been done for the identification and presentation of environmental taxes and environmentally motivated subsidies/transfers. So far main efforts have been focused on the survey on EPE for industry. Previous studies at Statistics Sweden (SCB 2000, 2001, 2002, 2003a) have evaluated and developed better methodology thereby increasing the quality of the statistics for the *mining, quarrying, manufacturing and electricity and hot water supply* industries (NACE[4] rev 1.1 C, D and E). There have also been a couple of studies looking into government spending on environmental protection (SCB 1997, 2006). However, by only accessing parts of the economy unbalanced analyses are inevitable as was concluded in the 1996 study. By this is meant that only selected industries are highlighted and comparisons with for example the gross domestic product of a country is not completely accurate. It is at this stage important to evaluate what has been done and to link the efforts of the different actions previously made at Statistics Sweden.

1.2 Purpose

The overall objective of this project is to be able to compile environmental protection expenditure accounts (EPEA) for Sweden. This will be done according to international standards so that full harmonisation and compatibility exist for comparisons over country boarders.

The objective of this action can be divided into four actions.

Mapping data and compiling EPEA

1. An evaluation of the Swedish actions done in previous years in order to map the existing information for the completion of EPEA.
2. The data gaps in the EPEA needs to be described and where possible closed. It is anticipated that the expenditure aspect can be covered quite well, but problems might occur on the income and financing side.

[3] European system for the collection of economic data on the environment
[4] Statistical classification of economic activities

Analysis and evaluation
3. At a macro level, an evaluation of the use and result of the Swedish EPEA will be done with an outlook on international studies and analysis.
4. The fourth action consists of doing a separate analysis at a micro level, that is, at enterprise level. The micro level approach will interlink the monetary aspects of the EPEA with physical entities such as energy use and emissions. A selection of industries will be chosen, NACE rev 1.1 21 *Pulp and paper*, 24 *Chemicals*, 27 *Metal and steel* and 40 *Electricity, gas and hot water supply* industries will be the main targets.

1.3 Delimitations

This report is fully dependant on the basic statistical sources available today. No new data collection was foreseen for this project and none has been undertaken. Estimations have been done where possible for missing economic sectors or variables.

2. Method

The point of departure of this study is to evaluate previous studies done in Sweden that aimed at leading to the part completion of EPEA. The project will also take stock of other countries efforts and methods for example in Belgium, Italy and what has been done through the Eurostat funded Phare 2003 project in Lithuania, Poland, Latvia, Hungary and Slovakia.

The second step is to map existing data into the theoretical framework of EPEA (Eurostat EPEA compilation guide 2002) and identify data gaps and areas in need of further development. This step will be done in co-operation with relevant units at Statistics Sweden such as the National Accounts, the structural business statistics as well as sectoral statistics measuring the activities of for example the agriculture sector. It is expected that the expenditure side can be well covered for industry (NACE rev 1.1 C *Mining and quarrying*, D *Manufacturing* and E *Electricity, gas and hot water supply*) through the environmental protection survey, as well as for government through COFOG and specialised producers (NACE rev 1.1 90 *Waste water, waste management*) through the structural business statistics survey or through the National Accounts.

The third step is to evaluate the result of the compiled EPEA. Is the information that can be derived from the EPEA worth the efforts of compiling EPEA? Can useful comparisons be made to other countries that are compiling EPEA? How can results be communicated to the user community of decision- and policy makers?

Besides this evaluation at macro level (economic sectors) the underlying data will be available for further analysis. Through this project an opportunity is given to analyse individual enterprise statistics incorporating monetary data with physical data. Questions of interest are: have the spending of individual enterprises on environmental protection equipments, processes and materials had an effect on pollution levels, energy use or on eco-efficiency?

2.1 Definition and scope of environmental protection

Definition
In the early 1990s Eurostat and national statistical offices developed a framework for the compilation of economic data on environmental protection. The results were published in the 1994 SERIEE (European System for the Collection of Economic Information on the Environment). The following definitions are applicable to this report:

Environmental protection groups together all actions and activities that are aimed at the prevention, reduction and elimination of pollution as well as any other degradation of the environment. This includes measures taken in order to restore the environment after it has been degraded due to the pressures from human activities (1994 SERIEE §2006).

Activities like water supply or the saving of energy or raw materials are regarded as the management of natural resources and are excluded from environmental protection. However, such activities are considered environmental protection activities to the extent that they mainly aim at environmental protection. An important example is recycling which is included to the extent that it constitutes a substitute for waste management (1994 SERIEE § 2008).

It is important to keep in mind that that the selection criteria for the activities (and the related expenditure) are that environmental protection is the prime objective. Actions and activities

which have a favourable impact on the environment but which serve other goals are not included in the statistics of environmental protection.

National environmental protection expenditure
Eurostat describes and elaborates on the definition and scope of aggregate national environmental protection expenditure and are cited below (Eurostat 2002a pages 15-16).

In a National Accounts perspective, environmental protection expenditure (EPE) includes:
a) The domestic uses of EP products (goods and services). These EP products are either EP services (e.g. waste or wastewater collection and treatment services) or connected and adapted products (e.g. refuse containers, catalytic converters, lead free gasoline, etc.). Uses are either final uses (final consumption or capital formation) or intermediate consumption. EPE also includes the value of the EP services produced in-house for internal use to reduce the environmental impact of the main production activities (ancillary activities).
b) Domestic gross capital formation for environmental protection (investments for EP).
c) Those transfers for EP that are not already reflected in the expenditure recorded under the two previous categories. These are in particular subsidies, which lower the prices paid by the users of EP services. Ignoring these subsidies would result in an underestimation of total expenditure. However, in practice such subsidies are often not very important. In practical accounting transfers without a counterpart in basic data may also be important (e.g. government transfers designed to fund environmental protection to non-profit institutions, farmers or others when the expenditure of these beneficiaries is not surveyed). These transfers are also to be included in EPE when data on the EP expenditure of the beneficiaries are not available.

The sum of these components gives total domestic EPE. Adding transfers (financing) to the rest of the world and deducting transfers received from the rest of the world leads to total national EPE. This aggregate is constructed in a way that avoids double counting and makes the sum comparable with standard National Accounts aggregates such as gross domestic product (GDP) or gross national income (GNI).

Classification of Environmental Protection Activities
The classification used in this report follows the Classification of Environmental Protection Activities (CEPA 2000). This is a UN classification adopted already in 1994 and revised in 2001. CEPA is a functional classification to classify activities, products, outlays and other transactions whose primary purpose is environmental protection.

Table 1. CEPA 2000 classes

1 Protection of ambient air and climate
2 Wastewater management
3 Waste management
4 Protection and remediation of soil, groundwater and surface water
5 Noise and vibration abatement
6 Protection of biodiversity and landscapes
7 Protection against radiation
8 Research and development
9 Other environmental protection activities

This report will present CEPA classes 1, 2, and 3 separately and classes 4-9 as one class labelled "Other".

Economic activities
The EPEA tables will require information about which the actors are providing EP services[5] (Table B) and who is purchasing these activities (Table A). A third set of activities needed to be identified; who is financing EP expenditure (Table C). That means that three aspects need to be evaluated.

Firstly, who are the specialised producers? It has been described in literature that primary activities of specialised producers can be identified as entities belonging to waste and waste water management (NACE rev 1.1 90 Waste water and waste management) (Eurostat 2002a, 2007a). On top of this there are secondary activities performing services to treat pollution. These are for example from a Swedish perspective pulp and paper industries purchasing waste from the local area to burn in their furnaces for energy production. A Belgian study identified specialised secondary producers belonging to NACE rev 1.1 41 *Water distribution*, 45 *Construction*, 51 *Whole sale trade and commission trade*, 60 *Transport*, 70 *Real estate*, 74 *Other business activities* and 75 *Public administration* when further developing the Belgium EPEA tables (Vandille 2005). An Austrian study identified an additional group performing EP services located in NACE 73 *Research and development* and 92.53 *Botanical gardens, animal parks and natural reserves* (Baud 2006). In addition the Italian statistical bureau lists also NACE categories such as 25.12 *Retreading of tyres*, 35.11 *Building of ships* (Istat 2008). A third group, ancillary activities can also perform EP services. These are activities not sold to a third party but used in-house and exist in all sectors of the economy. The EPEA tables (Tables B and B1) do not include the measurement of the production of EP goods, i.e. what is known as part of the environmental goods and services sector; on the other hand, the uses of EP goods is covered within the national EP expenditure (Table A) and consequently in the aggregates describing the financing of the national expenditure (Tables C and C1).

> · Specialised producers, i.e. environmental protection is their main activity (e.g. producers whose main activity is the collection and treatment of wastewater). Government specialised producers are distinguished from other specialised producers (mainly enterprises).
> · Producers that undertake environmental protection as a secondary activity (e.g. a cement producer which also sells services for burning waste in its furnace, recycling companies that also treat waste).
> · Producers that undertake EP activities in-house for own use (ancillary activities) in order to limit the negative environmental effects of their main production activity (e.g. a refinery or electricity producer that treats its exhaust gases or effluents).
>
> (Eurostat 2002a page 19)

Secondly, who are users of EP services? The EPEA follows the same principles as the supply and use approach of the National Accounts. This means that the double entry accounting system applies. If someone is using a service there must be someone providing the resource and this is in short what is meant by supply and use. The same goes for someone who receives a transfer; the transfer has to be given by somebody. To monitor these activities seems a simple enough task but the measurement has to be in line with the definition stated above as well as be recorded in statistics. What can we consider to be an environmental protection investment, consumption or a transfer/transactions for example within the industry? Or the households? Or the government?

Eurostat has developed more detailed operational guidelines on environmental protection expenditure in industry as well as for specialised producers and governments (Eurostat 2005a,

[5] So called characteristic producers which include principal (specialised producers), secondary and ancillary (non-specialised producers) activities.

2007a). While operational guidelines are provided for all economic and institutional sectors also in the Eurostat 2002 EPEA Compilation guide, some areas remain still open for discussion and interpretation, such as for example households.

Thirdly, who is the financing unit of EP services? The same considerations apply here as for the ones made previously. Supply must equal demand. In this case the most important aspects to capture are government outlays; for example investment grants, subsidies or transfers to households for environmental protection or to the business sector.

Below in section 2.3 are these three aspects described for each sector that are presented later on in this report.

2.2 Swedish environmental quality objectives

In 1995, 15 environmental quality objectives were adopted by Parliament. In late 2005 an additional objective was accepted. These objectives define the state of environment which environmental policy aims to achieve and provide a coherent framework for environmental programmes and initiatives at national, regional and local level.

For this report the 16 objectives are a guide to where to look for expenditure that could potentially fall under the environmental protection definition. At the same time, from a Swedish perspective it is of interest to see how much the EPEA can capture out of the 16 environmental objectives and if there are areas not covered by the EPEA framework. Some measures can be isolated to one sector of the economy but some of them will affect several sectors.

16 Environmental Quality Objectives

1. Reduced Climate Impact
2. Clean Air
3. Natural Acidification Only
4. A Non-Toxic Environment
5. A Protective Ozone Layer
6. A Safe Radiation Environment
7. Zero Eutrophication
8. Flourishing Lakes and Streams
9. Good-Quality Groundwater
10. A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos
11. Thriving Wetlands
12. Sustainable Forests
13. A Varied Agricultural Landscape
14. A Magnificent Mountain Landscape
15. A Good Built Environment
16. A Rich Diversity of Plant and Animal Life

2.3 Sectoral specific activities of environmental protection

As mentioned above two in-depth handbooks have been published by Eurostat in order to assist in determining and identifying some main aspects of environmental protection statistics. However, some sectors are still not covered by any guideline other than the broad definition. In order to clarify what this report has covered a discussion follows below on some main sectors and some main variables that are attempted to be quantified in the EPEA tables.

Agriculture, forestry and fishery (NACE rev. 1.1. 01, 02, 05)

Agriculture

The agricultural sector is considered to produce ancillary EP services (for Table B) as non-specialised producers to the extent that they are performing activities to reduce their own pressure on the environment.

Environmental quality objective 13 cover: *A varied Agriculture landscape* "The value of the farmed landscape and agricultural land for biological production and food production must be protected, at the same time as biological diversity and cultural heritage assets are preserved and strengthened."[6]

Organic farming is a production method growing in popularity in Sweden. Organic farming in Sweden means that chemical pesticides, artificial fertilizers and GMO's cannot be used in the production process. Organic farming for meat production also exists. For a meat producer to be labelled organic means for example that he/she has to provide grazing opportunities for the cows, pigs or chickens. It cannot be said that organic farming in-itself can be defined under the definition of environmental protection statistics. However, the cost of restructuring and maintaining the farm production from traditional to organic could be considered an EP activity. Today the government is supporting organic farming through finances from the state budget and which is, by experts in the area, considered to cover the cost of restructuring traditional type farming to organic farming.

In addition, activities that a farmer is doing to prevent leakage into nature from manure and the expenditure of removing waste would fall under the definition. Expenditure also exists in the form of licences, environmental reporting and similar issues that the farmer has to provide to the municipalities and government agencies.

Forestry

The forestry sector is considered to produce ancillary EP services (for Table B) as non-specialised producers to the extent that they are performing activities to reduce their own pressure on the environment.

Objective 12 covers the area of *Sustainable forests*. "The value of forests and forest land for biological production must be protected, at the same time as biological diversity and cultural heritage and recreational assets are safeguarded."[7] On top of this environmental objective a further 4 environmental objectives cross into the forestry area. These are: *Thriving Wetlands*, *A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos*, *Flourishing Lakes and Streams* and *A Varied Agricultural Landscape*. As far as the objective for *Reduced Climate Impact* is concerned, the goal there states that "in assessing progress towards the target, no allowance is to be made for uptake by carbon sinks or for flexible mechanisms".

As with organic farming, sustainable forestry will effect the production process of the industry by them changing production methods. This can specifically apply to certifying forests. The expenditure of changing behaviour of fertilizing the ground for a speedy growth of the trees, the expenditure for the certification itself and for the people involved would be considered an EP activity.

At the same time the Swedish national policy aims at looking to the producers for them to leave some forest as nature reserves. This policy is based on voluntary agreements and would not provide the producers with some compensation. These voluntary agreements are for some

[6] www.miljomal.nu/english/obj13.php
[7] www.miljomal.nu/english/obj12.php

enterprises part of their environmental policy. It can be seen as promoting biodiversity, facilitating for other activities such as recreation or reindeer management or simply as benchmarking and attracting environmentally aware customers. In terms of expenditure it seems to be difficult to pinpoint these. The direct expenditure would off course be the time spent by the individual enterprise selecting the areas to be reserved, i.e actual management costs. Others could be if the enterprise bought land and earmarked some of that to be reserved. From an economic perspective it would be tempting to look at the loss of production as expenditure for the reservations. However, these are not actual outlays but fictional and could not be considered falling under the definition of environmental protection. However if the forest enterprise bought forest particularly to set it aside the investment would be considered an EP activity. But after discussions with experts in the field it appears as if this is not a common procedure.

Fishery
The fishery sector is considered to produce ancillary EP services (for Table B) as non-specialised producers to the extent that they are performing activities to reduce their own pressure on the environment.

Environmental objective 10 cover *A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos* "The North Sea and the Baltic Sea must have a sustainable productive capacity, and biological diversity must be preserved. Coasts and archipelagos must be characterized by a high degree of biological diversity and a wealth of recreational, natural and cultural assets. Industry, recreation and other utilization of the seas, coasts and archipelagos must be compatible with the promotion of sustainable development. Particularly valuable areas must be protected against encroachment and other disturbance. "[8] In addition to the main objective, sea life is also under consideration in other objectives such as *Flourishing Lakes and Streams*.

One has to be careful when it comes to sustainable fishery. Adapting fishing methods would reduce for example the amount of fish caught and thereby reduce the amount of fish that has to be thrown back into the sea as residue. Is this an action to improve the biodiversity or to be careful with the amount of natural resource extracted that the country is responsible for? A Swedish government proposition described in 1997 that the largest impact the fishery has today is the amount of non-wanted side-catches and the damages on the sea floor. If too much fish is caught in combination with reduced oxygen levels this can increase eutrophication. In addition, the national environmental objective for the area would support that for Swedish situation expenditure for implementing sustainable fishery would be considered an EP activity. However, according to current methodology the correct procedure would be to separate the environmental protection activity from the management of resource activity (i.e. management of fish stocks) (UN/FAO 2004).

Mining, Quarrying and Manufacturing (NACE rev. 1.1. 10-36)
The mining, quarrying and manufacturing sector is mainly considered to produce ancillary EP services as non-specialised producers (for Table B) to the extent that they are performing activities to reduce their own pressure on the environment. However, this group of economic activities can perform EP services as secondary producers. Some of them would fall under consulting activities in relation to sales of environmental goods (filters, pumps etc.). There are a few enterprises that offer a package to the customer where also the maintenance and service are included.

The industries are rarely directly mentioned in the Swedish environmental quality objectives. Several targets are phrased in a way that the entire Sweden is concerned with reductions in

[8] www.miljomal.nu/english/obj10.php

pollutions. One exemption where the industry is directly mentioned concerns environmental quality objective 15 *A Good Built Environment* "Cities, towns and other built-up areas must provide a good, healthy living environment and contribute to a good regional and global environment. Natural and cultural assets must be protected and developed. Buildings and amenities must be located and designed in accordance with sound environmental principles and in such a way as to promote sustainable management of land, water and other resources"[9]. The interim target for this objective set for 2005-2015 states that the amount of industrial waste to landfills has to decrease by at least 50 % (this excludes waste from the mining and quarrying industry) by 2005 compared with 1994. Another interim target for the same objective says that by 2010 food waste and comparable wastes from food processing plants etc. will be recovered by means of biological treatment.

There are legal measures for the industry to improve the environmental impact. For example: the ban on CFC's in cooling systems (leads to improved ozone layer) and directives such as the emission ceilings for air pollution are have effected the expenditure of industries. However, it should be noted that emission permits would not fall under the definition of environmental expenditure. This is because the permits allows, at the enterprise level, the same level or increased levels of pollutions and does not aim, at enterprise level, for the reduction of pollution levels.

Recycling (NACE rev. 1.1. 37)
The recycling industry is a secondary producer (non-specialised), but it is so important that it is considered as a specialised producer within the OECD/Eurostat Joint questionnaire. They provide services such as accepting materials that has reached the end purpose of a consumer, sorting the material and even providing education for customers to recycle their own material.

Within the national environmental objectives one objective considers recycling. Objective 15 *A Good Built Environment* describes the importance of improved and increased recycling. However the objectives more anticipate the increase of business for this industry rather than putting restrictions to it.

Electricity, gas and hot water supply (NACE rev. 1.1. 40-41)
The Electricity, gas and hot water supply sector is mainly considered to produce ancillary EP services as non-specialised producers (for Table B) to the extent that they are performing activities to reduce their own pressure on the environment. As with, in particular the manufacturing industry these industries can contain consulting activities and other services that could be considered belonging to secondary EP services.

Construction (NACE rev. 1.1. 45)
The construction sector is mainly considered to produce ancillary EP services as non-specialised producers (for Table B) to the extent that they are performing activities to reduce their own pressure on the environment. However, it could and has, as mentioned previously in Vandille (2005) and Baud (2006), be argued that parts of the construction sector also produce a service as a non-specialised secondary producer. This would apply if the sector performed tests or other services. Industries where they could be included in are 45.12 *Test drilling and boring*, or 45.212 *General constructions of buildings and civil engineering works*.

But what if the construction enterprise is producing an entire building according to a greener concept? Could that be classified as an EP service? It would certainly not be in line with the traditional services of more or less end-of-pipe solutions such as waste or waste water

[9] www.miljomal.nu/english/obj15.php

management but more to a solution that prevents pressure on the environment in the first place. Looking at the current projects in Sweden where several larger construction enterprises are promoting their "green housing" the measures taken are mainly in order to reduce energy use, switching to renewable energy sources and such like. From the point of view of the construction industry this can be regarded as a measure to reduce the environmental impact of their product in the form of reducing climate change thereby changing the production process. In this sense it could be included as an EP service as a specialised producer. However, a previous discussion in the field considers "adapted buildings" or equipments that make building adapted/greener not to be services. Nevertheless the expenditures for making buildings greener should be captured from the use side (expenditures for connected and adapted goods - Table A), but not from the supply side which in the EPEA covers only services (Tables B and B1). The EP services related to adapted buildings – to be accounted for in Tables B and B1 – could be e.g. engineering, consulting, etc. or installation and maintenance services]

Environmental quality objective 4 *A Non-Toxic Environment impacts* on the construction industry. "The environment must be free from man-made or extracted compounds and metals that represent a threat to human health or biological diversity"[10]. One interim target set for 2010 is to phase-out substances of very high concern.

Waste management and waste water treatment (NACE rev. 1.1. 90)
Both waste management and waste water treatment are considered specialised producers for environmental protection. In Sweden the municipalities have the responsibility of maintaining the service but are in general purchasing it from private enterprises.

Services (NACE rev. 1.1 50-99 excluding NACE 90)
The service sector is mainly considered to produce ancillary EP services as non-specialised producers (for Table B) to the extent that they are performing activities to reduce their own pressure on the environment. However, most interest in Sweden today in the service sector in relation to environmental concerns is to reduce the use of non-renewable energy and to become more energy efficient. These types of activities would not fall under the definition of environmental protection.

The service sector can also be performing EP services as non-specialised secondary producers. Some non-specialised secondary producers are for example consultants, testing and analysis enterprises in NACE 74 *Other business activities* or various non-profit institutions that are active in the field of environmental protection (mainly for the protection of landscape and biodiversity, or as general environmental lobby groups) in NACE 99 *Extra-territorial organizations and bodies*.

Households
In literature (Eurostat 1994, 2002) the households are seen as consumers of EP services and of connected and adapted products. That means that they purchase the service for someone to come and collect their waste or their waste water and they purchase products that has less environmental impact in the use phase, products labelled connected and adapted products.

In Sweden, there is a focus on reducing the impact of climate change. Households are encouraged to switch their sources of energy and heat from non-renewable sources to renewable, such as wind, solar or others. This is normally a large purchase but could it be seen as an environmental protection activity or should it be regarded as the management of natural resources and therefore be excluded in the EPEA tables? The Swedish government is subsidising

[10] www.miljomal.nu/english/obj4.php

investments in this area and Eurostat recommends these government grants to be seen as an EP activity (Eurostat 2005).

Studies in Sweden asking the households why they invest have shown that more often then not behaviour of energy efficiency is not related to environmental concerns or economic constraints but is rather a way of life (Elforsk 2005, KTH 2002). The environmental concern is obviously also there but not as a number one priority.

To compare household purchases of energy products with the enterprise statistics of EPE, the Swedish survey on EPE in industry has not accepted them as EP investments as far as purchase of the new equipment, removal of old equipment and installation is concerned. The exception is if the enterprise is changing energy source from a non-renewable to renewable energy. The main reason for not accepting energy efficient measures as EP relates to the main reason for the purchases; reducing energy use also reduces the cost. However it is becoming increasingly mentioned by the enterprises that if they invest the reason is to reduce the impact on climate change.

It is important to remember that the leading criterion for including/excluding expenditures and classifying them by environmental domain is not the "intention" of the economic operator, but the technical nature of the (produced/purchased) output. In the case of investments for reducing energy consumption the technical nature reduces the intake of energy resources (and in extension air pollution); such expenditures, according to the approach recently adopted by the London Group and the Eurostat TF on EGSS, fall out for the EP scope. They should be classified as resource management.

Other measures that the households take to reduce their environmental pressure relates to food and transport. This means purchasing organic foodstuff or alternative fuels for their transportation.

The environmental quality objectives only concerns the households directly through objective 15 *A good built environment*. An interim target set for 2015 aims for recycling of household waste by 50% through materials recovery and biological treatment. There is also an interim target aiming for the recovery of food waste from the households through biological treatment.

General Government

The General Government includes the central government (ministerial departments, administrations and government agencies) as well as the local government. In Sweden there is a third group, so called County councils (Landsting) that are excluded from the concept of General Government.

The government is in the EPEA considered as both specialised producers (their gross fixed capital formation) and consumers (their non-market EP output). In Sweden the government is responsible for the administrative tasks of laying the foundation to environmental policy, strategies for the future and the implementation of legal restrictions. The majority of government agencies are funded through the state budget appropriations. There are cases where fees or charges are applied to further finance the agencies but in terms of environmental relevance there're not significant. It should be noted that there are no earmarked taxes in Sweden from consumers to the government.

2.4 Statistical sources and quality

Overall the basic data individually is of good quality. The different surveys are performed and executed according to the standards of official statistics. The National Accounts follow set up of international definitions and quality criterions. However, adapting these to the EPEA tables have not always been easy or totally satisfactory. It has not been possible to retrieve information about ancillary EP activities for all sectors of the economy. It has also not been possible to retrieve full information about EP services in different sectors.

The EPEA tables partly follow the Eurostat Excel workbook of 2002 and partly follow the methodology of the Belgian EPEA tables. In particular, the Belgian method of estimating imports and exports has been used as well as some assumptions made in the Belgian tables. These assumptions mainly refer to the area of government transfers and are further described below.

Table 2: Sectors covered in EPEA tables

Sectors/activities	Specialised producers	Secondary activities (non-spec. producers)	Ancillary activities (non-spec. producers)	c/a products
Agriculture			NA	
Forestry			NA	
Fishery			NA	
Mining			X	
Quarrying		NA	X	
Manufacturing		NA	X	
Recycling	X^1			
Electricity		NA	X	
Construction		E	NA	
Water, waste water treatment	X			
Services		E		
Households				X^2
General government	X			

NA: no data used or available, X^1:should have been classified as secondary activity in accordance with SERIEE but in this case the Joint OECD/Eurostat Questionnaire instructions were followed, X^2: parts of used or available, E: estimated

Estimations of secondary non-specialised producers

For the secondary non-specialised producers of EP services the Swedish database on environmental sector at Statistics Sweden was used in order to calculate a share. This was needed as there is no detailed statistics available on their activities and expenditures.

The ratio was calculated on the basis of a share of turnover for the industries in NACE 45, 51, 60, 70, 73, 74 and 92 (see below in table 3 for the names of the industries). These sectors were chosen on the basis of the studies made in Belgium, Italy and Austria.

The procedure was to take the turnover of the establishments in the database as numerator to the total turnover of the specific sector it belongs to. Table 3 shows the ratios being applied in the EPEA tables.

Table 3: Secondary non-specialised producers, % of total turnover

NACE rev. 1.1 45 Construction	3,1%

NACE rev. 1.1 51 Whole sale trade and commission trade,	2,7%
NACE rev. 1.1 60 Transport	4,9%
NACE rev. 1.1 70 Real estate	0,4%
NACE rev. 1.1 73+74 Research and other business activities	7,3%
NACE rev. 1.1 92 Recreation and other activities	0,0%
Total	2,3%

The establishments are coded according to a type domain recommended in the Eurostat/OECD manual (and up-dated in accordance to the draft Environmental Goods and Services Sector handbook currently underway). Through the domain code it was possible to exclude establishments in the relevant NACE categories that dealt with for example indoor air quality or eco-tourism. Table 4 shows the domains included in the data extraction.

Table 4: Enterprises in following domains were chosen from EGSS database:

Air	Water	Waste	Soil and ground water
Air outlet regulator	Waste water treatment	Waste treatment	Noise
Renewable energy		Recycled materials	Surveillance
Heat and energy saving			Sustainable forest
			Other

Estimation procedures for ancillary activities of environmental protection
The EPEA tables require information about ancillary EP activities. Ancillary activities fit the description of own account measures to reduce environmental pressure as described above. The survey of EPE in industry has been used to approximate these activities.

Calculations for consumption of fixed capital
Consumption of fixed capital (CFC) for environmental investments had to be calculated for ancillary activities. The total EP investments from the EPE industry survey have been used as basic background data and the National Accounts ratios have been applied per NACE. The National Accounts apply the perpetual inventory model (PIM) to derive appropriate ratios. The depreciation rate was made on type "non-specified machines" with an expected life time of 10-25 year depending on industry. An average was calculated by 2-digit NACE and applied to the EP investments.

Non-environmental output
It is described in the 2002 Eurostat manual that NACE 37 main output is non-environmental (i.e. secondary raw materials). It is further outlined that it is important to deduct the value of the recovered materials from total output to get the environmental protection part of the output. However, in Sweden the total output of this sector is so low that the effect in the tables in relation to the amount of work for the separation has not been seen as outweighing the importance of specificity.

Calculations for other taxes on production and other subsidies on production
The EPEA tables require that other taxes on production and other subsidies on production are calculated in order to receive appropriate net operating surplus. To calculate the EP share of taxes and subsidies an estimation based on the total of the sectors was conducted. The basic principle meant to approximate the environmental protection share in total production (the production value). However, the National Accounts data were used for sectors specifically identifiable, i.e. specialised producers.

Calculation of market final consumption for Table B1
There are some issues concerning waste and waste water treatment activities. If market activities are measured by household payments of waste and waste water treatment then the final market consumption is almost 8 billion SEK. However, if the market final consumption is measured based on the share of the use of NACE 90 activities final consumption only amount to just below 1 billion SEK. In the end it was decided to use the Belgian approach of approximating the data based on the national accounts supply and use table. The decision was based on the problems of separating the raw data into the variables needed for the table. By doing this it was discovered that the data on government expenditure were missing data on waste water expenditure.

Imports/Exports
The supply and use Table B1 must consider the aspect of imports and exports of EP services. The reason being that national expenditure describes the uses of economic resources by the domestic economy.

Choosing data source for imports and exports proved to be difficult. At Statistics Sweden three sources were identified dealing with either imports or exports or both. Table 5 below provides an overview of the different sources.

For exports of EP services the database on the environmental sector could be used as one option. All producers that have been classified in the waste or waste water domain could be identified and their collective exports recorded in Table B1. It would also be possible to identify other producers in different environmental domains and get an estimate for their exports as well. The drawback of using this database is that imports cannot be identified and would require an additional data source. Another drawback is that the exports are related to the establishment as a whole. This means that if the establishment is exporting other goods then their main activity it is also included. This can be seen in table 5 as the exported amount is much larger then both National Accounts data and the material flow account data.

Imports and exports of waste based on a project within the material flow team at Statistics Sweden were another possibility. The project has however discovered that in the area of waste management it is difficult to separate what is waste and what is input as raw material even though it is sold as waste. It is however interesting work as they have gone through the raw data of imports and exports and selected a number of products that gives a good indication of the trade flow of wastes (Statistics Sweden 2009).

The National Accounts supply and use matrix is also a possible source of data. The regular symmetric input-output table for imports show that the export of NACE 90 products are quite low, SEK 234 million, see table 5. The input/output table show that NACE 90 imports several services themselves, in 2005 worth SEK 2 160 million. By going into the symmetric input-output table for imports specifically it is shown that NACE 90 imports quite a large share of consultant services; Research and development services accounted for 28 per cent of all imports from NACE 90 enterprises. On the other hand imports of NACE 90 type products only came to SEK 143 million.

In the end, the decision was taken to use the methodology of the Belgian study (Vandille 2003, 2005). This methodology is based on the supply and use table of the National Accounts. Shares of the use of the different categories are applied to total EP output from Table B. The reason for using an estimation method is to cover all environmental domains and not only show one. This is also the main difference to the Belgian methodology. The same share was used across all

domains in the Swedish EPEA while the Belgian EPEA use the ratio to waste and waste water only (this is also the most appropriate way the ratios should be used).

Table 5: Different statistical sources: imports – exports SEK million, 2005

Products – Import

	NA	EGSS	MFA
From NACE 90	2 160	-	-
NACE 90 type products	143	-	-
Waste products	-	-	4 730
Waste water products	-	-	-

Products – Export

	NA	EGSS	MFA
From NACE 90		188	-
NACE 90 type products	234		
Waste products		14 612	3 116
Waste water products	-	5 090	-

Calculations of compensation of employees
When the National Accounts have been used the calculation of compensation of employees contains: taxes on salaries, accounted salary, fees to unions. The data also contains estimation for salaries not reported to the tax authorities, so-called "black salaries". Compensation of employees for ancillary activities also contains the salary, taxes on salaries and fees. However, no estimation for non-accounted salaries has been done.

Calculation of non-deductible VAT
In Sweden households pay 25 per cent VAT on waste water services as well as for waste management. In the case of waste management the 25 per cent applies to non-hazardous waste.

The calculation of VAT on waste water management is based on SCB publication *The economic structures and environmental pressure in the Swedish river basin districts 1995-2005 (*SCB 2007a*)*. Total revenue of waste water services were in 2005 about SEK 13 billion. This figure includes some industries that are connected to the municipal sewerage system. According to this study are 85 per cent of the population connected to the sewerage system and their volume is 478 million $m^{3.}$ Based on this information the total household expenditure was in 2005 SEK just below 5 billion. The VAT is then calculated to SEK 1 billion.

The calculation of VAT on waste services are based on information from an organisation called Avfall Sverige – Swedish waste management. According to their calculations the average cost for the average household (living in houses) is SEK 1 940 per year. In Sweden there are about 4.7 million households. The VAT is then calculated by these parameters.

Transfers
In the case of transfers data from the National Accounts are further elaborated on by the Environmental Accounts. The transfers are selected on the basis of environmentally motivated attributes and aggregated by consumption or investments. The data are only disaggregated to rough sectors such as: business, households, municipalities, non-profit organisations and international cooperation. During this project there was no time to break down transfers within the business sector to the appropriate NACE and the same assumption as the Belgian study was

made, i.e. that all current transfers go to the specialised producers. This assumption is known to be wrong as for example the agriculture, fishery and forestry sector is known to receive support from the government. However, due to time constraints this first effort of compiling Sweden's EPEA went for the option of international comparability and allocated the transfers to specialised producers in the EPEA tables. The error is quite significant, for example the agriculture sector is known to have received about 51 per cent of all government transfers in 2005.

The Swedish EPEA also aggregate both capital and current transfers for households as households, according to the set-up of the National Accounts, do not invest, only consumes.

Below follows a separate description of expenditures in different sectors.

Agriculture, forestry and fishery

Agriculture

Currently there are no statistics for the agriculture sector monitoring how much is spent on environmental protection by farmers in terms of investments or current expenditure.

However, as regards transfers, the agriculture sector receives both subsidies and investment grants from the government. Official statistics show that in 2006 the agriculture sector received about SEK 4.7 billion (SCB environmental accounts 2008).

Forestry

Currently there is no monitoring of investments or current expenditure done for environmental protection in the forestry sector. But the Swedish Forest Agency is distributing funds to forest owners. In 2006 about 142 SEK million was paid to different measures of protecting the environment in forests (Swedish Forest Agency 2008). Some funding goes to private owners but some projects by non-profit organisations also receive funding. It is currently not possible to separate these in the statistics.

Fishery

Currently there is no monitoring of investments or current expenditure done for environmental protection in the fishery sector. However, every year the Swedish government allocates a budget to the Swedish board of Fisheries of an amount just below SEK 100 Billion in 2005 of which the board used about SEK 15 Billion for work on the Swedish Environmental Quality Objectives. In addition, a special appropriation is paid out from the state budget called *Fish conservation*, the amount was in 2005 just below SEK 29 Billion. The Swedish board of Fisheries, in turn allocate the funds to local administrations and others in need of funding. On top of this the EU support monetary assistance to the sector related to the conservation and sustainability of fishery, in 2005 about SEK 11 Million. It has not been possible to distinguish the different flows of these funds to local administrations or other actors.

The data source for government funding of the agriculture and fishery sectors is: Environmental accounts, Statistics Sweden. Data source for funding in the forestry sector from the Swedish Forest Agency.

Mining, quarrying and manufacturing

There is an existing survey monitoring EP activities of the mining, quarrying and manufacturing industry such as investments and current expenditure. They are included as ancillary activities in the EPEA tables. In Sweden, the Mining, quarrying and manufacturing industry has over the years spent around SEK 9 billion on activities to reduce their own pollution levels (SCB 2008).

As mentioned above there are services sometimes performed by especially the manufacturing industry that could be considered as environmental protection services in connection to installation services or consulting activities. However, identifying them would be rather time consuming and are therefore lacking in the EPEA tables.

Data source is Statistics Sweden: Survey on Environmental protection expenditure in industry in accordance with the structural business statistics and National Accounts.

Recycling (NACE rev 1.1 37)

The recycling industry is surveyed by Statistics Sweden through the general economic business survey. Statistics show that the industry has grown. During 1997 to 2004 the number of enterprises has increased from 117 to 259. The net operating surplus has increased by 87 percent from 1997 to 2004.

The data source for the EPEA tables is Statistics Sweden: the National Accounts and the structural business statistics.

Electricity, gas and hot water supply (NACE 40-41)
There is an existing survey monitoring EP activities of the Electricity, gas and hot water supply industry. In 2007 the sectors spent around SEK 2 billion to reduce their environmental pressure.

It should be noted that in Sweden water purification and waste water treatment enterprises are often one and the same. Therefore, the statistics may include investments for waste water treatment improvements as well as water purification activities. Due to this, the National Accounts, in their statistics, contains information on water distribution as well as waste water treatment activities are grouped as one. In the EPEA tables there are therefore double counting existing in the ancillary activities of water distribution and specialised producers of waste water treatment.

Data source is Statistics Sweden: Survey on Environmental protection expenditure in industry in accordance with the structural business statistics.

Construction (NACE 45)
For data on the secondary producers of EP services an estimation procedure was performed. Firstly the Swedish database on environmental sector was used to identify the number of establishments in the construction sector and their turnover. The turnover was then used on the national total for the construction industry to the variables asked for by the EPEA tables. The ratio was described above and shown in table 4.

Data source is Statistics Sweden: National Accounts and Environmental accounts.

Today there is no statistical survey measuring the ancillary EP activities of the construction industry.

Waste and waste water treatment including water distribution (NACE 90+41)
The waste and waste water treatment industry is surveyed by Statistics Sweden and the data source for the EPEA tables is the National Accounts. The data from the National Accounts includes water distribution.

During 1997 to 2004 the number of enterprises in these sectors increased from 815 to 1013 enterprises. The majority of enterprises belong to the waste and waste water treatment industries (90 percent in 2004). The net operating surplus has increased by 26 percent during the same time period.

Data source is Statistics Sweden: the National Accounts.

Services (NACE 50-99 excluding NACE 90)
For data on the secondary producers of EP services an estimation procedure was performed. Firstly the Swedish database on environmental sector was used to identify the number of establishments in the sectors chosen and their turnover. The turnover was then used on the national total for the chosen sectors to arrive at the variables asked for by the EPEA tables. The ratio was described above and shown in table 4.

For the secondary producers of EP services the Swedish database on environmental sector at Statistics Sweden was used. The sectors covered are shown in table 6.

Table 6: Sectors covered

NACE rev. 1.1 51 Whole sale trade and commission trade,
NACE rev. 1.1 60 Transport
NACE rev. 1.1 70 Real estate
NACE rev. 1.1 73+74 Research and other business activities
NACE rev. 1.1 92 Recreation and other activities

Data source is Statistics Sweden: National Accounts and Environmental accounts.

Households

According to literature households purchase so called adapted or connected products. Connected products equal in principal pollution treatment items while adapted products equal pollution prevention items. The first type of expenditure can statistically be captured either through household budgets survey or through price estimates. The second type of expenditure is more difficult to not only pinpoint but to collect statistics for. Examples of connected and adapted products have always been vessels for waste/composting, or lead free petrol or even insulation work in housing. There is a proposal to calculate (estimate) the value of these products. The proposal is to use the value of the production of these products. The estimate is accounted for in Table A as use, the output is not recorded in Table B as this would create double counting (Eurostat 2002 page 40). However, this procedure was not applied in this project.

For this project it has been possible to distinguish how much households spend on purchasing hybrid cars and how much they spend on organic food. However it has not been possible to distinguish the extra cost of these purchases. Therefore the expenditure of the hybrid cars and organic food has been included in the EPEA tables.

Data sources are: Registration statistics of the vehicle register – hybrid cars and the Household budget survey – organic foods from Statistics Sweden

General Government

The statistics on government expenditure by functions have been used (COFOG). The COFOG statistics are still under development and in 2007 Eurostat published a manual on how to allocate government expenditures (Eurostat 2007c). This means that the statistics used in the Swedish EPEA tables are not fully accurate in terms of environmental protection expenditure. One such example is the expenditure for waste water treatment. All those expenditures are allocated to COFOG 063 water distribution. Unfortunately, there was no time to adjust the data accordingly even though alternative data are available.

Central government includes:
all administrative departments of central government and other central authorities and institutions whose powers range over the entire economic territory, apart from the administration of the social security sector. This demarcation coincides to a large extent with the legal entity of the State. Also included are non-profit institutions, which are controlled and largely financed by central government. The legal form of these institutions is that of representational associations, other foundations or funds, social security funds and public corporations and establishments along with a few public limited companies. The public service undertakings of central government are classified as market producers and are therefore included in the non-financial corporations sector.

Local government includes:

290 civic primary municipalities (primärkommuner, pk), 18 county councils and 2 regions (landsting, lt) and 103 local federations (kommunalförbund, kfb).2 The calculations of the local government sector also include the Swedish Association of Local Authorities (Svenska kommunförbundet, Skfb), the Federation of Swedish County Councils (Landstingsförbundet, Ltfb) and nonprofit institutions (ideella organisationer, IO) belonging to the local government sector.

Data source: National Accounts ESA95 questionnaire on Expenditure of general government by functions.

2.5 Methodology and sources in industry and micro level analysis

In this section of the study, the idea is to analyse enterprise statistics both at industry level and micro level. When starting up the project the plan was to interlink monetary data with physical data such as emissions and energy use. In the micro level analysis, the selection of enterprises was taken from pulp and paper industry (NACE 21), chemical industry (NACE 24), metal industry (NACE 27) and the energy industry (NACE 40). The reason to this choice was that these industries consist of large enterprises from which data is collected on a regular basis. Besides from that, the chosen industries constitute an important part of Swedish industry.

The data collected for these industries and to be used in the analysis was taken from a number of different sources, namely environmental protection expenditure statistics (EPE), energy statistics, data on paid taxes from the Swedish tax board, national accounts and business statistics. The variables include, by industry and by the individual enterprise:

- Total spending on environmental protection expenditure (investments and current expenditure)
- Total spending on environmental protection investments regarding protection of ambient air and climate (CEPA 1), (investments).
- Total energy use
- Total emissions, (CO_2, SO_2, NO_x)
- Total paid energy related taxes (taxes on energy and CO_2)
- Total turnover

The data on EPE is retrieved from the annual EPE survey directed to enterprises in NACE 10-41 (excl. NACE 37). The population consists of roughly 4500 enterprises from which a sample of around 1000 is drawn. Until 2006 the cut-off was 20 employees but since then the cut-off has been raised to 50 employees. From the replies, national estimates are made through an enumeration method based on size of the enterprise and NACE group. The expenditures are broken down by types of costs, environmental domain (CEPA) and 20 economic activities for industries (NACE). National estimates are applied at the industry level analysis[11] and in the micro level analysis direct replies are used. In the analyses year 2002 are not present due to the fact that there are no data available on current expenditure on environmental protection. The time period are therefore

[11] Official statistical database at Statistics Sweden, www.ssd.scb.se

between 2001, 2003-2006 in the analysis except for the regression analyses that uses the time span 2001, 2003-2004.

Data on energy use and emissions are taken from the Swedish Environmental accounts. The foundation is the energy statistics on the use of fuel which is used by the environmental accounts to calculate energy use and emissions by economic activity. The emissions are calculated as a product of fuel use and emission factors. The factors come from the official statistics on emissions and originate from the Swedish Environmental Protection Agency. In the analysis at industry level, NACE aggregates are used[12] and survey replies are used in the micro analysis.

The data used regarding paid energy related taxes (CO2 and energy tax) are collected from the Swedish Tax Board. The Tax Board keeps record of which tax, and to what sum, the enterprises are paying. The total paid tax is an aggregate of five different taxes: 1) *tax on electric power*, 2) *tax on oil, liquefied petroleum gas and methane*, 3) *tax on natural gas, carbon fuel and petroleum coke*, 4) *tax on gasoline* and 5) *tax on crude tall oil*. The CO2 and energy taxes can not be separated using the time period of 2001 to 2006. However, it is possible to separate the two from 2006. The allocation of the tax to industries is based on the NACE classification each enterprise has in the Swedish Business Register.

Data on turnover is collected from two different sources. The data regarding entire industries come from the national accounts and data on individual enterprises is collected from the business statistics.

When the data was collected it was discovered that the gaps in coverage, especially regarding data on energy and emissions, was to large to allow for a systematic analysis of decent quality. It was soon decided to abandon the idea of using the energy/emission data in the micro level analysis except from one case where it was tested to which extent EPE leads to lower levels of emissions. Instead, we chose to do the analysis regarding this data on the industry level and focus on environmental expenditure and the energy related taxes in the micro level analysis.

[12] Environmental accounts' analysis and simulation website, www.mirdata.scb.se/MDInfo.aspx

3. The resulting tables

As mentioned above the EPEA tables are a set of tables to identify the total amount of economic resources for protecting the environment. The main result should be an aggregate indicator that is fully consistent with the national accounts. The aggregate indicator is, according to theory, best suited for international comparisons and the more detailed components of the aggregate best suited for national policy application.

In practise it is very difficult to compile a full EPEA. Variables, sectors and environmental domains all add to the complexity of the accounts. Nonetheless, each component provides interesting knowledge and results.

In Sweden, the main policy tool for environmental protection and management are based on 16 environmental quality objectives. Linking the goals to expenditure of the economy and their flows has proven difficult. Partly because the goals of the quality objectives rarely specifies an industry and partly because the data cannot be identified on the level of detail needed. However, following the structure of the EPEA it links data on expenditure by the private sector and transfers (subsidies and investment grants) by the government into comparable sets of tables ready to be used.

To recapitulate, the contents of the Swedish EPEA tables contain the economic actors shown in table 7:

Table 7: Economic sectors included in the Swedish EPEA tables

Specialised producers	Secondary non-specialised producers	Ancillary producers	Final consumers
NACE rev. 1.1 90+41	NACE rev. 1.1 45	NACE rev. 1.1 10-41 excl. 37	Households
NACE rev. 1.1 37	NACE rev. 1.1 51		Government*2
Government *1	NACE rev. 1.1 60		
	NACE rev. 1.1 70		
	NACE rev. 1.1 73		
	NACE rev. 1.1 74		
	NACE rev. 1.1 92		

*1 As producer in the production table B, *2 as non-market EP output deducted by transfers

Important to remember from chapter 2.4 (Statistical sources and quality) is that all transfers to the business community has been allocated to specialised producers in accordance with the Belgian methodology. However, it is known that the agricultural sector received in 2005 about half of the total environmentally motivated subsidies. As explained above, there was no time during this project to properly allocate current and capital transfers to their appropriate destination and the decision was therefore to follow the line of international comparison.

3.1 The production table (Table B)

The production table describes who is producing environmental protection services, i.e. who is supplying waste or waste water management services as their main task for others (specialised producers with corresponding market and non-market output) and who is managing to provide measures for environmental protection, but not as a main task (non-specialised producers with

secondary activities) and those that are producing EP services for their own use (non-specialised producers with ancillary activities).
The production table consists of a number of variables such as environmental protection output, current environmental protection resources and gross fixed capital formation to mention a few. The value of output is calculated via the cost of production: intermediate consumption, compensation of employees, consumption of fixed capital and other taxes on production. Current EP resources equal the receipts of the EP producers (EP output that is sold) and current transfers (subsidies and other current transfers from government) for the production of EP services.

Missing in table B is *financing by producers.* It could not be calculated as there is a lack of information on investment grants and other capital transfers as a way of financing the capital uses.

Table 8 shows the data on the specialised producers, non-specialised producers, and the government. The main contributor to total EP output comes from non-specialised secondary producers, they account for 47 per. These are enterprises that sell services for environmental protection, not as their main activity, but as a secondary business interest.

Table 8: Share of environmental protection output by economic actor, 2005

	Air	Water	Waste	Other	Total
Specialised producers	-	0.71	0.52	-	0.38
Secondary producers Non-spec. producers	0.91	0.19	0.34	0.73	0.47
Ancillary producers Non-spec. producers	0.09	0.10	0.04	0.09	0.07
Government	0.00	0.00	0.10	0.17	0.08

The production table (table 19 below) is the first table to compile for the full accounts. It is the first table to compile as from this table basically all others stem from, transformed or complemented with additional information. Important variables in table 9 are the environmental protection output (EP output), current EP resources and gross fixed capital formation. By EP output is meant the value of production of services. Table 8 above related the economic actors to EP output as a way to show who it is in Sweden that produces EP services. Their combined output of EP services in 2005 amounted to a total of SEK 93 billion which was about 2 per cent of total output in Sweden.

It is seen in table 9 that the majority of the output, at 49 per cent, is due to waste management services. So it falls naturally that specialised producers are the major contributors to the supply of environmental protection services. In Sweden they account for 52 per cent of the total output in the domain waste (see again table 8). The second largest contributor to waste management services were the non-specialised secondary producers.

Table 9 also show that current EP resources are systematically less than the value of EP output, the exception being for the environmental domain of water. The general conclusion of this would be that for every environmental domain there is a non-market provider, i.e. from the general government. However, this assumption is from table 8 seen to be weak. Even though the Swedish government does show EP output in all domains the expenditure is so low it does not show in table 8. One reason for the phenomena could be that current transfers are not completely allocated properly. It should be remembered that all current transfers were allocated to waste and waste water producers, in accordance to Belgium's assumptions, in 2005 SEK 5.3 billion. These transfers have been added to the data from COFOG.

When it comes to transfers the production table is incorporating the related statistics but at the moment they are not complete. To start, COFOG data have been complemented with current

transfers given to businesses. In addition, the COFOG statistics distributes subsidies, current transfers and capital transfers according to environmental domain. In table 9 they are distributed in variables 1.1.5 *Less other subsidies on production*, 1.3.2 *Current transfers* and 2.3 *Investment grants received*. However, the collective amount that the COFOG has distributed for 2005 were about SEK 2.2 billion. As mentioned previously it is known that transfers from the government to the agricultural sphere for environmental protection reached SEK about 2.3 ion in 2005[13]. It is assumed that the data from COFOG in table 9 have not allocated environmental issues in the agriculture to the environmental domain but to COFOG class 04.2 Economic affairs: Agriculture, forestry, fishing and hunting. The same probably applies for other areas as well. However, there was no time to dig further in the statistics to see where the differences are.

Table 9: Table B, the production, 2005 SEK millions

		Air	Water	Waste	Other	Total
1	**Current transactions**					
1,1	Current uses					
1.1.1	Intermediate consumption	6 197	8 263	26 610	9 341	50 410
1.1.4	Other taxes on production	73	39	233	106	451
1.1.2	Compensation of employees	4 828	4 200	11 519	5 892	26 439
1.1.3	Consumption of fixed capital	1 011	4 285	3 227	640	9 163
1.1.5	Less other subsidies on production	149	47	1 173	1 008	2 377
1.1.6	Net operating surplus	1 324	211	4 783	2 201	8 519
1.2	Output (basic price or cost of production)	13 475	17 001	45 439	17 370	93 285
1.2.1	Non-environmental output	0	0	0	0	0
1.2.2	Environmental protection output	13 475	17 001	45 439	17 370	93 285
1.2.2.1	Non-market	1 219	1 741	6 411	4 610	13 981
1.2.2.2	Market	12 256	15 260	39 029	12 760	79 304
1.3	Current environmental protection resources	12 275	17 033	42 491	12 826	84 625
1.3.1	Market output (including partial payments)	12 256	15 260	39 029	12 760	79 304
1.3.2	Current transfers	19	1 773	3 460	66	5 321
2	**Capital transactions**					
2.1	Gross fixed capital formation	3 014	2 593	4 914	2 088	12 609
2.2	Other capital uses	n.a	n.a	n.a	n.a	n.a
2.3	Investment grants received	n.a	n.a	n.a	n.a	n.a
2.4	Other capital transfers received	n.a	n.a	n.a	n.a	n.a
3	Financing by producers	n.a	n.a	n.a	n.a	n.a
4	Labour inputs	n.a	n.a	n.a	n.a	n.a
5	Stock of fixed assets	n.a	n.a	n.a	n.a	n.a

-: not applicable n.r.: not recorded n.a.: not available

Gross fixed capital formation (GFCF) for environmental protection was in 2005 about SEK 12.6 billion, as seen in table 9. This is just about 3 per cent of total GFCF in Sweden in 2005. Table 10 below shows that specialised producers and ancillary producers invest almost an equal amount (33 per cent and 31 per cent) of total EP investments. Among the actors, ancillary producers invested more in air protection then any other actor (69 per cent).

[13] The official statistics on *Total environmentally motivated direct subsidies 2000-2007* shows that in 2005 environmental supports in agriculture were SEK 4.6 billion and explains that about half is paid by the EU.

Table 10: Share of GFCF for environmental protection by economic actor, 2005

	Air	Water	Waste	Other	Total
Specialised producers	-	0.49	0.58	-	0.33
Secondary producers					
Non-specialised producers	0.31	0.10	0.24	0.47	0.27
Ancillary producers					
Non-specialised producers	0.69	0.42	0.08	0.18	0.31
Government	0.00	0.00	0.10	0.35	0.10

3.2 The supply and use table (Table B1)

Main purpose of the table is to distribute the supply of market EP services among uses (how the service is used) by final consumption, intermediate consumption and capital formation. Final consumption means household and government activities and intermediate consumption is relating to industries; capital formation mainly relates to the purchase of EP services for land improvement. Table B1 is also describing the origin of the products, i.e. if the products have been manufactured domestically or if they've been imported for use.

The Swedish supply and use table is based on the Belgian method to apply a ratio to the environmental output. The ratio is based on the *use* of the supply and use table of the national accounts and was described above in chapter 2.4.

By using a ratio applied methodology to the supply and use of EP services it is shown in table 9 that market use account for 85 per cent of total use. It is mainly non-specialised producers that are the major users.

According to table 11 it is also seen that market exports are larger then imports of EP services (total SEK 726 million vs. SEK 440 million). It is seen that the market exports are mainly related to the domain water, by 49 per cent. Comparing the total export as described in the national accounts (table 5 above) water and waste water products is sold to a value of SEK 234 million. This is lower, just above SEK 260 million then what the estimation of exports of corresponding EP domain has shown in table 9. Comparing imports and exports of waste to the data from the material flow project (also shown in table 5) the estimation in table 11 is far lower. The MFA data suggests that Sweden is exporting waste to a value of over SEK 3 billion. It is highly likely that there is a definitional issue here to dig deeper into. However, there was not time to do so within the limits of this project.

Table 11 also show non-deductible VAT in the domains waste and water. They relate to household expenditure for EP services for waste management and waste water treatment.

Table 11: Table B1 the supply and use, 2005 SEK millions

Table B1 Supply - Uses of characteristic services

		NON-MARKET	Air	Waste	Water	Other	Total
NON-MARKET	1	Uses of resident units (purchasers' prices)	1 219	1 741	6 411	4 610	13 981
	1.1	Intermediate consumption	1 182	1 734	2 002	1 635	6 553
	1.1.1	of which by specialized producers	0	0	0	0	0
	1.1.2	of which by non-specialised producers	1 182	1 734	2 002	1 635	6 553
	1.1.3	of which by non-characteristic producers	0	0	0	0	0
	1.2	Final consumption	37	7	4 409	2 975	7 428
	1.3	Gross capital formation (land improvement)	n.a.	n.a.	n.a.	n.a.	
	2	Exports	0	0	0	0	0
		Total uses (1+2) = total supply (3+4+5+6)	1 219	1 741	6 411	4 610	13 981
	3	Output (basic prices)	1 219	1 741	6 411	4 610	13 981
	4	Imports (customs price)	0	0	0	0	0
	5	Non-deductible VAT	0	0	0	0	0
	6	Other taxes on products (if any)	0	0	0	0	0
	7	Subsidies on products (if any)	0	0	0	0	0

Table B1 Supply - Uses of characteristic services cont.

		MARKET	Air	Waste	Water	Other	Total
MARKET	1	Uses of resident units (purchasers' prices)	12 212	15 205	38 888	12 714	79 018
	1.1	Intermediate consumption	12 008	14 952	38 240	12 502	77 702
	1.1.1	of which by specialized producers	437	544	1 391	455	2 826
	1.1.2	of which by non-specialised producers	9 510	11 841	30 285	9 901	61 538
	1.1.3	of which by non-characteristic producers	2 061	2 567	6 564	2 146	13 338
	1.2	Final consumption	203	253	648	212	1 316
	1.3	Gross capital formation (land improvement)	n.a.	n.a.	n.a.	n.a.	
	2	Exports	112	140	357	117	726
		Total uses (1+2) = total supply (3+4+5+6)	12 324	15 347	39 246	12 830	79 748
	3	Output (basic prices)	12 256	15 260	39 029	12 760	79 304
	4	Imports (customs price)	68	85	216	71	440
	5	Non-deductible VAT	0	2	1	0	4
	6	Other taxes on products (if any)	0	0	0	0	0
	7	Subsidies on products (if any)	0	0	0	0	0
		TOTAL					
TOTAL	1	Uses of resident units (purchasers' prices)	13 431	16 946	45 298	17 324	92 999
	1.1	Intermediate	13 190	16 686	40 242	14 137	84 255
	1.1.1	of which by specialized producers	437	544	1 391	455	2 826
	1.1.2	of which by non-specialised producers	10 692	13 575	32 287	11 536	68 091
	1.1.3	of which by non-characteristic producers	2 061	2 567	6 564	2 146	13 338
	1.2	Final consumption	240	260	5 057	3 187	8 744
	1.3	Gross capital formation (land improvement)	n.a.	n.a.	n.a.	n.a.	
	2	Exports	112	140	357	117	726
		Total uses (1+2) = total supply (3+4+5+6)	13 543	17 088	45 657	17 441	93 728
	3	Output (basic prices)	13 475	17 001	45 439	17 370	93 285
	4	Imports (customs price)	68	85	216	71	440
	5	Non-deductible VAT	0	2	1	0	4
	6	Other taxes on products (if any)	0	0	0	0	0
	7	Subsidies on products (if any)	0	0	0	0	0

-: not applicable n.r.: not recorded n.a.: not available

3.3 The expenditure table (Table A)

Table A describes the aggregate "national expenditure for environmental protection". The national expenditure is presented by categories of users of EP goods and services and of EP investments. The table is re-using the data produced in Table B and B1 described above. New data in the table relates to connected and adapted products and to transfers. It should be noted that the data on transfers in table 12 below are taken from the Environmental Accounts and corresponds to the official statistics on *Total environmentally motivated direct subsidies 2000-2007*.

This means that a better coverage are provided than from the COFOG statistics and the issues with allocation in that statistics.

Some components of Table A are more important then others in terms of monetary weight. In literature (Eurostat 2002a) more importance are given to uses of EP services and capital formation than to uses of connected and adapted products.

Table 12 show a table not satisfactory filled, but what is possible to see is that total uses of EP services are accounting for almost 86 per cent of total uses of residents. The majority of the use comes from the intermediate consumption of non-specialised producers, i.e. expenditure for running of daily business related to environmental protection.

It is interesting to see that for households their expenditures for EP services are lower then their expenditures for uses of adapted and connected products (final market consumption in table 9). Households paid in 2005 about SEK 1.4 billion for the EP services and about SEK 2 billion for adapted and connected products. The adapted and connected product is in this case mostly for new cars running on alternative fuels. It is important to remember that the full cost of the car is included and not the extra cost. It should also be noted though that other estimates of waste and waste water services for the households show much higher expenditure. A study in 2007 by Statistics Sweden showed that households pay about SEK 5 billion for waste water services (SCB 2008c) and based on information from the organisation Avfall Sverige households pay about SEK 2 billion for waste services (see above chapter 2.4 Calculation of non-deductible VAT). The non-market final consumption of households refers to transfers from the government, both for consumption and investments. The majority of the transfers to the households are assistance to reduce energy use.

The national expenditure in 2005 in Sweden was about SEK 108 billion. This was about 4 per cent of GDP. The largest share of the national expenditure are attributed the non-specialised producers by 70 per cent. These are as mentioned before enterprises that provides EP services as secondary activities.

Table 12 has not been broken down into environmental domains, but based on the previous tables it can be assumed that waste and waste water are the dominating areas in the table.

Table 12: Table A National expenditure by users/beneficiaries

	All domains	PRODUCERS				USERS			
		Specialised produces		Other producers		Consumers		Rest of the	Total
	Components of national expenditure	Government	Other	Non-spec.	Non-charact.	Households	Government	world	
1.	Uses of EP services	-	-	68 091	13 338	1 377	7 367		90 173
1.1.	Final consumption	-	-	-	-	1 377	7 367	-	8 744
	market	-	-	-	-	1 316		-	1 316
	non-market	-	-	-	-	61	7 367	-	7 428
1.2	Intermediate consumption	n.r.	n.r.	68 091	13 338	-	-	-	81 429
	market	n.r.	n.r.	61 538	13 338	-	-	-	74 876
	ancillary	n.r.	n.r.	6 553	-	-	-	-	6 553
1.3	Capital formation (land improvement)	n.r.	n.r.	n.a.	n.a.	-	-	-	0
2.	Gross Capital formation for EP	1 213	4 099	7 297	-	-	-	-	12 609
3.	Uses of adapted & connected products	n.r.	n.r.	n.r.	n.r.	2 157	-		2 157
3.1	Final consumption	-	-	-	-	2 157	-.	-	2 157
3.2	Intermediate consumption	n.r.	n.r.	-.	-	-	-	-	0
3.3	Capital formation	n.r.	n.r.	-	-	-	-	-	0
4.	Specific transfers	166	5 321	0	0	61	1 395	1 530	8 472
4.1	Subsidies on production	n.r.	n.r.	0	0	0	0	0	0
4.2	Other specific transfers	166	5 321	0	0	61	1 395	1 530	8 472
4.2.1	current	0	5 233	0	0	7	1 395	963	7 598
4.2.2	capital	166	88	0	0	53	0	567	874
5.	Total uses of resident units (1+2+3+4)	1 379	4 099	75 388	13 338	3 595	8 763	1 530	108 090
6.	Financed by the rest of the world	n.a.					n.a		
7.	National expenditure for EP (5-6)	1 379	4 099	75 388	13 338	3 595	8 763	1 530	108 090

-: not applicable n.r.: not recorded n.a.: not available

3.4 The financing table (Table C)

The financing table presents on one hand the beneficiaries and on the other hand the financers. These two combined gives a complete picture of the giving and receiving. However, the table is incomplete in the sense that transfers given to the government is lacking. The EU is providing assistance to Sweden through different programs to for example the fishery or agriculture sector which is not shown in the table. Also not included in the table are the transfers to non-profit organisations (NPISHs) as they are not included in the data on production and the use of EP services. The Swedish government gave them just above SEK 640 million in current and capital transfers in 2005. There are no earmarked taxes in Sweden and as such the household taxes related to the environment are not included.

The main expenditures seen for the specialised producers, financed by themselves, as seen in table 13, relates to investments (gross fixed capital formation) deducted by transfers. In the case of government specialised producers transfers received from other parties, including transfers from abroad should have been deducted from the total, but as these data are not yet available this has not been done.

The main expenditure for other producers, financed by themselves, are for non-specialised producers gross fixed capital formation and intermediate consumption. That is, investments and expenditure for daily business related to environment protection. The data has not been deducted by any transfers as all of them have been applied to specialised producers. In the case of non-characteristic activities the data refers solely to intermediate consumption. The expenditure have been split on the government and on corporations based on their share of intermediate consumption of NACE 90 type goods (waste and waste water).

Household expenditure relates to total final consumption as described in Table A. The transfers received from the government include both current and capital transfers based on the assumption that households do not invest but only consumes. It should be remembered here that on the one hand the household expenditure is severely underestimated in terms of expenditure for waste and waste water services and on the other hand overestimated for products purchased by the households.

Table 13: Table C the financing table, 2005, SEK million

	TABLE C	PRODUCERS				USERS			
	FINANCING UNITS	Specialised producers		Other producers		Consumers		Rest of the world	Total
		Government	Other	Non-spec.	Non-charact.	Households	Government		
1.	General government	1 379	88	0	623	61	8 763	1 530	12 448
	State government	1 379	88		623	61	8 763	1 530	12 448
	Regions	-	0		0	0	-	0	0
	Local government	-	0		0	0	-	0	0
2.	NPISHs								0
3.	Corporations	0	4 011	75 388	12 715	0	0	0	92 114
	Specialized producers		4011						
	Other producers			75 388	12 715				
4.	Households	0				3534	0	0	3 534
	NATIONAL EXPENDITURE	1 379	4 099	75 388	13 338	3 595	8 763	1 530	108 096
	Rest of the world	0					0		0
	Uses of resident units	1 379	4 099	75 388	13 338	3 595	8 763	1 530	108 096

-: not applicable n.r.: not recorded n.a.: not available

3.5 International outlook

The monitoring of environmental economic flows has been developed and adopted worldwide in the statistical sphere since the early 1990'ies. The UN draft handbook of *Integrated Environmental and Economic Accounting 2003* (commonly referred to as SEEA2003) describes and relies on a framework for environmental protection expenditure developed known as the SERIEE 1994. With the existence of world wide accepted methodologies in this area the potential of comparing and presenting thorough analysis are vast. However, large frameworks and intricate details reduce the number of countries willing to commit to the compilation of a full system. In Europe the compilation of the EPEA has been supported by the European Commission through Eurostat and Directorate-General Environment. This has enabled several European countries to evaluate and conduct pilot studies in the area.

Worldwide statistical production around environmental protection expenditure is fairly established. Surveys monitoring investments and current expenditure for the protection of the environment are established in Canada in the west to Japan in the east, with Europe and the Caucasus countries in the middle. The economic coverage and variables might vary from country to country but they all relate to the SEEA and the 1994 SERIEE.

However, only a few countries have attempted to compile the full EPEA. The most recent studies related to EPEA were carried out in 2005 by: Hungary, Belgium, Poland, Latvia, Lithuania and the Slovak Republic. Most studies were of the character of investigating the possibilities to compile EPEA from a data availability perspective. The exception was the Belgian study that already has a functioning reporting system and could focus more on the fine tuning the methodology and concluding aspects of EPEA. Most countries that investigated the possibilities of compiling EPEA came to the conclusion that it is possible to bring forth the area in terms of data availability although most of them acknowledged that there are quite a lot of data gaps to be filled.

The most common problems encountered with the EPEA tables concerns adapted and connected products. All studies acknowledge the products but leaves them untreated. Based on literature it seems acceptable as the monetary amount are (have been) low and in that sense do not effect the EPEA to any large extent. However, the policy interest in this area is growing and there is an opportunity here for the EP statistics and the EPEA to produce compatible and harmonised statistics. Another area where the coverage appears to be weak internationally is in relation to transfers. Few countries can account for transfers and if they can then the disaggregation is not complete.

However, in comparison with previous studies carried out between 1995 and 1999 the situation of the data coverage has improved considerably (Eurostat 2002b). The coverage of environmental domains has improved as has the coverage of intermediate consumption of environmental protection services by specialised producers.

As regards the coverage of ancillary activities by industries (non-characteristic producers) the same problems as during the mid 1990's still exist. The coverage of mining, quarrying, manufacturing and electricity and water supply industries are good while agriculture, construction, transportation, services and households are still lacking. The studies do not appear to estimate these industries, simply leaving them out. In a way, this situation makes comparisons better but the overall net cost of environmental protection is underestimated in all studies. However whenever that extra variable or sector is covered then immediately international comparisons are reduced in accuracy.

Most countries seem however to leave the area of EPEA after the pilot applications. More proper analyses of the use of the compiled statistics are needed. The exceptions can be found in only Belgium and Italy. The directions of the analysis are different in the two countries. The Federal Planning Bureau has conducted an evaluation of the inter linkages of environmental protection investments, environmental taxes and air emissions by industry. The Italian National Statistical Institute on the other hand provides first and foremost EPEA related tables for the government and links the information to the timing of that of the National Accounts. The production of regional EPEA tables have also been launched in Italy for answering to a specific policy need expressed by the general government bodies responsible for territorial development policies.

Looking to non-statistical offices for analytical suggestions of the EPEA Barry and Convery published an article in the European Environment in 2002: *The policy relevance of environmental protection expenditure accounting*. Their conclusions in the paper were that the statistics could be useful from a competitiveness perspective and see to investment levels and output in for example export oriented industries. Other studies in the area have been done by for example VITO in 2007: *Sectoral costs of environmental policy*. The study aimed at answering questions like the significance of the costs to enterprises and if the costs affected their competitiveness.

4. Analytical possibilities of EP statistics

This section will be divided into two parts, the first will discuss and analyse industry data over environmental protection costs, emissions and energy related taxes. The second part will try to analyse more disaggregated industry data on enterprise level.

4.1 Introduction

The approach in this section will interlink the monetary aspects of the EPEA with physical entities such as fuel use and emissions. A selection of industries will be given extra focus; NACE 21 (Pulp and paper industry), 24 (Chemical industry), 27 (Metal industry) and 40 (Energy industry). However when possible, data for NACE 10-41 will be considered.

In this project we have used environmental and economical *micro* data in the same dataset, that is data on company level on environmental protection costs, emissions, fuel use and energy related taxes (CO2 tax and energy tax). This has enabled us to take the first steps towards making useful analyses based on these variables. However, it has also made evident that there are some weaknesses in the data material, which we have tried to improve.

A report from Belgium in 2005[14] included an analysis section where they studied the question if industries that pay more taxes also spend more on environmental protection. The mentioned report studied this on an industry level. However, in the conclusion it was stated that "*A more refined analysis is necessary to substantiate our conclusions. This implies that more disaggregated industry data and a longer time horizon are necessary in the EPEA.*" In this project we have used such a dataset, i.e. data on company level. The current report will though, just like the Belgian report, start out discussing industries and thereafter go more into the micro data.

4.1.1 Which questions can the data answer?

Having emission and fuel use data together with the monetary data of EPE and energy related taxes, gives us the possibility to study a selection of questions.
- What are the correlations between these variables?
- Have the spending of individual enterprises on environmental protection equipments, processes and materials had an observable effect on pollution levels or energy use?
- Have the most polluting industries spend more on EPE Air (CEPA 1) than the less polluting?
- Have the industries spending most on EPE also reduced their air emissions the most?
- Are environmental taxes an incentive for firms to spend more on environmental protection? And does this higher spending on EPE lead to a decrease in taxes paid?

[14] Vandille, 2005a

4.2 Industry analyses

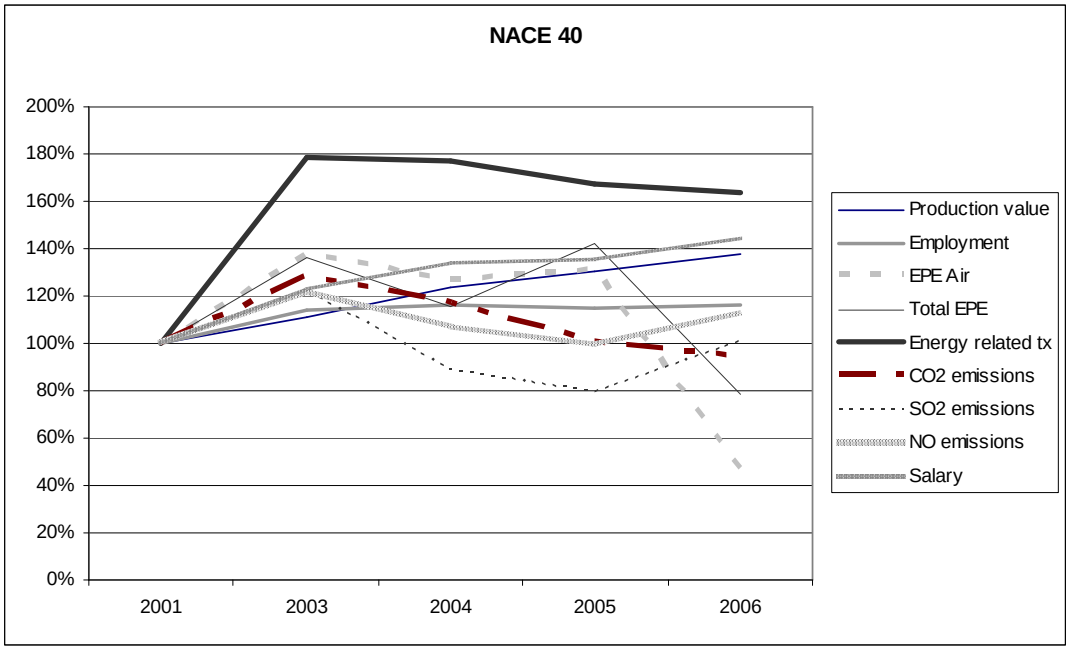
This section will analyse the data on industry level. Mainly NACE 21, 24, 27 and 40 will be analysed, as in the micro section later in this chapter, but all industries (NACE 10-41) will be considered if possible.

Before analysing the data set more in detail we will give an overview of the variables and their development over time.

4.2.1 Environmental economic variables developed over time

Figure 1 illustrates the energy industry (NACE 40) and the reference year is 2001. The energy related taxes in the figure including both the CO2 tax and energy tax. The data is available broken down on different fuels, which is used later in the chapter. The highest increase in the period 2001 to 2006 has been for energy related taxes for which it was an 80 percent increase between 2001 and 2003 and a 64 percent increase in the whole period.

Figure 1. Indexed variables using 2001 as reference year, NACE 40. 2001-2006



* 2002 is not included, since it was not available for all variables

For the chemical industry (NACE 24) the highest increase was also for the energy related taxes, 30 percent between 2001 and 2006, see figure 2. Environmental protection expenditures in the area of air (EPE air, which is CEPA 1) decreased with more than 50 percent in the same period, while total EPE decreased with 15 percent.

Figure 2. Indexed variables using 2001 as reference year, NACE 24. 2001-2006

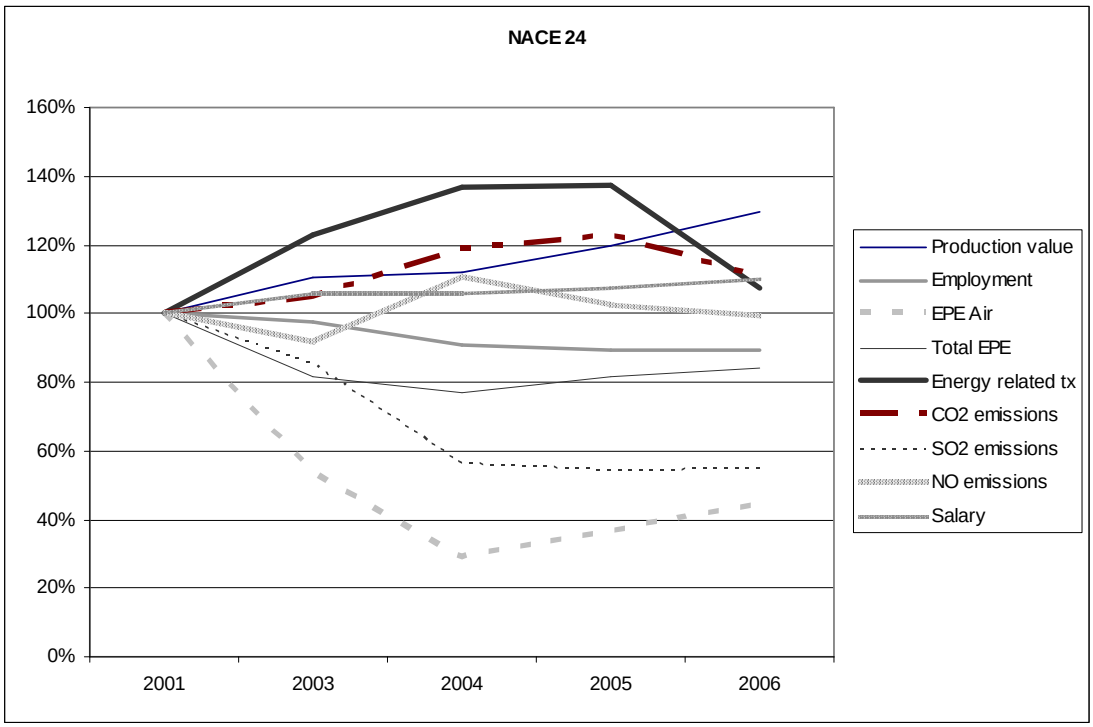
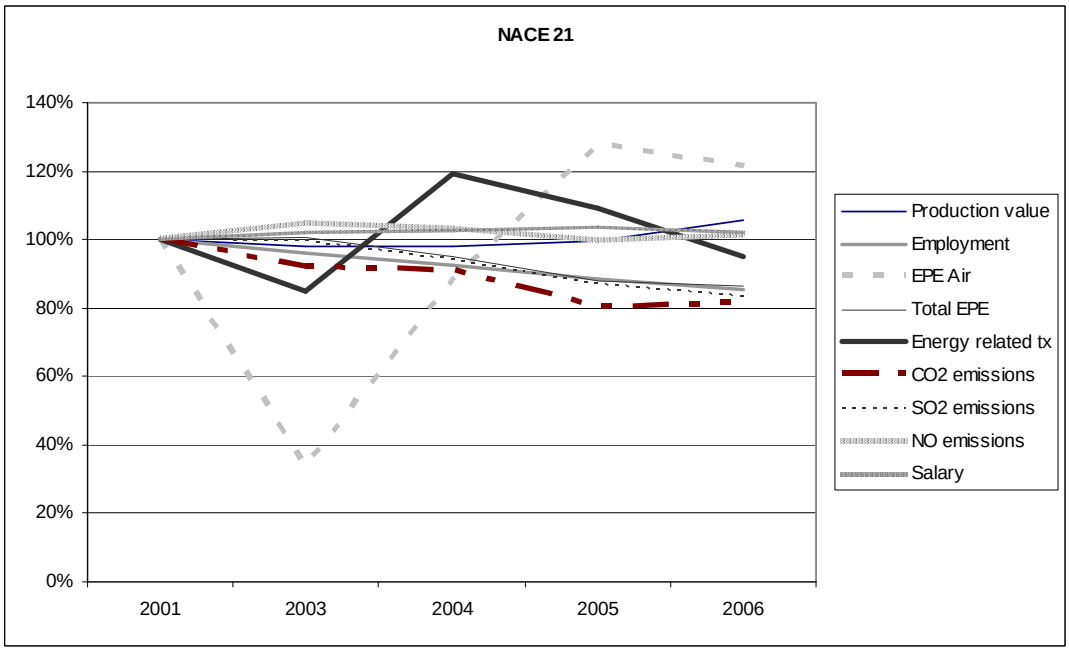


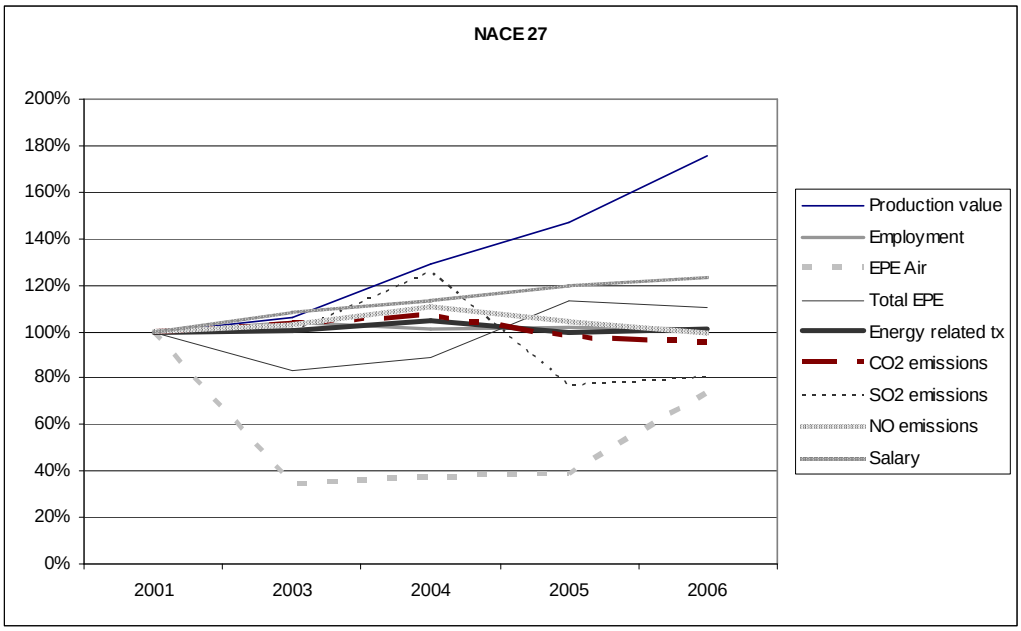
Figure 3 show the pulp and paper industry (NACE 21) where EPE air increased with 22 percent in the period 2001 to 2006. For this industry there was a slight decrease for both energy related taxes and the emissions of CO2 and SO2.

Figure 3. Indexed variables using 2001 as reference year, NACE 21. 2001-2006



The development in the metal industry (NACE 27), as shown in figure 4, has been increasing regarding production value (almost 80 percent) and total EPE (11 percent). EPE air has decreased with about 25 percent between 2001 and 2006.

Figure 4. Indexed variables using 2001 as reference year, NACE 27. 2001-2006



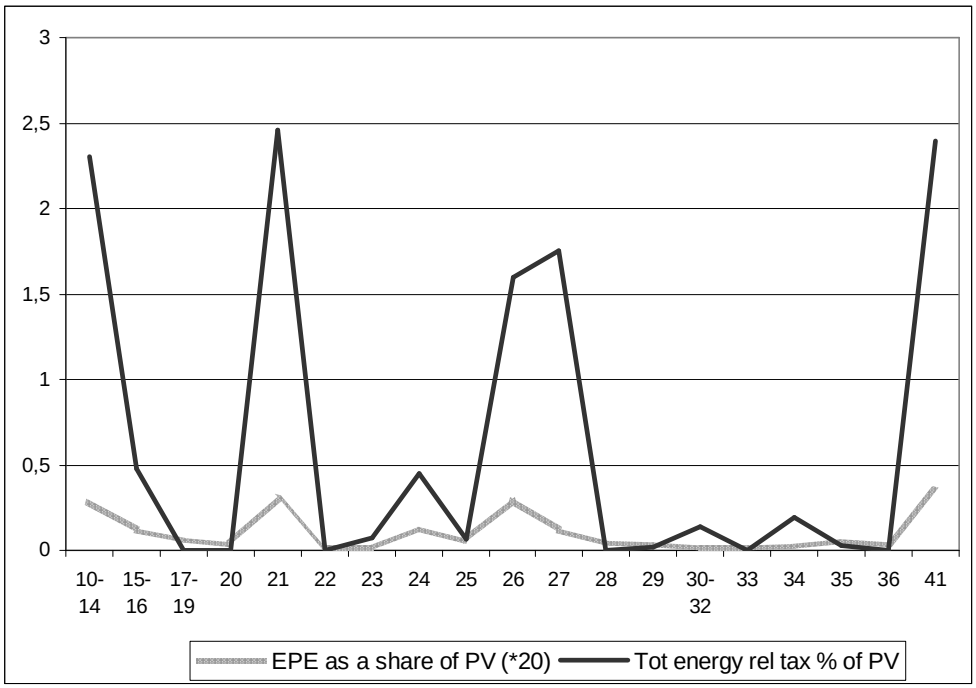
4.2.2 Energy related taxes (CO2 and energy tax) and EPE

This section will study if energy related taxes are an incentive for enterprises to spend more on environmental protection and if these higher costs/investments lead to lower taxes in the long run. However, we will use the data available in this project which is the CO2 and energy tax as one which is not optimal since it would be more correct using the emission taxes separated from the energy tax.

Do energy related taxes and environmental expenditure influence each other? Do industries that pay a lot of energy related taxes also spend a larger share on environmental protection than industries not paying as much taxes? We will try to look at this using industry statistics on NACE 2 level for NACE 10-41.

Only using the total energy related tax value does not give us a very good indication on which industries have the highest tax burden, since it is influenced by the share of the industry. We have therefore tried to take the industry size into account, by using both value added as well as a production value as weights. This will give a better indication of the environmental protection burden as well as the energy related tax burden. Figure 5 illustrates the energy related taxes and environmental protection as shares of the production value (PV). The environmental expenditures have been rescaled (*20) to make the figure more readable.

Figure 5. Energy related taxes (CO2 and energy tax) as a share of PV and environmental protection as a share of PV, 2006



*PV=production value

NACE 40 has been removed from the figure above since its values were so much higher than the other industries (its value for energy related tax as a share of PV was as high as 85).

So do industries pay high energy related taxes if they have high costs for environmental protection expenditure? The correlation between EPE as share of PV and total energy related taxes as a share of PV is 0,67 (also including NACE 40, even though not in the figure). The correlation is therefore high and we can assume so.

However, there is a low correlation between EPE as a share of PV and total energy related taxes as share of value added (VA), only 0,33. This is illustrated in table 14. But, by *not* including NACE 40 in the correlation analysis, the relationship between EPE as a share of PV and total energy tax as share of VA increased to 0,76, indicating a high correlation. Excluding NACE 40 also gives us a very strong correlation between EPE as a share of PV and energy related taxes as a share of PV, 0,94.

Table 14. Correlation between energy related taxes (share of VA and PV) and EPE. 2006. NACE 10-41.

	Tot energy rel tax % of VA	Tot energy rel tax % of PV	EPE as a share of PV	Air EPE as a share of PV
Tot energy rel tax % of VA	1,00			
Tot energy rel tax % of PV	1,00	1,00		
EPE as a share of PV	0,33	0,31	1,00	
Air EPE as a share of PV	0,49	0,45	0,67	1,00

*VA=value added, PV=production value

These results imply that industries for which energy related taxes are relatively important (both as share of PV or of VA) tend to spend more on environmental protection. What is this dependent on? Could it be that taxes act as an incentive to invest more in environmental protection?

It is also possible to break down the total energy related taxes in the following taxes, se below. For all these taxes, CO2 tax and energy tax are recorded together. (Unfortunately so in our current dataset, in the future it will be possible to separate between CO2 and energy tax.)

- tax on electric power
- tax on oil/LP gas/methane
- tax on natural gas/carbon fuel/petroleum coke
- tax on gasoline
- tax on crude tall oil

The highest correlations when breaking the information down to environmental protection on air and these energy related taxes are found between air expenditures and the tax on oil, LP gas and methane where the correlation is 0,71. There are also relatively high correlations between air and the taxes on natural gas/carbon fuel/petroleum coke (0,62) and tax on crude tall oil (0,61).

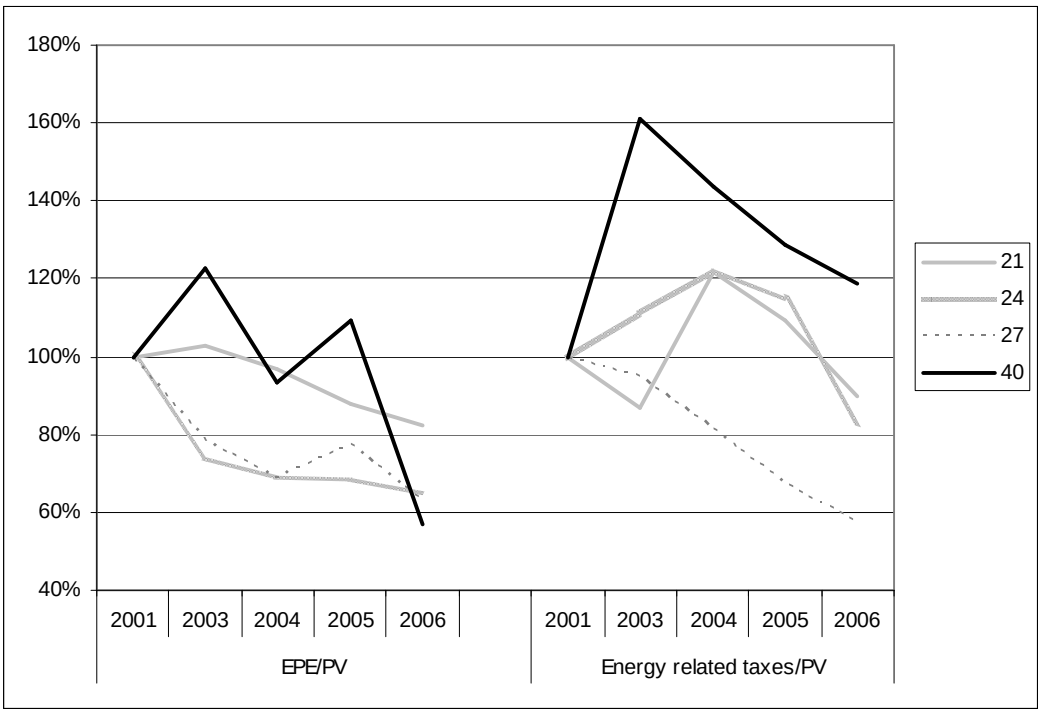
4.2.2.1 Change in the period of 2001-2006

Are there are correlations between environmental protection expenditure and energy related taxes "on time", that is during the time period 2001-2006? Questions interesting to study are if energy related taxes are an incentive for firms to spend more on environmental protection (and thereby lower their tax burden in the future)? Does higher spending on environmental protection actually lead to a decrease in paid taxes?

It is interesting to see the change over time in paid environmental protection costs as well as energy/CO2 tax. As a introduction, figure 6 illustrates these two variables by industry as a share of the total production value in four different industries, NACE 21, 24, 27 and 40 between 2001-2006. The results are indexed using 2001 as reference year.

In the energy industry (NACE 40), EPE as a share of production value (PV) decreased with 40 percent between 2001 and 2006, while energy related taxes as a share of PV increased with 20 percent in the same period. For the other industries in figure 6, NACE 21 (pulp and paper), 24 (chemical) and 27 (metal), the development in the period has been more similar for the two different variables trying to illustrate the burden of EPE and energy related taxes.

Figure 6. EPE (as share of PV) and CO2 and energy taxes (as share of PV), NACE 21, 24, 27 and 40. Index (2001 = reference year)



In order to see if energy related taxes are an incentive for companies to spend more in EPE we have studies the difference in values during the period. The first analyse is to use the energy related tax values for 2001 and compare it to the *difference* between 2006 and 2001 regarding EPE. Also here, as before, we have used shares of the production value (PV) and value added (VA) in order to see the tax and expenditure burden, rather than the total values which are influenced on the size of the industry.

To see if high energy related taxes (or just the fact that the industry has to pay energy related taxes) in 2001 has had an impact on how much firms tend to spend on environmental protection in the future we have used industry data to find an answer. We have used the difference between environmental protection as a share of production value (PV) between 2006 and 2001. The outcome has been compared to energy related taxes as a share of value added (VA) in 2001. The result is shown in table 15.

If energy related taxes were an incentive to pay more on environmental protection we would see positive correlations between the variables since then there is a relationship between high taxes in 2001 and higher environmental protection burden during the period. If there is a negative correlation the industries with a high burden of energy related taxes 2001 have gotten a lower EPE burden. The results in table 14 shows that the EPE in the area of air has negative correlations with almost all of the taxes, significant negative correlations with the electricity tax (-0,72) and the total energy related taxes as a share of VA (-0,73). There does not seem to be a relationship between a high burden of taxes in 2001 and an incentive to spend more on EPE.

Table 15. Correlation between difference in EPE (2006-2001) and energy related taxes in 2001. NACE 10-41.

	Elecr tax/VA	*Oil etc tx/VA*	*Nat gas etc tx/VA*	*Gasoline tx/VA*	*Tall oil tx/VA*	*Tot tx/PV*	*Tot tx/VA*	*Tot tx/empl*	*Tot EPE/PV difference 06-01*	*EPE Air/PV difference 06-01*
Elecr tax/VA	1									
Oil etc tx/VA	0,31	1								
Nat gas etc tx/VA	0,94	0,30	1							
Gasoline tx/VA	-0,08	-0,07	-0,11	1						
Tall oil tx/VA	-0,06	0,30	-0,05	-0,07	1					
Tot tx/PV	1,00	0,37	0,95	-0,09	-0,02	1				
Tot tx/VA	0,99	0,43	0,95	-0,08	-0,01	1,00	1			
Tot tx/empl	1,00	0,35	0,95	-0,07	-0,03	1,00	1,00	1		
Tot EPE/PV difference 06-01	-0,42	-0,42	-0,29	-0,07	-0,11	-0,43	-0,44	-0,44	1	
EPE Air/PV difference 06-01	-0,72	-0,47	-0,54	-0,06	0,19	-0,72	-0,73	-0,73	0,70	1

Another way of looking at the matter is to see if high spending on environmental protection in 2001 actually leads to a decrease in taxes paid? For this we have used the difference value of energy related taxes (share of VA, but also the total tax values) between 2006 and 2001 and compared this to the EPE (share of PV). These correlations are presented in table 16. If there is a negative correlation, the industries with high environmental protection costs in 2001 would have gotten a lower tax burden in 2001-2006. A positive correlation on the other hand, could mean that the industries with high environmental protection costs in 2001 have gotten an even higher tax burden.

The results in table 16 give very different results. For example, there is a high correlation between EPE air (share of PV) and the tax on oil etc (0,83) but there is no relationship between the same air value and the oil tax as a share of value added (0,10). Another interesting thing is that we have a high negative correlation between air and natural gas tax as a share of value added (-0,70) implying that high EPE costs in 2001 has lead to a lower tax burden. However, by removing NACE 40 from the correlation analysis the correlation is very low (0,22).

There is a high positive correlation between the electricity tax difference and the EPE air cost in 2001, stating that the industries actually have gotten a higher tax burden even though a high environmental protection burden in 2001. This may not be very peculiar since EPE air investment and electricity tax has no obvious relationship.

Table 16. Correlation between difference in energy related taxes (2006-2001) and EPE in 2001. NACE 10-41.

	Tot EPE/PV	*EPE Air/PV*
Elecr tax (06-01)	0,57	0,85
Elecr tax/VA (06-01)	0,55	0,83
Oil etc tx (06-01)	0,56	0,83
Oil etc tx/VA (06-01)	-0,06	0,10
Nat gas etc tx (06-01)	0,63	0,89
Nat gas etc tx/VA (06-01)	-0,46	-0,70
Gasoline tx (06-01)	0,22	0,13
Gasoline tx/VA (06-01)	0,21	0,04
Tall oil tx (06-01)	-0,45	-0,23
Tall oil tx/VA (06-01)	-0,45	-0,23
Tot tx/PV (06-01)	0,49	0,80
Tot tx/VA (06-01)	0,46	0,75

4.2.3 EPE and emissions

This section will study if highly polluting enterprises also spend more on environmental protection. This is done by comparing emission as a share of value added (in order to get a value of emission intensity) to the environmental protection expenditures, implying that industries with low values of emission intensity are more eco-efficient than industries with high values. High values mean that they have more emissions as a share of their value added.

Also interesting to look closer at is the change over time. Does high emissions in 2001 lead to an increased spending in environmental protection in following years, for example? It would also be interesting to try to see if this possible increased spending lead to lower emissions in the long run, that is trying to see if it is so called "effective" spending. This is difficult to answer using our set of industry data, but it is interesting to keep in mind.

As an introduction we will analyse if there are correlations between environmental protection expenditure and emissions in 2006. Do industries with high emissions also pay more on EPE?

Table 17 shows the correlation values for environmental protection and emissions in 2006. There are positive correlations between the total emissions and environmental protection in some cases. The highest relationships are between NOx and total EPE (0,91) as well as between EPE air and Nox (0,98). However, large industries both emit and have more environmental protection costs than smaller industries, just due to their size. Therefore emission intensity as well as the industry's EPE burden (EPE/PV) is included. Trying to estimate the emission intensity, that is taking emission as a share of value added together with the expenditure burden (share of PV), does not give us the same high relationships. The highest is also here between air expenditures and NOx, 0,76. There is no correlation between CO2 emissions, regardless of total values or share of VA, and emission intensity, and not a high correlation with SO2.

Table 17. Correlation between environmental expenditure and emissions, 2006.

	Total EPE	*Total EPEt/PV*	*EPE Air*	*EPE Air/PV*
CO2	0,62	0,68	0,81	0,84
CO2/FV	0,04	0,25	0,16	0,32
SO2	0,90	0,75	0,87	0,74
SO2/FV	0,42	0,50	0,45	0,51
Nox	0,90	0,83	0,84	0,75
Nox/FV	0,25	0,68	0,26	0,51

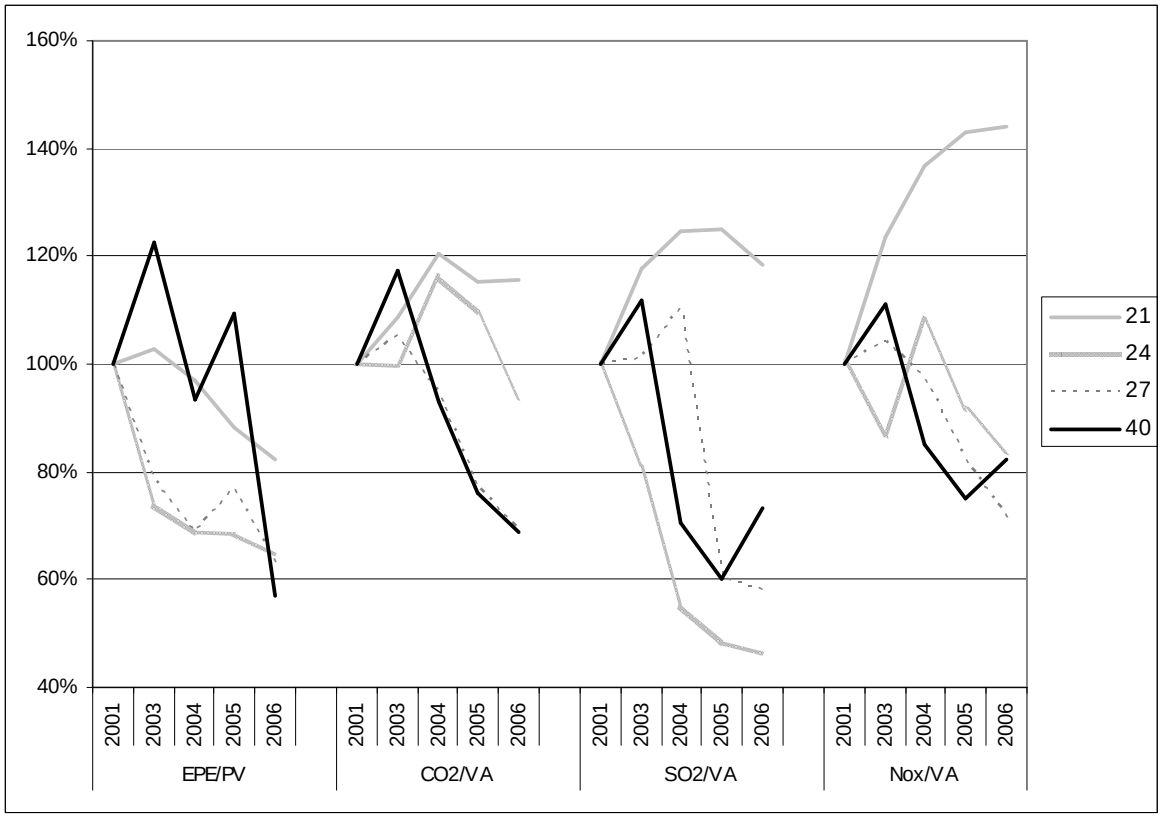
*PV=production value , VA=value added

It would have been interesting to analyse this more in detail concerning environmental expenditure, separating between current expenditures and investments. It may have given different results.

Industries investing in environmental expenditure are those that emit the most, according to the correlations. The correlation is the highest when looking at SO2 and NOx. Looking at the kind of investments the companies need to do in order to classify a cost as air expenditure, one that directly affects air emissions is the transfer from "worse" fuels to "better" fuels, but that concerns CO2 emissions. An example of air investment that has effects on both SO2 and NOx emissions is emission filters.

Figure 7 shows the change over time in environmental protection costs (EPE) as a share of production value (PV) as well as the emissions of CO2, SO2 and NOx as a share of value added. In the Energy industry (NACE 40) both EPE and emissions decreased during the period, EPE as a share of PV decreased with 40 percent, CO2 with 30 percent, SO2 with 25 percent and NOx 20 percent. In the pulp and paper industry (NACE 21), EPE decreased with 20 percent between 2001 and 2006, while all three emissions increased in the same industry, CO2 and SO2 with 20 percent and NOx with 45 percent. In both the chemical industry (NACE 24) and the metal industry (NACE 27) all shown variables decreased during the period.

Figure 7. EPE (as share of PV) and emissions of CO2, SO2 and NOx (as share of VA), NACE 21, 24, 27, 40. Index (2001 = reference year)



4.2.3.1 Change in the period of 2001-2006

Did high emissions in 2001 lead to that the companies invested more in environmental expenditures in the following years? Table 18 illustrates the correlations between the emissions in 2001 and the change between 2006 and 2001 regarding environmental protection and energy related taxes. Both total values as well as share of value added (VA) or production value (PV) are

included since we both want to examine whether there are relationships in the so called emission intensity, that is industries' emission as a share of their value added, as the actual emissions.

So did high emissions in 2001 lead to that more is spent on environmental protection? In order to just try to approach this question we have the correlations between the emissions in 2001 and the difference between 2006 and 2001 for environmental protection in table 18. A positive correlation implies that a more emission intensive industry have spent more of their share of production value on EPE than other industries not as emission intensive.

The results in table 18 indicate that there are no significant positive correlations between emissions and EPE. Nor are there any high negative correlations in the results. However, it shows that the correlations are slightly more negative (more polluting industries are *not* spending more in EPE). Also here, it may have given different results if EPE was divided on current expenditures and investment rather than total values. A Belgian report[15] separated between investments and current expenditures and it showed that the correlation was a lot higher for the investments. It also looked at the average importance of the EPE in the period and not the difference as we have made, which may be another thing to try.

Analysing emissions as a share of the industry's value added does not give correlations between air emissions and the change in environmental protection, neither if we look at total environmental protection values or its a share of production value. The relationships are a little higher with total values of emissions, but still not very high.

Table 18. Correlations between emissions in 2001 and the difference between 2006 and 2001 regarding EPE and energy related taxes (CO2 and energy taxes).

	CO2	CO2/VA	SO2	SO2/VA	Nox	Nox/VA
Total EPE	-0,25	0,16	-0,47	-0,09	-0,45	0,18
Total EPE/PV	-0,37	-0,05	-0,42	-0,29	-0,38	-0,23
EPE Air	-0,57	-0,09	-0,33	-0,16	-0,20	0,00
EPE air/PV	-0,50	-0,11	-0,34	-0,26	-0,29	-0,29
Electr tax	0,76	0,13	0,47	0,18	0,49	0,12
Electr/VA	0,75	0,11	0,47	0,16	0,48	0,08
Oil etc tax	0,73	0,14	0,39	0,14	0,41	0,15
Oil/VA	0,14	-0,18	0,21	-0,21	0,28	-0,45
Nat gas tax	0,76	0,09	0,59	0,24	0,61	0,15
Nat gas/VA	-0,77	-0,33	-0,31	-0,18	-0,33	-0,16
Gasoline tax	0,08	-0,04	0,28	0,08	0,11	0,01
Gas/VA	-0,03	-0,50	0,18	-0,35	0,10	-0,22
Talloil tax	-0,12	0,05	-0,62	-0,29	-0,77	-0,27
Talloil/VA	-0,12	0,05	-0,62	-0,29	-0,77	-0,27
Total tax/PV	0,70	0,08	0,42	0,10	0,44	0,02
Total tax/VA	0,67	0,02	0,47	0,08	0,50	-0,07
Total tax/empl	0,75	0,12	0,47	0,17	0,49	0,13
Total tax	0,76	0,13	0,47	0,18	0,48	0,12

We also included the energy related taxes (difference between 2006 and 2001) in table 18 above, just in order to try to see if there is any correlations between the emissions in 2001 and the energy taxes (as well as the energy tax burden). A positive correlation would indicate that high emissions in 2001 are correlated to a higher tax burden (if using energy related tax/VA). There are positive correlations between the actual value CO2 emissions and the taxes on electricity, oil etc, natural gas as well as to the total energy related taxes. There is also high correlation between the CO2 emission and the electricity tax as a share of value added (VA), 0,75.

[15] Vandille, 2005a

However, looking closer at emissions and energy related taxes is not that interesting since there is an obvious link between the two. The company is being taxed based on its emissions. However, it can be interesting the other way around, to see if paying a lot of taxes in 2001 has been an incentive to lower its emissions in the long run. However, the mean of doing can be seen as investing more in environmental protection so the variables are linked together. See more in table 19 below.

It is also possible to look closer at the change in emissions between 2001 and 2006 and compare this to the environmental expenditures in 2001. The idea is to try to see if high expenditures (or high taxes) lead to lower emissions in the long run?

As seen in table 19, there are links between the change in emissions between 2006 and 2001 and the environmental expenditures in 2001. However, both positive and negative correlations can be found. There is a negative correlation between the change in CO2 emission in the period and the total EPE costs (-0,70). This implies that high environmental spending in 2001 has a correlation to lower CO2 emissions in the period of 2001 to 2006. There is also a high positive relationship between the environmental protection burden, as share of production value, and CO2 emissions (0,63). Breaking down the EPE information to only the air area also gives negative correlations as seen in the table. For NOx emissions the correlations are instead positive, so then high environmental protection spending in 2001 has a relationship to higher NOx emissions in the period.

Interesting to consider may be that all industries but NACE 20, 23, 24 and 26 had negative values in CO2 emissions 2006-2001 (fossil emissions), that is they had lowered their emissions in the five years we have data for.

Table 19. Correlations between EPE in 2001 and the difference in emissions between 2006 and 2001. NACE 10-41.

	Total EPE	*Total EPE/PV*	*EPE Air*	*EPE air/PV*
CO2	-0,70	-0,63	-0,67	-0,59
CO2/VA	-0,12	-0,58	-0,22	-0,46
SO2	-0,62	-0,36	-0,42	-0,21
SO2/VA	-0,09	-0,38	-0,20	-0,36
Nox	0,50	0,63	0,79	0,83
Nox/VA	0,28	-0,32	0,16	-0,21

In table 19 above, we found a correlation between emissions and energy related taxes, stating that there is a correlation between some of the taxes and some emissions. Interesting to look closer at is therefore the change in emissions between 2001 and 2006 and its relationship to energy related taxes in the year 2001, see table 20. There is a positive correlation with NOx and all the energy taxes besides gasoline and crude talloil. Those that had a high tax burden for the electricity and natural gas taxes in 2001 have increased their NOx emissions in the period. It may be more positive to then look at negative correlations, as seen for CO2 and SO2, indicating that there are at least some examples of when a high tax burden in 2001 has lead to lower emissions. For this see for example the oil etc tax as a share of value added (VA) and its relationship to CO2 as a share of VA (-0,73).

Table 20. Correlations between energy related taxes in 2001 and the difference in emissions between 2006 and 2001. NACE 10-41.

	Electr tax	*Electr/ VA*	*Oil etc tax*	*Oil/ VA*	*Nat gas tax*	*Nat gas/VA*	*Gasoline tax*	*Gas/V A*	*Talloil tax*	*Talloil/ VA*	*Total tax/PV*	*Total tax/VA*
CO2	-0,54	-0,54	-0,81	-0,56	-0,55	-0,47	0,00	0,24	-0,53	-0,53	-0,6	-0,6
CO2/VA	-0,31	-0,31	-0,39	-0,73	-0,32	-0,37	0,11	0,30	0,16	0,15	-0,4	-0,4
SO2	0,12	0,12	-0,44	-0,35	0,10	0,13	0,05	0,11	-0,45	-0,45	0,1	0,1
SO2/VA	-0,17	-0,18	-0,33	-0,71	-0,17	-0,17	0,09	0,14	0,36	0,35	-0,2	-0,3
Nox	0,92	0,92	0,66	0,34	0,93	0,94	-0,11	-0,17	0,12	0,13	0,9	0,9
Nox/VA	-0,02	-0,03	0,12	-0,43	0,00	0,00	0,06	0,02	0,38	0,38	0,0	-0,1

4.3 Micro analyses

In this section of the study, the idea is to analyse enterprise statistics at a micro level to be able to see what is happening over time. When starting up the project the plan was to interlink monetary data with physical data such as emissions and energy use. The main difference from the previous section is that we have collected, or distributed, the data on enterprise level.

One thing of interest is to see what is correlated and try to analyse this in more detail. It is also of interest to analyse some of the variables more separately, such as for example environmental protection expenditure (EPE) and energy related taxes (energy- and CO2-taxes), in order to see the correlation and also the change over time. This will be carried out in separate sections below.

As said above, the gaps in coverage regarding data on energy and emissions is to large to allow for a sound analysis. Therefore, in the sections below data on energy and emissions are left out due to the lack of consistent data sets at the micro level with the exception of one case. In our opinion, the idea of analysing data at this level could be fruitful but a complete analysis have to be work for the future where even more focus and effort are put in to correct the data sets. For this reason, in the following subsections data on EPE, energy related taxes and turnover will be the focus.

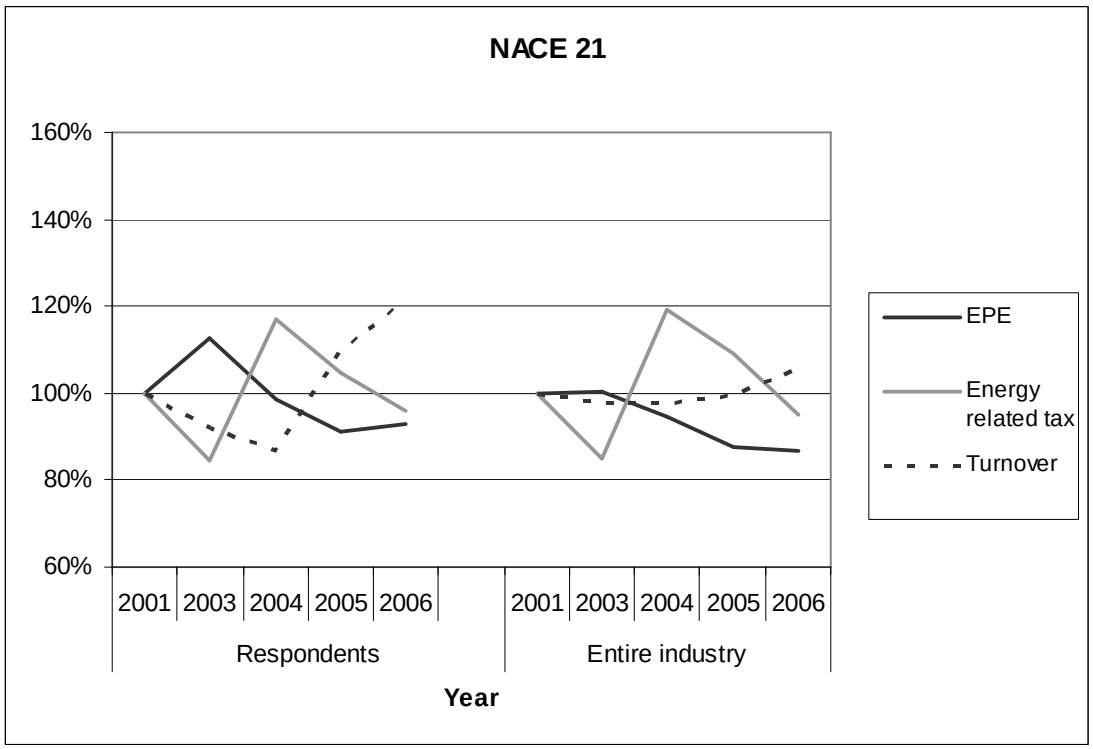
This chapter is divided in mainly two subsections; first, a comparison of variables between respondents in the EPE survey and the total of their NACE group; and secondly, a regression analysis of the micro material regarding EPE and the other variables.

4.3.1 Comparison, respondents of the EPE survey and its industry

In the first of the two subsections we turn the attention to a comparison between *EPE*, *energy related taxes* and *turnover*, partly within the group of respondents to the EPE survey, partly within the entire industry to which the respondents belong. The idea behind such an analysis is to have a notion of whether the sample of enterprises responding to the survey differ from the entire industry they belong to and to what extent they could be seen as representative of the industry.

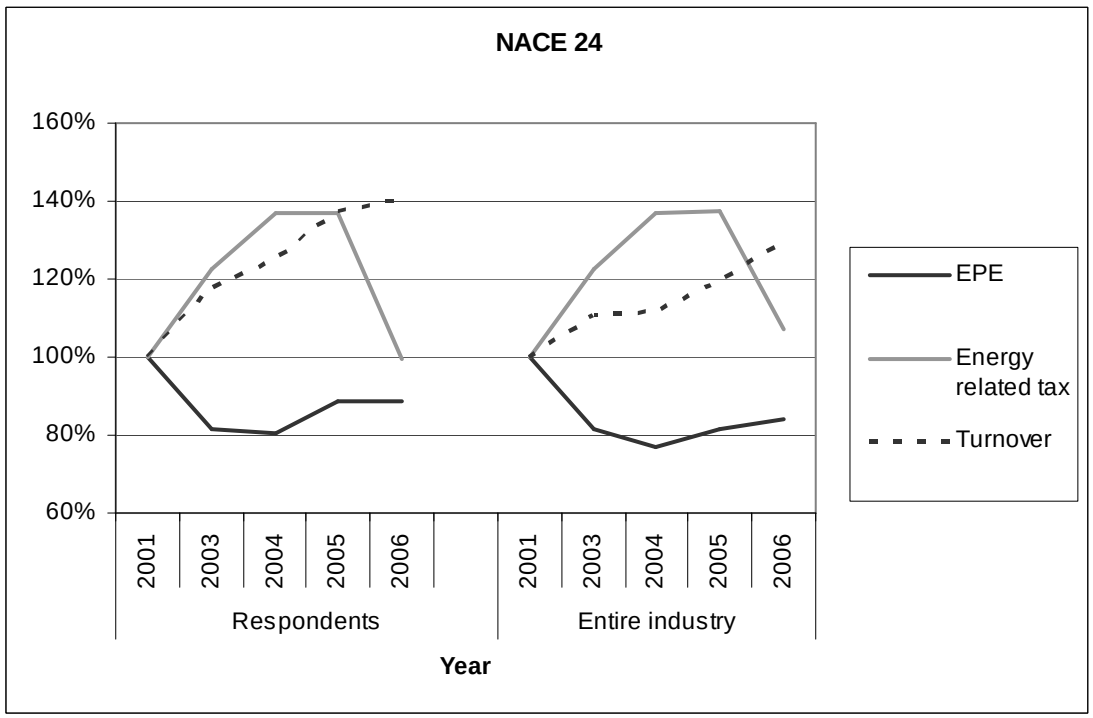
As seen in figure 8, in the pulp and paper industry (NACE 21), the group of respondents follow their entire industry well regarding paid taxes and EPE, with the exception for year 2003. The increase in turnover is more evident in the respondent group than in the total industry.

Figure 8. Pulp and paper industry, NACE 21, Total environmental protection expenditure, paid energy and CO2 tax and turnover for respondents to the survey and the entire industry. 2001-2006



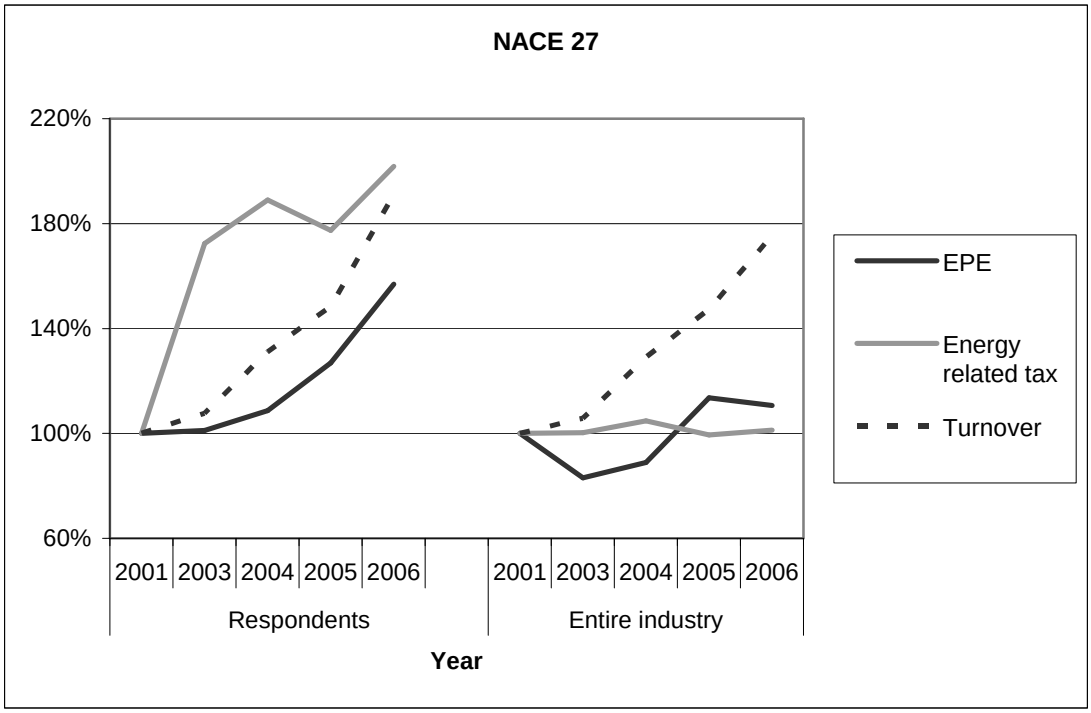
Regarding the chemical industry (NACE 24), the respondent group do not differ significantly from the whole industry. As in the case of NACE 21, the enterprises participating in the survey have had a larger increase in turnover than the entire industry, as is shown in figure 9.

Figure 9. Chemical industry, NACE 24, Total environmental protection expenditure, paid energy and CO2 tax and turnover for respondents to the survey and the entire industry. 2001-2006



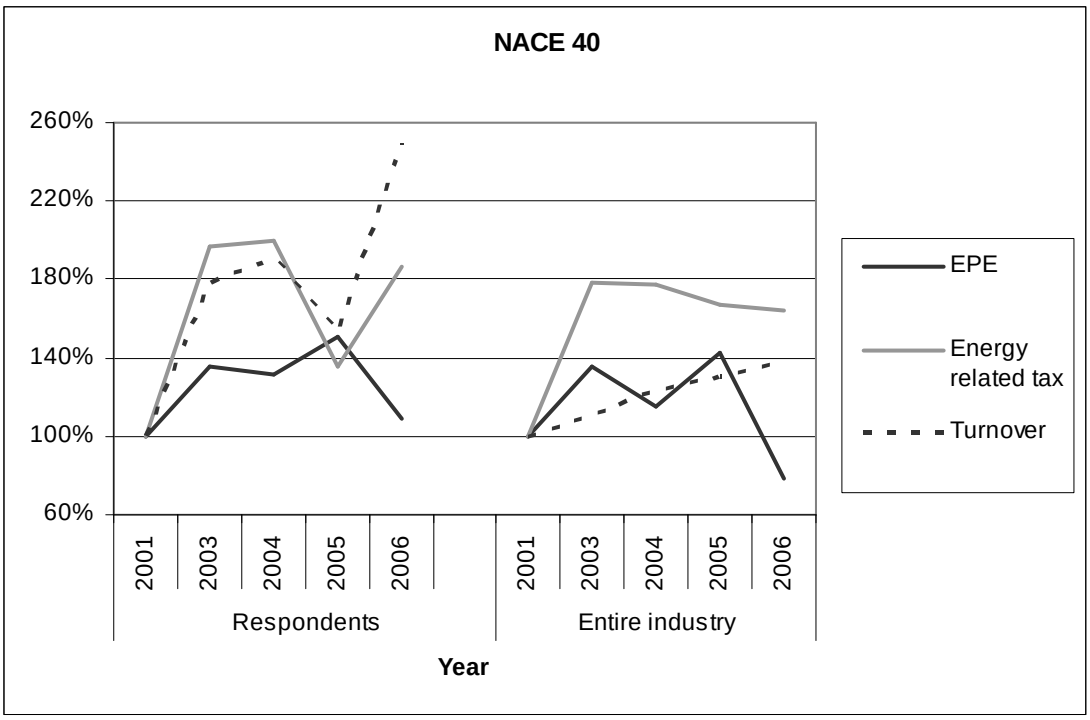
The respondents in the metal industry (NACE 27), see figure 10, present the biggest difference in patterns of the four industries compared to their total industry. The turnover in both groups are more or less similar but the curves regarding EPE and tax differ quite a lot from each other. This might indicate that the group of respondents are not representative of the industry. This in turn needs to be considered when conducting analysis on a finer level.

Figure 10. Metal industry, NACE 27, Total environmental protection expenditure, paid energy and CO2 tax and turnover for respondents to the survey and the entire industry. 2001-2006



This might even be the case in the energy industry (NACE 40), shown in figure 11, even though the differences in patterns here are not as marked as in NACE 27. The curves representing EPE and taxes show similar patterns except for year 2003 regarding paid taxes. Also, the group of respondents have spent relatively more on EPE than the entire industry. The big difference in NACE 40 lies in the turnover, but this may be negligible in the case of studying correlations between EPE and energy related taxes.

Figure 11. Energy industry, NACE 40, Total environmental protection expenditure, paid energy and CO2 tax and turnover for respondents to the survey and the entire industry. 2001-2006



4.3.2 Regression analysis

For this second subsection, a couple of regression analyses of the collected micro material were conducted. This was partly to be able to look into the possibilities of analysis at this level, partly because to see whether there in fact could be said something about the relations between the actual variables. In this section there is also a case of exception regarding the use of data on emissions as we wanted to make a attempt for the relation between EPE and emissions.

The method used is a simple regression analysis where we assume that a *p-value* less than 0,05 indicates a relation between the variables. The strength of the relation is shown by the *R-sqr* and the relations should be linear.

A few things need to be stressed here. The availability of data is of great importance as well as the time period available. The case of data availability and the gaps in coverage has been dealt with above. Regarding the issue of time period and these regression analysis there should be said that the time span 2001-2004 is in fact to short to answer the rather complex questions dealt with here. Therefore, the analysis and the conclusions should be viewed as an attempt to show what can be done with such data rather than solid results to act upon.

4.3.2.1 Taxes and EPE

The first question posed to the material concerned the relation between EPE and energy related taxes. The expectation was that there might *be a connection where high taxes (paid taxes at the individual enterprise) leads to a higher amount of EPE*. The model employed here uses a regression analysis as follows

$EPE_t = a + b * TAX_{t-1} + e_t\text{-}1$

where the general idea being that paid taxes in a specific year (TAX_{t-1}) leads to higher EPE the year after (EPE_t). The results of the analysis are shown in table 21.

Table 21: Regression analysis of energy- and CO2-taxes and EPE, NACE 21, 24, 27 and 40

	Estimate (b)	No. of obs.	R-sqr	p-value
NACE 21	2,10679	281	0,13	0,0001
NACE 24	2,60790	280	0,22	0,0001
NACE 27	0,78593	170	0.35	0,0001
NACE 40	-0,00016421	227	-0,00	0,9765

The results show that there seem to be a relation between high paid taxes and a high amount of EPE in all of the industries except for the energy industry (NACE 40). In the energy industry there are a lot of tax exceptions which might explain this result. In general, NACE 40 pay less tax shares even though the total sum of the tax from this industry is large.

4.3.2.2 EPE and taxes

A second matter we wanted to analyse is rather the opposite from the first question: *Does high amounts of EPE lead to lower taxes in the long run*? Once again a regression analysis was used built on the difference between paid taxes in year 2004 compared to the taxes paid in 2001. This was tested against the sum of EPE investments during the period 2001-2004 as seen in table 22.

Table 22: Regression analysis of sum EPE total investments, 2001-2004, and difference in paid energy- and CO2-taxes 2001-2004

Variable	Estimate (b)	No. of obs.	R-sqr	p-value
Tax diff.	-0,03136	440	0.0001	0,8748

In this example it is obvious that there could not be found any evidence that a high spending on EPE lead to lower taxes as the p-value is way over 0,05. One drawback was that we in the analysis only could use the enterprises participating in the survey on EPE and this most certainly biased the result. Again, it should be stressed that the time period in fact is too short to actually say something about the relationship between the variables. As said above, the important thing in this subsection of the project is to make some attempts and show some examples of what can be done with this kind of data.

4.3.2.3 EPE and CO2-emissions

The last analysis of this section deals with if EPE affects the level of emissions in the long run. The same kind of regression analysis, as in the second case of EPE and taxes, were employed but with the difference of using the CO2-emission variable as the independent and the sum of investments in EPE Air (CEPA 1) as the dependent variable. The expectation was that lower levels of emissions during the period could be related to high levels of EPE investments.

Table 23: Regression analysis of sum EPE Air investments (CEPA 1), 2001-2004, and difference in CO2- emissions 2001-2004

Variable	Estimate (b)	No. of obs.	R-sqr	p-value
Co2-diff	2,13937	283	0.0157	0,0353

In this case, as seen in table 23, we could not find evidence supporting the expectation since the level of explanation in the R-sqr variable is very low. Also, the result came out quite the opposite from the expectation. Instead of lower emissions among those companies with high amounts of EPE there seem to be rather the other way around (as the supposed estimate figure should be negative). In this case the estimate is positive, which indicates that the companies with high amounts of investments in EPE Air seem to have increased their emissions during the period.

Again as in the previous case, the sampling with only the enterprises participating in the EPE survey is problematic. Another point worth mention is that there are several reasons to record an investment in CEPA 1 but actually only one thing that really makes a difference regarding CO2-emissions to air, namely the substitution of fuel. The consequence being that a regression analysis between these variables might be irrelevant or at least at this level. To be able to conduct a proper analysis in this field the demand would be to examine each investment in CEPA 1 to deduct those investments not contributing to lower levels of emissions.

5. General discussion and conclusion

5.1 EPEA

There are basically three main categories of actors that need to be identified; government, enterprises and households and their economic transactions for the protection of the environment in order to establish the environmental protection expenditure accounts (indeed also non-profit institutions serving households should be considered).

The intention was to let the 16 Swedish environmental objectives provide a lead in covering the EPEA tables with a full picture of the actions in relation to environmental protection. The complexity of the objectives showed that a lot of the objectives cross into several actors and they do not provide a clear guidance on who should deal with them. So this project could mainly make assumptions on where there might be actions taken on the basis of the goals of the objectives.

The next step was then to search the statistics. However, main economic statistics do not separately identify transactions related to the environment which create difficulties setting the tables up. Based on the Belgian experience providing a thorough methodology for estimating most data with the help of the national accounts input/output tables it was decided to use the same approach for the Swedish EPEA tables. This was done where major data gaps were seen as for the supply and use table (Table B1) and for the national expenditure table (Table A).

Turning to the National Accounts for assistance in governmental activities was possible in terms of main expenditure where the appropriations were allocated directly to environmental expenditure through the COFOG statistics. Also available from the National Accounts and the Environmental Accounts were the data on transfers (for consumption and for investments). However, these data could not be broken down into environmental domains during the course of this project. The data on transfers differed between the COFOG and the Environmental Accounts. This meant that the production table (Table B) and the Expenditure table (Table A) did not match up properly (as well as for the financing table, Table C).

Despite difficulties the EPEA tables that were possible to fill came up with some interesting results. The production table (Table B) required a thorough investigation of data availability of specialised producers, secondary non-specialised producers and ancillary activities. The National Accounts could assist with most variables needed, the only exception being investment grants for specialised producers and secondary non-specialised producers. This meant that specialised and secondary producers could be well covered in the EPEA tables. However, for ancillary activities it was only possible to present data from the EPE industry survey. Data on sectors such as agriculture, forestry and fishery, construction and services could not be found. During the search for statistics in these sectors an interest was shown from the agriculture department at Statistics Sweden to develop and conduct a new survey measuring the investments and current expenditure for environmental protection.

The tables took considerable time to compile as well as to understand. The results of the tables, based on the combination of raw data and estimation procedures, proved to be a challenge to interpret. There were so many different data sources to choose from, all with different definitions and content even though they seemed to cover the same issue.

In the case of interpretation and presentation of the results, the international studies could not assist in providing good analytical guidelines for more then parts of the EPEA tables at least not that could be found during this project. It has been pointed out though that just because of the initial efforts needed to launch the production of EPEA tables on a regular basis there simply has not been time to explore further analytical potential.

Eurostat (2002a) highlights three major indicators from the EPEA tables: Current and capital expenditure by industry and the financing of these expenditures. The publication also recommends these indicators to be compiled annually and to compile the full EPEA perhaps every five years. To the authors, the EPEA tables are a solid base to those who understand national accounts and should be maintained as such. However with the large amount of estimations, data gaps and unexplained statistics in the Swedish EPEA the simpler indicators are to be recommended until better knowledge of the statistics are available.

5.2 Industry and micro level analysis

Starting out in this part of the project a sense of optimism was prevailing of what could be done with these kind of data. During the project the optimism was dampened with the harsh reality of inconsistent micro data. However, data on EPE, energy related taxes, use of energy, emissions and regular business statistics were collected. When linking all the data together it was apparent that the data from the different sources were not entirely compatible at the individual enterprise level. In the Belgian report (Vandille 2005a), cited several times above, one of the conclusions were that more disaggregated data and longer time series were needed to substantiate the results. In this project we have arrived at, more or less, the same kind of position. The idea and intention of the project was good but in the end the analyses made were impeded by difficulties with data quality, lack of consistent data sets and too short time periods to build firm results.

In order to make better analyses and to try to answering the questions posed above, the data sets used were simply not enough. They were certainly sufficient to start a discussion but not able to draw far-reaching conclusions from. Instead of discussing the uncertain results presented in the previous chapter, we rather discuss some considerations and implications of the analyses made and how to improve the data quality.

Regarding the data on EPE, it is clear that more in-depths studies are needed to be able to divide data which are to be used for these kind of purposes. For example, which kind of EPE Air (CEPA 1) could be directly referred to decreasing emission levels? This could be done in a few ways and possibly the most adequate way to attain knowledge in this matter is to do enquiries into the causes and effects of different investments. A way to do this is to set up a dialogue directly with a number of enterprises in different industries which do not necessarily involves an ordinary survey. It is more of a complement to the already existing survey on EPE. In the same line, it would be interesting to use more separated data on environmental protection in similar analyses, especially since we did not always get correlations between the variables we tested. The Belgian report (Vandille 2005a) separated between investments and current expenditures and it showed that the correlation was a lot higher for the investments (to emissions). The case might be the same for Sweden, and that lower correlations to the current expenditures work against the result we could have had. The Belgian study also studied the average importance of the EPE in the period and not the difference as we have made, which may be another thing to attempt in the future.

For the energy- and CO2-taxes one of the problems in the project have been that these taxes come as a total from the Swedish Tax Board (even though divided as listed above). When energy taxes are lumped together with CO2-taxes it has implications when it comes to the possibilities of doing analyses on taxes and emissions. This problem might already be solved as the Tax Board since 2006 separate energy taxes from the CO2-taxes which offer new potentials of analysis.

In all, this part of the project has been both rewarding and discouraging. Rewarding in that sense that we have collected a data set and made several attempts to analyse it in a way that could be interesting from a policy point of view. Discouraging in means of solid results and substantial conclusions. The sum of the experiences will be forwarded to new projects and new developments in the field.

Litterature

Aujeszky. P., Hajdu. V., Valkó. G. 2005. Towards Environmental Protection Expenditure and Environment Industry Accounts in Hungary. Hungarian central statistical office

Barry. Conor P., Convery. Frank J. 2002. The policy relevance of environmental protection expenditure accounting. European Environment 12, 291-302

Edited by Broniewicz. E.2005. Environmental Protection Expenditure Account in Poland Report on the Pilot Project. Central statistical office and the Foundation of Environmental and Resource Economists

Baud., S. 2006. Improvement of data quality in Environmental Expenditure Account as well as in Eco Industry – Sample survey at service industries. Statistics Austria

FMS rapport 176 2002. Carlsson-Kanyama. A., Lindén. A-L. Hushållens energianvändning. Värderingar, beteenden, livsstilar och teknik – en litteraturöversikt
http://www.infra.kth.se/fms/pdf/Hushallensenergianvandning.pdf

Elforsk 2005. Litteraturöversikt - beteendestudier och elanvändning
http://www.elanprogram.nu/rapporter/litteratur_profu.pdf

Eurostat 2007a. Environmental expenditure statistics: General Government and Specialised Producers data collection handbook

Eurostat 2007b. Taxation trends in the European Union. Data for the EU Member States and Norway

Eurostat 2007c. Manual on sources and methods for the compilation of COFOG Statistics - Classification of the Functions of Government (COFOG)

Eurostat 2005a. Environmental expenditure statistics: Industry data collection handbook

Eurostat 2005b. Environmental Protection Expenditure in Europe by public sector and specialised producers 1995-2002 - Issue number 10/2005

Eurostat 2002a. Environmental Protection Expenditure Accounts – Compilation guide

Eurostat 2002b. Environmental Protection Expenditure Accounts – Results of pilot applications

Eurostat 2001. Environmental taxes – a statistical guide

Eurostat 1994. SERIEE 1994

FN et al 1995. System of National Accounts 1995

KRAV: www.krav.se

Krepstuliene. D. Data Collection Project on Environmental Protection Expenditure. Statistics Lithuania 2005

Lazdina. A., Zvirbule. 2005. I. Environmental Protection Expenditure accounts Latvia. Central statistical bureau Latvia

Länsstyrelsen i Norrbottens Län, Skogsstyrelsen 2006. Strategi för formellt skydd av skog i Norrbottens län – nedan gränsen för fjällnära skog

Project on Environmental Protection Expenditure and Environmental Industry Accounts. The statistical office of the Slovak Republic 2006

Regeringens proposition 1997/98:2 Hållbart fiske och jordbruk

SCB 2009. Bakgrundsfakta 2009:2. Carlsson. A. Combinations of codes in the Combined Nomenclature for Swedish Material FlowAccounts – Method Development.

SCB 2008a. MIR 2008:1. Palm. V., Steinbach. N., Cederlund. M. Environmental economic indicators in the Swedish state budget 1995-2006

SCB 2008b. ESA95 GNI Inventory Sweden – Revision 4 January 2008. http://www.scb.se/statistik/NR/NR0102/_dokument/GNI_Inventory_final%20version_Jan2008.pdf

SCB 2007a. MIR 2007:1. Steinbach. N. The economic structures and environmental pressure in the Swedish river basin districts 1995-2005

SCB 2007b. Eberhardson. M. Environmental protection expenditure in industry 2006. MI23SM0701

SCB 2006. Cederlund. M., Mårtensson. A. Public environmental protection expenditures and subsidies in Sweden

SCB 2003a. Olsson. N., Eberhardson. M. Environmental protection expenditure in Swedish industry – Evaluation of new variables, data quality and estimation methods

SCB 2003b. MIR2000:3 Larsson. M. Miljöskatter och miljöskadliga subventioner

SCB 2002. Olsson. N. Refined Environmental protection expenditure in Sweden

SCB 2001. Fränngård. P., Olsson. N. Tools to increase response rate and quality of environmental protection expenditure in industry

SCB 2000. MIR 2000:2. Johansson. U. Industrins miljöskyddskostnader 1997 – resultat från en svensk pilotstudie

SCB 1997. Johansson. U. Adaption of Swedish data on Environmental protection in the public sector to the SERIEE system

SCB 1996. Stoltz. P. Testing SERIEE's Environmental protection expenditure accounts in Sweden

UN/FAO 2004. Handbook of National Accounting: Integrated Environmental and Economic Accounting for Fisheries

Vandille. G. 2005. EPEA for Belgium 1997-2002. Federal Planning Bureau

Vandille. G. 2005a. Environmental Tax Accounts for Belgium, 1997-2002. Federal Planning Bureau

Vandille. G. 2003. EPEA for Belgium 1997-2000. Federal Planning Bureau

VITO 2007. Vercaemst. P., Vanassche. S., Campling. P., Vranken. L. (VITO), Agnolucci. P., Salmons. R., Shaw. B. (PSI), Jantzen. J., van der Woerd. J. (TME), Grünig. M., Best. A. (Ecologic). Sectoral costs of environmental policy.

Data sources
Statistics Sweden (Statistiska Centralbyrån): www.scb.se
National Accounts input-output matrix:
http://www.scb.se/statistik/NR/NR0102/2007A01O/TabellpaketarsSM_2005_publ_2008-04-28.xls

The Swedish National Financial Management Authority (Ekonomistyrningsverket): www.esv.se

Eurostat: http://epp.eurostat.ec.europa.eu

Swedish Forest Agency (Skogsstyrelsen): www.skogsstyrelsen.se

Environmental Objectives Portal: http://miljomal.nu/english/english.php

Avfall Sverige: www.avfallsverige.se

Interviews:
Svea skog: Johan Ekenstedt**,** co-ordinator ecological parks and Linda Andersson, Information manager.

Several members of staff at: Swedish Board of Agriculture and LRF konsult