Disaggregation and Improvement of the Swedish NAMEA

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1 Summary

Statistics Sweden have previously compiled statistics on energy use and emissions of certain pollutants for sixteen industrial sectors plus output in the public sector and private consumption. In this report, the previous data on 1993 energy consumption and emissions is disaggregated into 134 classes of industry plus government service and private consumption, in accordance with the new classification used in the national accounts. Included emissions are CO_2, SO_2, NO_x, NH_3 and metals (Pb, Se, Zn, As, Cd, Cu, Cr, Hg, Ni). The results are presented following the industrial classification proposed by Eurostat for compilation of NAMEAs.

The far-reaching disaggregation demanded an improved method of allocating mobile emissions. Since some emissions, like NO_x, are not proportional to the consumption of propellant the allocation to industry classes is difficult. For these emissions, statistics about age of vehicles, driving distance etc. can be used to allocate the emissions to different industry classes. Using these statistical sources has considerably improved the quality of the allocation of the environmental accounts data.

The change into more disaggregated accounts improve the possibilities to perform more detailed analyses of the links between industry structure and environmental pressure. It is clear that at least emissions of CO_2, SO_2 and NO_x to a large extent come from a very limited number of industries. However, after the disaggregation into 136 classes, some industries formerly part of a large ‘non-emitting’ aggregated group now show up in a selection of the most emitting industries.

2 Introduction

Statistics Sweden has been working to develop integrated environmental and economic accounts since 1993. The work is conducted within the scope of a governmental assignment to develop physical environmental accounts and improve and augment environment statistics.

Statistics Sweden has chosen the NAMEA accounting model developed in the Netherlands as the basic structure of the Swedish environmental accounting system. Previously, we have compiled statistics on energy use and emissions of certain pollutants for 1989, 1991 and 1993 divided into sixteen industrial sectors plus output in the public sector and private consumption[1]. In this report, we have disaggregated the previous data on 1993 energy consumption and emissions into 136 classes of industry, in accordance with the new classification used in the national accounts. Included emissions to air are CO_2, SO_2, NO_x, NH_3 and metals (Pb, Se, Zn, As, Cd, Cu, Cr, Hg, Ni).

Firstly, a Eurostat proposal for a standard classification of industrial activities is compared to the classification used in the Swedish NAMEA, as an introduction to the presentation of results. Thereafter, a description is given of how the data on energy use and emissions have been calculated. A discussion of the differences between the results for 136 sectors compared to the earlier 16 follows. The report ends with an outlook on the possibilities to include more pollutants.

[1] Environmental Accounts, Physical accounts for energy and air emissions for 1989, 1991 and 1993, Na 53 SM 9601, Statistics Sweden, 1996.

3 Compatibility of the Swedish classification with Eurostat proposal

Eurostat has made a proposal on a standard classification of industrial activities for the sake of comparability of NAMEAs for EU countries[2]. The Swedish classification used in the most disaggregated NAMEA version is the same as the national accounts classification (see Annex A.1). Mostly this classification is more disaggregated than the Eurostat proposal which accordingly poses no problem to follow. A few exceptions exist, though, and these are listed below.

3.1 Differences in Eurostat and Swedish classification

Eurostat Proposed Classification (NACE Rev. 1)		**Swedish National Accounts and Swedish NAMEA Classification** (SNI 92, which corresponds to NACE Rev. 1 up to four digits)	
	Description		*Explanation*
10 11 12	Mining of coal and lignite; extraction of peat Extraction of crude oil and natural gas; service activities incidental to oil and gas extraction excluding surveying Mining of uranium and thorium ores	10+11+12	These classes are accounted for jointly. Except extraction of peat these activities are of negligible value in Sweden.
269	Manufacture of non-metallic mineral products n.e.c.	–	Code not used in SNI 92.
401 403	Production, collection and distribution of electricity Steam and hot water supply	401+403	These classes are accounted for jointly.
41	Collection, purification and distribution of water	41+ 90001	These classes are accounted for jointly. 90001= sewage treatment.
611 612	Sea and coastal water transport Inland water transport	61	The sub-classes are not used in the national accounts.
90	Sewage and refuse disposal, sanitation and similar activities	90 excl 90001	Excludes sewage treatment, see above.

To conclude, the Swedish classification differs from the Eurostat proposal in ten cases. In seven of these, the Swedish classification is too aggregated to permit the proposed Eurostat accounting. In two cases, Sweden do not use ”pure” NACE- code classes in the national accounts, but has made a particular grouping. In one case, Sweden do not use the proposed code at all.

[2] Ref. DG34/B/003586/21 XII 1995.

Two of the cases seem more important. First, the industries 401 and 403 are accounted for jointly in Sweden. Some data for the group can be divided between 401 and 403, for example energy and emission statistics, but it is not possible to present value added for each group. Also, the industries 611 and 612 are not subdivided in SNI 92, but accounted for as industry 61 in all base statistics. It is therefore almost impossible to disaggregate economic or energy statistics to 611 and 612.

As mentioned above, the Swedish environmental accounting classification corresponds to the national accounts classification. The reason for this is to enhance the compilation of coherent accounts where the economic and environmental data agree. The most disaggregated classification will probably seldom be used for all classes, since the amount of information then tends to be somewhat unwieldy. However, the most disaggregated, specified classification will always be interesting for certain industries with very industry specific emissions. The compilation of statistics at a very disaggregated level naturally give users of the environmental accounts possibility to choose more aggregated levels for their usage. For example, the physical environmental accounts will serve as basic data for an environmentally adjusted economic general equilibrium-model (CGE-model) developed at the National Institute for Economic Research. In this model, the industry will be divided into about fifty classes, but with a great variety in the level of classification used for the grouping. Sometimes five digit SNI-classes is used as single groups while some other, less environmentally interesting industries are grouped together at a two digit level.

3.1 Comments on data quality

In general, the allocation of emissions to 136 sectors leads to a higher uncertainty in the results for some sectors than was the case when only 16 groups of industries[3] were used. In the results presented in annex B, the quality of the results for three digit SNI-groups are quite uncertain. The numbers are presented here as a step in the ongoing process of development of environmental account statistics, but with reservations for their correctness. Accordingly, the data calculated for four digit SNI-classes in the full list of 136 sectors are also very uncertain. The reason for an increasing uncertainty for some sectors is that a top-down model has to be used when allocating data. The total is known by estimation or earlier surveys, and is then broken down to different groups. When the number of groups increase each estimation becomes more uncertain.

The quality in the emission data are closely linked to the quality in the energy accounts, since they are partly the basis for the emission calculations. In chapter 4.1.4 quality and sources used for energy accounts are further described.

[3] The old classification into 16 industries + government service and private consumption is presented in Annex A.2.

4 Methodology

In this chapter both the method for calculating energy use and emissions to air, as well as the method for attributing the emissions to 134 classes of industry plus output in the public sector and private consumption will be described.

4.1 Energy consumption

Statistics on energy consumption connected to economic sectors are an important tool for analysing linkages between economic activity and energy flows. Energy accounts also form a link from the national accounts to the environmental accounts.

4.1.1 The structure of energy statistics

The Swedish energy statistics describe both the supply and the consumption of energy commodities, in relative detail. The statistics mainly concentrate on charting energy consumption in physical quantities. When coupled with price statistics, this also allows energy consumption to be calculated in terms of value.

Energy statistics can be divided into two categories. Firstly, there are the statistics based on information supplied by producers of energy commodities (so-called suppliers' statistics) and secondly, there are statistics based on energy consumers, e.g. enterprises or property owners (so-called consumer statistics).

Suppliers' statistics include monthly and annual electricity statistics - the latter also being combined with annual district heating statistics - and annual gasworks statistics. There are, in addition, monthly fuel statistics, comprising details of supply and deliveries of oil products, some coal and coke-related information, and the supply of natural gas. There are also quarterly statistics on fuel consumption and production based on information received from electricity, gas and heat producers.

Consumer statistics provide more in-depth information on energy consumption. This data includes annual energy statistics for one- or two-dwelling houses, multiple- dwelling buildings and buildings with premises. Energy consumption within agriculture and fishing is only charted one year in five. Details of the manufacturing industry's fuel usage are contained in the quarterly fuel statistics. These provide information on industry's stockpiling and consumption of both purchased fuels and fuels produced internally. The annual statistics on manufacturing contain more detailed information on the industry's use of energy purchased in quantities and values. Energy data contained therein can be related to SNI-group, occupation, production, value-added, region e.t.c.

Energy flow descriptions in physical quantities, or energy balances, as they are known, provide collective overview data on the country's total energy supply and use. They are compiled every quarter in addition to the above-mentioned short-periodic statistics. Annual energy balances, based on definitive annual statistics (where such exist) are also compiled. The precision of measurement of these balances is greater than that of the quarterly statistics and they also provide considerably more detailed information, particularly on the consumption side. The national accounts' input/output tables can also be said, in those sections which refer to energy commodities, to constitute a form of energy balance, shown in monetary terms.

4.1.2 Energy accounts

The term energy accounts refers to a system whereby energy data, in both physical and purely monetary terms, are incorporated into the national accounts' accounting system. This facilitates the consistent description and analysis of energy consumption in relation to economic activity, as described by the national accounts. This approach also provides a basis for the corresponding linkage of data on the environmental effects of energy consumption to the accounting system, as the emissions of substances which affect the environment can largely be linked, both factually and computationally, to the physical consumption of various energy products.

Drawing up energy accounts mean that the supply and use of energy products are recorded in physical terms in accordance with the bases for division used in the national accounts' input/output system. This allow quantities to be linked to the value data which is the chief component of the system.

4.1.3 Source data for the calculation of energy accounts

The source data for the quantities calculated has primarily been drawn from the annual energy balances[4]. The annual energy balances are, in certain respects, more functionally-oriented in their breakdown than the activity-based breakdown in the national accounts. The industrial breakdown is also, particularly with regard to the service industries, more aggregated than that required as a basis for energy accounts. The quantity data for certain industry aggregates has thus been calculated on the basis of larger aggregates using existing value data.

The source data for compiling of quantities consumed within SNI 10-37 have mainly been drawn from the annual statistics on manufacturing. Attributions have been made for smaller establishments not included in the survey population[5] of the statistics. The total consumption of energy has

[4] A description of statistical sources, calculation methods, content etc. is given in Statistical Review: Annual Energy Balances 1991-1992, Statistics Sweden, 1994.
[5] In the survey population a cut-off limit for companies with less than 10 employees is used.

been broken down to a more detailed product level for the emission calculations. Quantities of energy products used as raw materials for products, e.g. in the chemical industry, have been listed separately.

The transport industry (SNI 60-64) includes the shipping industry's oil consumption, as per the national accounts' shipping calculations. Hence these figures include Swedish shipping's consumption of oil purchased both in Sweden and abroad. The air transport's consumption of jet fuel is correspondingly also included in the calculations.

The calculation procedure when compiling the source data for the environmental accounts may lead to a certain lack of consistency arising between the quantity data presented here and existing value data in other sections of the input/output tables, in that the source material is not calculated from the ground up, using coherent quantity and value data.

In Annex B.1 the energy consumption (PJ) of various energy products are presented.

4.1.4 Comments on statistical source data for energy accounts

Statistics are, at present, available on a sufficient scale to provide the source data for Swedish energy accounts in a number of areas. This applies in particular to the manufacturing industry and the electricity, gas and heat industries, where the annual statistics on manufacturing respectively the annual statistics on electricity, district heat and gas, provide, in every significant respect, a sufficient information base. The statistical source data can also be said to be relatively satisfactory for agriculture and fishing.

However, there are no energy consumption statistics whatsoever for forestry and the construction industry within the framework of the current statistical surveys. The data currently presented in the energy balances are based on projections of data from an ad hoc survey carried out in 1985. The calculations do, however, contain a significant degree of inherent uncertainty, mainly because these industries have undergone comprehensive structural changes in recent years. The recent introduction of new statistics on the construction industry may possibly give new stability to the calculations of energy consumption within this industry, but the uncertainty with regard to the energy consumption in forestry remains.

Statistics are capable, to varying degrees, of showing the energy consumption by the service industries at a detailed level. Electricity statistics permit a relatively detailed industry breakdown of electrical power supplied - allowing, however, for a degree of uncertainty with regard to the electricity suppliers' ability to classify deliveries to the correct industry properly. Energy statistics on buildings with premises provide what is primarily very limited individual industry-related information for oil and other fuels. There is, however, a possibility to break down energy consumption at a detailed industry level by processing existing statistics

(concurrent operation with the central register of enterprises). The statistical source data for listing the households´ energy consumption may be deemed satisfactory.

Details of the consumption of gasoline and diesel oil are based on calculations. The calculations are based on the number of vehicles in operation classified by industry and assumptions with regard to specific consumption and distances driven. Unlike the gasoline model, however, the diesel model is based on empirical source data for distances driven, collected from the kilometre tax register. This source data is, however, no longer available for the years after 1993 as a result of the reorganisation of the diesel taxation system and the calculations must, therefore, be reviewed. There is also a need for a review of the so-called gasoline model.

4.2 Emissions from stationary sources

Stationary sources include combustion, industrial processes and emissions of ammonia. Emissions from combustion is closely linked to fuel consumption, emissions from processes can depend on a variety of different things, i.e. production volume, leakage and installed cleaning equipment, while emission of NH_3 very much depend on production, storing and spreading of manure. In this chapter methods for calculating emissions from stationary sources will be described. The results from the calculations of emissions are shown in appendix B.2-6.

4.2.1 Stationary combustion

As mentioned before emissions from stationary combustion are closely linked to fuel consumption. The formula for calculating emission quantities is:

$$X_i = \sum_{j,k} E_{i,j,k} \times d_{i,j} \times V_j \qquad \text{(a)}$$

where E is an emission factor which gives the specific emission in gram/MJ fuel. E gives the emission at the plant, i, for a given type of fuel, j, and under different technical consumption conditions, k. d represents the quantity of fuel consumed of type j at plant i, and V is the fuel j's energy value. Energy values and emission factors used for different fuels and substances are shown in Annex C.

Quantity of fuel consumed for each of the 136 sectors originate from the energy accounts. That way energy consumption form a link between national accounts and environmental accounts, and emissions from stationary combustion are therefore consistent with the national accounts. For some specific industries more detailed information has been collected, so that special conditions during combustion can be corrected for when

calculating the emissions. All data on fuel consumption is produced at Statistics Sweden, as well as the calculations of emissions.

The emission factors that are used are the same as the ones used when calculating official statistics on emissions to air. The Swedish EPA are responsible for producing and updating of national emission factors. To do this they use knowledge about the fuel's quality, surveys about conditions during combustion for different furnaces, etc. For some large emitters results from measurements are also used to produce specific emission factors. The quality and certainty in the emission factors varies a lot, up to a factor of 10. When the content in a specific type of fuel determine the amount of emission, and type of combustion does not influence, the certainty of the emission factor is high. This is the case for CO_2 and partly for SO_2. This is also valid for metal emissions, but here the level of certainty is still not very good, since too few surveys have been done to get good knowledge of the metal content in different type of fuels. When not only type of fuel but also conditions during combustion is important, it is more difficult to get good quality of the emission factor. Special studies and measurements from different types of combustion is needed, which is the case for NO_x and NH_3. Emissions of NMVOC were calculated and presented in the report with 16 industrial sectors[6], but for the 136 sectors they have not been calculated. This depends partly on the large uncertainties in the emission factors. Measures in chimneys have shown that the amount of NMVOC can differ with a factor 10 within a short period of time, which makes it very difficult to decide on a general emission factor.

Another thing that might influence the amount of emission is cleaning equipment that has been installed to reduce emissions. In those cases specific emission factors are used for that special plant to increase the certainty in the emission statistics.

4.2.2 Industrial processes

Data on emissions from industrial processes are taken from the official statistics, and they are calculated by the Swedish EPA and Statistics Sweden. The statistics are based on measurements, production volume, consumption volume, special environmental reports from specific plants, previous summaries and subjective approximations. Most data is available at either a specific plant level or for a specific group of industries. This makes it easy to aggregate data to economic sectors. In some cases the definition of a plant differs between EPA and Statistics Sweden. For example EPA labels one industry 'producers of chemical products', where Statistics Sweden use a SNI-code for 'manufacturing of pulp'. The EPA use *amount* of goods produced as a criterion for classification, whereas the SNI-classification is based on the *economically most important* production.

[6] Environmental Accounts, Physical accounts for energy and air emissions for 1989, 1991 and 1993.

A consequence of this is, that results published by EPA differ when compared to the environmental accounts at a detailed level, but the totals are the same for both. Some EPA-data is more difficult to allocate to industries because the EPA-classification represent a lot of industries. In those cases the emissions are presented for the whole group and are not further split. This is the case for emissions of metals from the processes casting and galvanizing. Those processes can be found in any of the SNI groups 27-36 and no help information is known so it can be disaggregated. When NMVOC will be split into 136 economical sectors (today they are only split into 16, see annex A.2), the same problem will occur.

The definitions of emissions from industrial processes differ a bit depending on which substance that is being calculated. Acidifying substances (SO_2, $NO_{x)}$ and NMVOC, have one definition that has been used since the calculation of statistics for those emissions started in Sweden (in the middle of 1970). For greenhouse gases (CO_2, CO, CH_4, and N_2O) the definition used is the same as IPCC propose. It is the line between combustion and process that sometimes differ. This does not cause any problem when the data is used for national needs, but it might disturb comparisons between countries.

Some sources of emissions from industrial processes are difficult to measure or develop a good calculation model for. The explanation to this is either that the process is very complex, or lack of knowledge about why there is an emission. The statistics on emissions of metals from industrial processes have been calculated for the first time recently, but the method has to be further developed. In those figures there are some uncertainty.

4.2.3 Emissions of ammonia

The main source for emission of ammonia is agriculture and the emissions are related to production, storing and spreading of manure. The model for calculating emissions from agriculture is very detailed and a lot of effort has been put into getting a high level of accuracy[7]. Information that is used can be categorised into four different groups;

i) how manure is handled
ii) information about number of animals, milk production, etc.
iii) content of nitrogen in manure
iv) emission factors

The main users in Sweden has agreed on the model and the data used in it. The emission factors are probably the weakest part since they vary depending on the circumstances.

[7] Emissions to air in Sweden of sulphur dioxide, nitrogen oxides and ammonia in 1993, Statistics Sweden, 1994.

Emissions from power plants, industries and manure from pets cause only about four percent of the total, and are based on rather rough estimations. As a consequence the accuracy in attributing these emissions to sectors in the environmental accounts is not very high, and one sum can not be disaggregated at all[8]. The remaining 96 percent are emissions from only one industry, Agriculture.

4.3 Emissions from mobile sources

Calculation of emissions from mobile sources has been done in two different ways, depending on whether the emission is strictly fuel-related or not. When the emission is called ”fuel-related” the emission factor only depends on type of fuel used. For ”not fuel-related” emissions type of fuel is not the only aspect considered, but also engine type, driving modes, the strain on the machine, etc. The different calculation methods are described in this chapter. Since the methods used for attributing the emissions to different sectors also differs between fuel-related and not fuel-related emissions, they are also described in respective chapter.

Fuel-related emissions	*Not fuel-related*
CO_2	NO_x
SO_2 (excl. shipping)	SO_2 (shipping)
Pb[9]	

4.3.1 Calculation of fuel-related emissions

Emissions that are strictly fuel-related are calculated by the same formula as stationary sources (a). Quantity used for different kinds of fuel originate from the energy accounts, and are disaggregated to different sectors. The fuels that are considered as mobile fuels are; petrol, diesel oil, jet fuel, aviation paraffin, and some heavy duty oil (bunkers). The source for emission factors is also the same as for stationary sources, and the comments made in the chapter that describes stationary combustion can be applied here too.

The reason for not letting the calculating of SO_2 from shipping be based on the energy accounts is that sulphur content of bunker oils purchased abroad is unknown, and that some of the larger ships have installed equipment to clean the fumes from SO_2. The amount of bunker oil in the energy account is quite large and calculation with an emission factor that says either 0.7, 3 or even 5 percent sulphur content gives three different totals. 0.7 refers to Swedish heavy duty oil, 3 percent is the average in international bunkers, but the sulphur content can be as high as 5 percent.

[8] Emissions from chemicals used in laboratories, freezing equipment and other.
[9] The only metal calculated for mobile sources is Pb, and it is only estimated for road traffic and aviation.

4.1 Total emissions of SO_2 from shipping for three different sulphur content in heavy duty oil. Ton

Sulphur content in heavy fuel oil	0.7%	3%	5%
SO_2 from shipping, ton	24 397	92 030	150 712

Further studies are needed to improve the knowledge about the content of sulphur in bunker oil. The problem is that this kind of information is very difficult to obtain. Shipping is a very international market with special rules and agreements, and with a strong unity. It would be very expensive for the oil companies to refine bunkers further so it is not in their interest, or the shipowners, to force the work in getting more knowledge about the environmental pressure from shipping. In the meantime, emissions of SO_2 from shipping in the environmental accounts is not calculated on fuel consumption, instead the total of SO_2 emission from shipping from the official statistics is used. A description of that source is found in chapter 4.3.2 where emissions not fuel-related are presented.

4.3.1.1 Attribution to economic sectors

Attribution to economic sector needs no extra work since the calculation is based on the energy accounts.

4.3.2 Calculation of emissions not fuel-related

When the emissions are not only related to the amount of fuel used, different models have been used depending on type of mobile source.

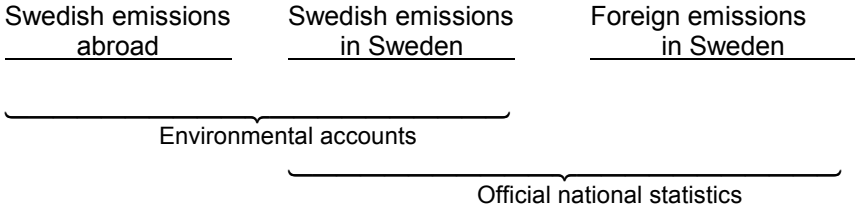
For road traffic a special model has been developed in Sweden adapted to Swedish conditions. The Swedish Road and Transport Research Institute, VTI, has been responsible for developing the model but the work was financed by the Swedish Environmental Protection Agency, EPA. In the development of the model a lot of important users have been involved besides VTI and EPA; the Swedish National Road Administration, Swedish Road Federation and the Association of Swedish Automobile Manufactures and Wholesalers. The model takes a number of different parameters into account; vehicle category, age, weight, type of fuel, driving pattern, average annual mileage, driving modes, etc.

For shipping the model for calculating emissions include variables as; type of fuel, engine capacity, the strain on the machine, motor model, time at different speeds, installed cleaning equipment, etc. The model has been developed by the Swedish National Administration of Shipping and Navigation.

The three different models used for aviation, railway and non-road mobile machinery use information on type of source, motor model, the strain on the machine, time of use, etc. They are developed by the Swedish Board of

Civil Aviation, the Swedish State Railway and the Swedish EPA, respectively.

The purpose of the models is to calculate the total emissions in Sweden. This means that foreign cars, trucks and ships travelling in Sweden are included, and Swedish transports abroad are excluded. In the official national statistics on air emissions this definition is applied for all sources of emission, so that the total pressure on the Swedish environment can be calculated. However, the definition does not correspond to the one used in the environmental accounts, where Swedish transports, no matter where they take place, should be included, and foreign transports in Sweden should be excluded. The difference in definitions is illustrated below.



The knowledge of Swedish emissions abroad which are not fuel-related, is defective due to lack of data for all sources except lorries. For the time being these emissions are assumed to be equal to foreign emissions in Sweden. The difference might not be so large for road traffic and aviation. For non-road mobile machinery and railway the problem does not exist, since they only operate in Sweden. For shipping on the other hand, a study[10] shows that there probably is a big difference between the two definitions. The amount of SO_2 emissions from shipping in the official statistics is 24 000 metric tons and, as shown in table 4.1, depending on sulphur content in bunkers the amount can vary from 24 000 to 151 000 metric tons SO_2 when calculating on consumption from the energy accounts. In those figures emissions from other fuels used for shipping are not included. This problem must be studied further before foreign emissions in Sweden from mobile sources can be replaced by Swedish emissions abroad.

4.3.2.1 Attribution to economic sectors

When data on emissions from mobile sources in the official national statistics are reported they are divided into different kinds of mobile sources and fuel types. To fit the environmental accounts they must be distributed to different economic sectors. Method used for distribution depends on type of mobile source and data availability. Description of each model is made under separate headings below.

[10] Environmental accounts and emissions from mobile sources. Statistics Sweden, 1997.

4.3.2.1.1 Road traffic

Emissions from road traffic are divided into five different groups; passenger cars, light duty vehicles, heavy duty vehicles, buses, and motorcycles and mopeds. The method for distributing emissions to different sectors differ depending on type of vehicle, so the description of each method is again presented under separate headings. Emissions from military vehicles are not included in the official statistics, but are here added and reported under Governmental services.

4.3.2.1.1.1 Passenger cars

Every group of economic activity, including government service and private consumption, own passenger cars. However, information or statistics on how far each car travel per year does not exist. But for three types of owners; households, companies and taxis, an approximation of annual mileage per year can be found. In a report from VTI[11] an estimation of km/year for privately owned cars and company cars has been calculated. From the Swedish Taxi Association an average figure for taxi cars was held. In table 4.2 the approximated annual mileage per year is presented, together with information on number of registered cars a total mileage per year for each group can be estimated. Table 4.2 shows that the private cars stand for about 80 percent of the total mileage per year.

4.2 Approximation of annual mileage per year for three owner groups, together with number of registered cars and calculation of total mileage per year.

Owner group	km/year		Number of registered cars 1993	Total mileage per year, milliard km	Share, %
Private cars	14 000		3 071 363	43,0	80%
Company cars	20 000		423 758	8,5	16%
Taxi	80 000		13 693	1,1	2%
Government	20 000	*	57 221	1,1	2%
Total			3 566 035	53,7	

* Assumed to have the same value as company cars.

The first step to divide the emissions from passenger cars into different NAMEA classes is to calculate the shares in table 4.2. For the sectors taxi, governmental services and private consumption the emissions can then be estimated by multiplying share with the total amount of emission. For the group company cars a second step is required to split the emissions on SNI- group 1 to 99 (excl. taxi). This step include data on number of registered cars in 1993. Of the 136 sectors of economic activity, 57 own 95 percent of the passenger cars. The accuracy in the figures will not be significantly higher by including all 136, since there are some uncertainties in the material and the smallest sectors owns less than 0.05 percent of the total amount of passenger cars. The emissions, 16 percent of the total, are

[11] Car usage determinants, Swedish Road and Traffic Research Institute (VTI), 1991.

therefore divided between the 57 groups according to number of cars. In table 4.3 the 15 largest of the 57 are presented.

4.3 Percent of the company cars emissions presented for the 15 largest emitters.

Sector		Percent of emission
other 50-52	Sale, maintenance and repair of motor vehicles and MC	23%
1	Agriculture	14%
45	Construction	8%
741	Legal, accounting, holdings	4%
851	Human health activities	3%
742+743	Architectural and engineering activities	3%
745/748	Labour recruitment, security activities	3%
6024	Freight transport by road	3%
502	Maintenance and repair of motor vehicles	2%
853	Social work activities	2%
72	Computer and related activities	2%
71	Renting of machinery and equipment	2%
2	Forestry, logging	2%
55	Hotels and restaurants	2%
93	Other service activities	1%

4.3.2.1.1.2 Light duty vehicles

The ownership of light duty vehicles is just like passenger cars spread on all 136 groups in the environmental accounts. There is no group that dominates. But unlike for passenger cars, there is no information available on distances driven, except from the total that is estimated to 2,5 milliard km per year. Therefore, only information on numbers of registered cars is used to distribute the emissions on different sectors.

Numbers of sectors are limited to the 36 that have 95 percent of the total number of light duty vehicles. In table 4.4 the top ten sectors are presented.

4.4 The ten sectors that have the most light duty vehicles and their share.

Sector		Share of vehicles
	Private consumption	26%
45	Construction	19%
other 50-52	Sale, maintenance and repair of motor vehicles and MC	10%
	Governmental services	7%
1	Agriculture	6%
6024	Freight transport by road	3%
853	Social work activities	3%
2	Forestry, logging	2%
502	Maintenance and repair of motor vehicles	2%
642	Telecommunications	2%

4.3.2.1.1.3 Heavy duty vehicles

A special study was made to improve the model for allocating emissions from heavy duty vehicles to economic sectors[12]. In the first Swedish report on environmental accounts only number of registered vehicles was used. For example, distance driven and model of vehicle was not taken into account. In the present allocation, a survey carried out by Statistics Sweden was used. It is a sample survey that gives estimates of the goods transport by lorries and trailers[13] where the population consist of lorries with a loading capacity of 2 tons or more. Every lorry can be connected to a SNI sector according to the owner. The study is very comprehensive and gives a lot of information that is possible to use in a model for allocating emissions to economic sectors. Using information from the survey about each vehicle and its distance driven, four methods were tested and combined with four different emission factors for NO_x. The results from the four methods were compared, se table 4.5.

4.5 Results from four methods of allocating emissions of nitrogen oxides to different SNI-groups. Tons

SNI-group[1]		NO_x allocated per vehicle km	NO_x km and weight-group[2]	NO_x km and age class[3]	NO_x km, age-class and weight
6024	Freight transport by road	34 370	39 320	34 020	39 230
other 50-52	Sale, maintenance and repair of motor vehicles and MC	5 510	2 110	5 630	2 130
	Governmental services	3 320	2 730	3 420	2 770
45	Construction	1 880	2 530	1 960	2 570
155	Manufacture of dairy products	710	680	690	680
853	Social work activities	690	410	690	410
90 excl 90001	Refuse disposal, excl. sewage disposal	660	230	690	220
1	Agriculture	600	360	620	370
159	Manufacture of beverages	560	520	540	510
151	Production etc. of meat	540	80	540	80
	Private consumption	500	340	510	340
14	Other mining and quarrying	330	730	330	720
1581	Manufacture of bread	320	50	310	50
634	Activities of other transport agencies	280	100	290	100
502	Maintenance and repair of motor vehicles	250	260	260	280
201	Sawmilling and planing of wood	240	290	240	280

1) 95% of the total mileage in 1993 were done by these 16 SNI-groups and they have been used in the modelling. The last 5% were spread on 83 different groups.
2) Two classes were used; - 16 tons and 16 tons-.
3) Three classes were used; -1987, 1988-1991 and 1992-.

[12] Allocation of NOx-emissions from heavy duty vehicles to 136 SNI-groups. Working paper, Sara Ribacke, Statistics Sweden, 1997 (in Swedish).
[13] Road goods transport by lorries during the second half of 1970, T 1972:32. Statistics Sweden, 1972.

The result depends a lot on the emission factors. Weight influence the factor a lot, while age is not so important. By taking the weight into account a quite different result appear than for kilometres driven and age.

The method chosen for allocating emissions not fuel-related from heavy duty vehicles, is the one that takes both weight and year into account. Year-group did not influence the result much but the belief is that it might do so for lorries manufactured after 1993. New regulations for heavy vehicles are applied from model 1993. The vehicles are also starting to be registered in different ”environmental classes”, and the method should probably take that into account too. Further tests on that must be done when calculating and allocating emissions for more recent years than 1993.

4.3.2.1.1.4 Buses

There are seven sectors of the 136 that dominate ownership of buses. Together they have 90 percent of the total amount of buses in Sweden. In table 4.6 the seven groups are presented. The total emissions were split on the seven groups.

4.6 Ownership of buses in Sweden 1993 for different sectors.

Sector		Share	Share of 90%
6021	Other scheduled passenger land transport	56%	62%
6022	Taxi operation	10%	11%
	Governmental services	9%	10%
6023	Other land passenger transport	8%	9%
71	Renting of machinery and equipment	3%	3%
	Private consumption	2%	2%
6024	Freight transport by road	2%	2%
Other	(129 sectors)	10%	

The total mileage per year for buses is estimated to 840 million km. The Swedish Bus Transport Association[14] publish statistics for buses and they approximate that buses in public service and buses in service on own account (regular traffic, taxi and charter) travel 790 million km. The rest, 50 million km are done by buses owned by county council, local authority, hire companies, sport clubs etc. From the Swedish Local Traffic Association[15] some extra information was collected and gave an estimation of mileage for public transport, about 460 million km 1993.

Number of buses together with estimated km give a possibility to divide emissions from buses to the seven sectors, and the result is given in table 4.7.

[14] Bussbranschens Riksförbund
[15] Sveriges Lokaltrafikförening

4.7 Share of emissions from buses for different sectors.

Sector		Share of emissions
6021	Other scheduled passenger land transport	71%
6022	Taxi operation	13%
6023	Other land passenger transport	10%
	Governmental services	4%
	Private	1%
71	Renting of machinery and equipment	0,5%
6024	Freight transport by road	0,5%

4.3.2.1.1.5 Motorcycles and mopeds

Motorcycles and mopeds are used in the private sector, by the police, delivery firms, etc. The use is not known, but the private sector is assumed to be the largest user, so the whole amount of emissions from motorcycles and mopeds can be found under the private sector.

4.3.2.1.2 Shipping

The group shipping is very large and heterogeneous concerning type of engine and use. In the official statistics the emissions from shipping are presented for seven different groups where field of application has determined the grouping; pleasure-boats, fishing-boats, ferries, ships on channels, working vessels, foreign and domestic ships.

Emissions from the different groups has been allocated to specific sectors in the environmental accounts. Military emissions are added to the official statistics and reported under Governmental services.

Pleasure-boats	=>	Private
Fishing	=>	SNI 5
Ferries	=>	SNI 61 Sea transports, shipping companies
Working vessels	=>	SNI 61 Sea transports, shipping companies
Ships on channels	=>	SNI 61 Sea transports, shipping companies
Foreign and domestic	=>	SNI 61 Sea transports, shipping companies
Military	=>	Governmental services

The ownership is not as straight forward as it looks above for some of the groups. In the Swedish register of shipping some large ships and ferries are found to be owned by SNI 26, 51 and 741. Their share of volume of the total is less than 1%, so there has been no corrections for this in the attribution to sectors. The problem with different definitions of 'Swedish emissions' in the official statistics and environmental accounts is larger and more important to find a solution for. This was described in section 4.3.1 above.

4.3.2.1.3 Railways

Emissions from railway is caused by diesel driven engines. All owners of such trains belong to SNI 601, Railway companies.

4.3.2.1.4 Aviation

There are a lot of different kinds of aviation: regular airlines, non regular air traffic, taxi, private, military, etc. In the emissions from the official statistics only regular airlines are included. For the rest, except military, there are no figures on their emissions to air. They are however expected to be low and their contribution to the total should be marginal. All of the emissions are attributed to SNI 62 Air transport.

Included in the amount of emissions are two kinds of routes; from take-off and to the Swedish border, from the Swedish border to landing. This is calculated for all regular airlines operating in Sweden.

For this study, emissions from military aircraft have been collected from the Defence Headquarter[16]. They are added to the figure from the official statistics and reported under Governmental services.

4.3.2.1.5 Non-road mobile machinery

The title non-road mobile machinery include a lot of different tools and vehicles. In the official statistics the emissions are divided into many different categories. The emissions are based on studies[17] that include information on field of application for the different machines, which is used when the emissions are divided into different sectors. However, for some categories the use is wide spread, e.g. power saws, generators, excavators, and in those cases the emissions can be found under the main users sector code. In table 4.8 the result from the disaggregation is shown.

[16] The military defence and the environment, The Military Defence, 1995.
[17] Study of polluting emissions from power tools. ÅF-Industriteknik, 1990.
Study of polluting emissions from tractors, machine tools etc. 3K Engineering AB, 1989.

4.8 The result from attributing emissions from non-road mobile machinery to economic sectors.

Sector		Share, %
1	Agriculture	22
2	Forestry, logging	16
10+11+12	Mining of coal and lignite	1
131	Mining of iron ores	1
132	Mining of non-ferrous metal ores	1
14	Other mining and quarrying	1
155	Manufacture of dairy products	0
201	Sawmilling and planing of wood	1
267+268	Cutting, shaping and finishing of stone	1
271	Manufacture of basic iron and steel	1
45	Construction	1
6024	Freight transport by road	3
6322	Taxi operation	10
6323	Other land passenger transport	1
633	Activities of travel agencies	0
642	Telecommunications	0
71	Renting of machinery and equipment	38
90 excl. 90001	Refuse disposal, excl. sewage disposal	3
	Private	1

5 Results

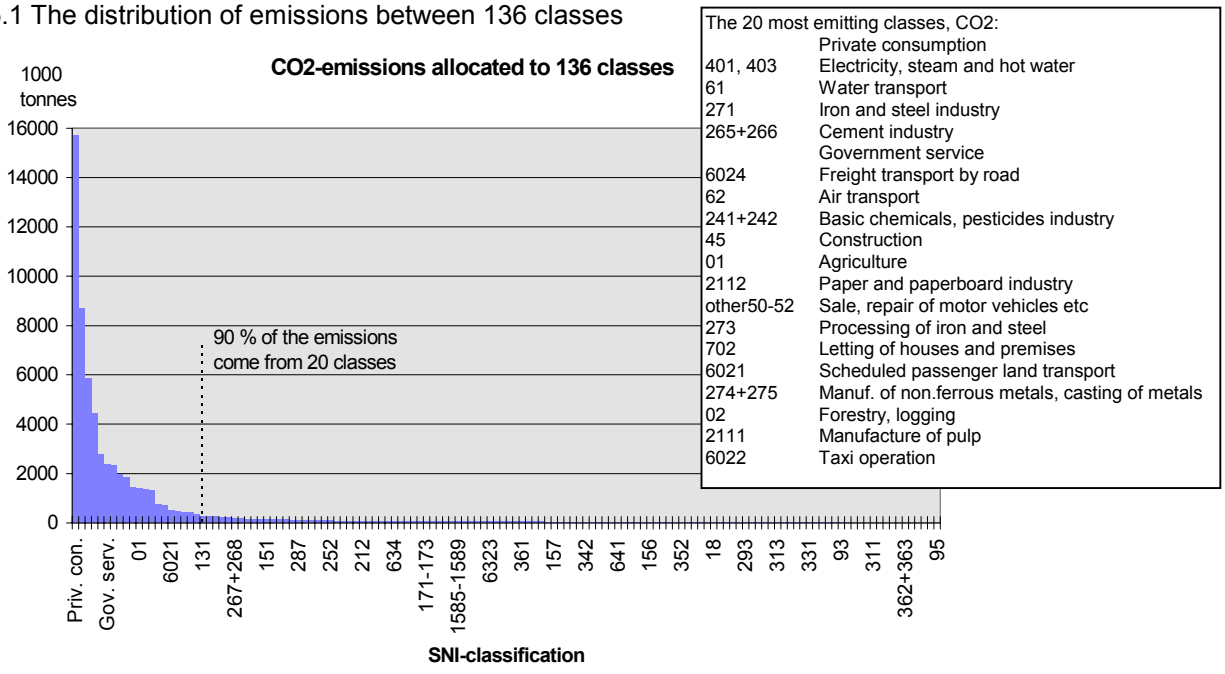
In this section, we present results and discussions on the difference between the earlier disaggregation of industry into 16 classes and the new disaggregation into 136 branches. The energy consumption and air emissions in Sweden 1993 is presented in Annex B1-6. The results for all 136 branches of industry are not shown, partly not to exhaust the reader but also for reasons of professional secrecy. As far as possible we have chosen to present the results classified according to Eurostats proposed classification (for deviations in classification, see section 3 above). For a detailed list of the disaggregated classes, se Annex A.1.

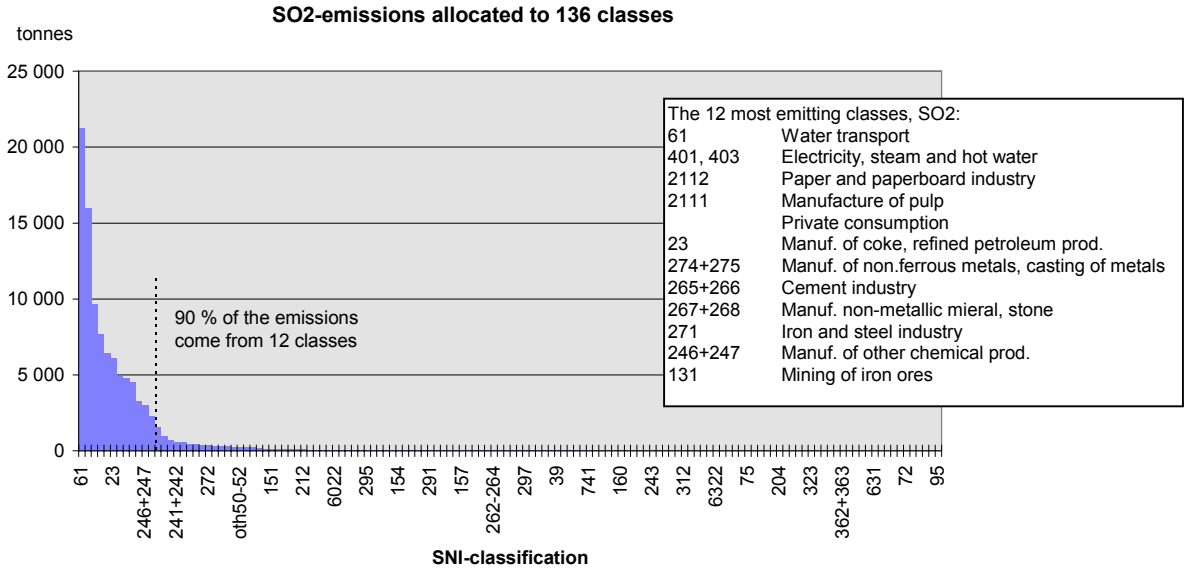
5.1 136 versus 16 industries

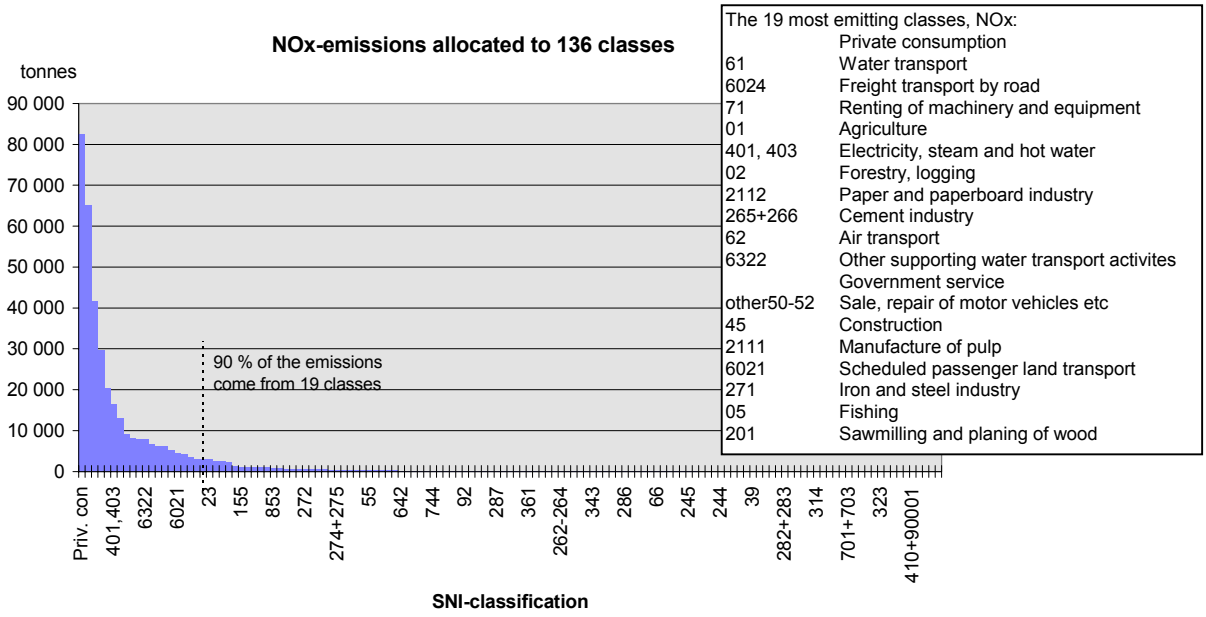
The change into more disaggregated accounts is carried out to improve the possibilities to perform more detailed analyses of the links between industry structure and environmental pressure. The earlier allocation of industry emissions into 16 classes was designed to cover the environmentally most interesting industries individually, and then group other industries into quite large aggregates. This resulted in that also the group with industries without any large emissions together made up quite a large proportion of the total emissions.

However, after the disaggregation into 136 classes, it is clear that in Sweden at least emissions of CO_2, SO_2 and NO_x to a large extent come from a very limited number of industries (see figure 5.1). For CO_2 90 % of the emissions come from 20 classes. The corresponding numbers for SO_2 and NO_x are 12 and 19 classes, respectively. With the old classification, 90 % of the CO_2-emissions were allocated to ten groups out of 18. For SO_2, the number was eight groups and for NO_x nine groups.

5.1 The distribution of emissions between 136 classes







One question is then if the improved disaggregation has had any importance for the identification of emitting industries. A comparison between the allocation of emissions is somewhat aggravated by the fact that Sweden now change SNI-classification. The old classification SNI69 was used for the grouping into 16 industries. A new classification, SNI92, will be used both in the national accounts and the environmental accounts from 1993 and onwards. Still, the two classifications are comparable, even though some deviations appear. The more disaggregated classification leads to that some industries formerly part of the large 'non-emitting' group now show up in a selection of the most emitting industries. This is a consequence of the fact that the disaggregation naturally shows the emissions for smaller industry groups than before. Even though the earlier

classification was designed to describe the most emitting industries, the disaggregated classification definitely gives a better basis for further analysis.

5.2 Comparison between old and new method to distribute mobile emissions to economic sectors

In previous publications of Swedish environmental accounts, the method for distributing ”not fuel-related” emissions from road traffic to economic sectors did only take number of cars registered on each sector into account. In the work with calculating emissions from 134 classes of industry plus output in the public sector and private consumption the method for the distribution had to be improved. Information about age of vehicles, weight and driving distances has been added, where such information exist. In chapter 4 the new method has been described and in this chapter the difference in the result between the old and the new method is compared. The total amount of emission is the same, only the methods for distributing the emissions differ[18]. For light duty vehicles and MC/moped the same method has been used as before, since no information is available about driving pattern or distances driven for any user groups.

5.2 Share of total emissions for different road traffic vehicles. Comparison between old and new method of distributing the emissions to industry, transport and storage, governmental services and private consumption. %

Sector	Passenger cars		Busses		Heavy duty vehicles	
	old	new	old	new	old	new
Industries, excl transport[1)]	11	15	7	0	50	16
Transport and storage[2)]	1	3	88	95	42	76
Governmental services	1	2	0	4	0	7
Private	87	80	5	0	8	1

1) Include SNI 1-37, excl. 60-64.
2) Include SNI 60-64.

In some cases there is a big difference in the result, i.e. the sector transport and storage increased their share of emission from heavy duty vehicles from 42 to 76 percent. The explanation to that is that they only own 42 percent of all lorries, but they use them more than other sectors and by taking that into consideration the picture of air emissions change. Some of the differences for governmental service are due to the fact that emissions from military sources are added to the total in the new model. These emissions were not available before.

[18] The data on emissions of NO_x from road traffic has been revised since earlier publications, resulting in lower total emissions.

A closer look at the heavy duty vehicles show that for some of the 136 sectors the consequence of the new method is quite large, table 5.3.

5.3 A comparison in result between two ways of allocating NO_x emissions to economic sectors. Ton

SNI- group		NO_x by number of lorries	NO_x by weight and year
6024	Freight transport by road	20 370	39 230
other 50-52	Sale, maintenance and repair of motor vehicles and MC	5 810	2 130
45	Construction	4 090	2 570
	Governmental services[1)]	3 800	2 770
	Private consumption	3 070	340
853	Social work activities	3 000	410
90 excl 90001	Refuse disposal, excl. sewage disposal	1 330	220
1	Agriculture	1 270	370
642	Telecommunications	680	-
401	Production and distribution of electricity	600	-
1581	Manufacture of bread	570	50
155	Manufacture of dairy products	550	680
502	Maintenance and repair of motor vehicles	510	280
159	Manufacture of beverages	440	510
80	Education	420	-
851	Human health activities	380	-
745/748	Labour recruitment, security activities	330	-
151	Production, processing and preserving of meat and meat products	310	80
6321	Other supporting land transport activities	310	-
2	Forestry, logging	290	-
265+266	Manufacture of cement, lime and plaster	230	-
284+285	Forging, pressing, stamping	220	-
201	Sawmilling and planing of wood	210	280
92	Recreational	200	-
14	Other mining and quarrying	190	720
634	Activities of other transport agencies	180	100
741	Legal, accounting, holdings	170	-
1582	Manufacture of rusks and biscuits	160	-
75	Public administration and defence	150	-
281	Manufacture of structural metal products	140	-
93	Other service activities	120	-

1) Military defence not included

For some of the groups the emissions have been doubled by taking weight and age of their fleet of lorries into account, and for some it is the opposite. A lot of the classes have lorries, but they seem to use them quite little in comparison with others, therefore they get nothing when using the new method with a cut-off at the cumulative sum of 95% of kilometres driven. This difference show that it is important to find information on distances driven for allocating emissions from road traffic into different SNI-groups in the environmental accounts.

6 Possibility to include more pollutants

Soon more pollutants will be possible to include in the environmental accounts. Development of methods and emission factors for calculating emissions of different substances is primarily done for the production of official national statistics. When a model exists it takes some more time and effort to include the emissions in the system for environmental accounts. Just recently models for calculating CO, CH_4 and N_2O has been established, and work can now start to include these substances in the Swedish environmental accounts. Results are expected to be finalised in the beginning of 1998 for year 1993.

NMVOC has not been disaggregated to 136 sectors because of uncertainties in both emission factors and the model for calculating emissions from industrial processes. This problem applies to the official national statistics as well as the environmental accounts. As soon as the quality in the official statistics has improved, NMVOC will be disaggregated to 136 sectors. It is not yet decided for which year this will be done.

Publication of updated environmental accounts statistics, for years after 1993, is for the time being delayed by the present work to change the national accounts. The change to the new SNA together with improvements of the national accounts connected to the Swedish EU-membership, have delayed the provision of data to the environmental accounts. According to present plans, the national accounts will publish new supply- and use-tables for the years 1993-97 in 1999. No new energy accounts are planned before that either. For the environmental accounts, this time delay seems unsatisfactory. We might look into the possibility to calculate preliminary emission data for the years 1995 and 1997, without the basis of updated energy accounts consistent with the national accounts.

7 References

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Annex A.1 Classification used in the Swedish NAMEA, dissaggregated version

SNI-92 Section	Group	Activity Title
A	01	Agriculture, hunting and related service activities
A	02	Forestry, logging and related service activities
B	05	Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing
CA	10+11+12	Mining of coal and lignite; extraction of peat, crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying, mining of uranium and thorium ores
CB	13.1	Mining of iron ores
CB	13.2	Mining of non-ferrous metal ores, except uranium and thorium ores
CB	14	Other mining and quarrying
DA	15.1	Production, processing and preserving of meat and meat products
DA	15.2	Processing and preserving of fish and fish products
DA	15.3	Processing and preserving of fruit and vegetables
DA	15.4	Manufacture of vegetable and animal oils and fats
DA	15.5	Manufacture of dairy products
DA	15.6	Manufacture of grain mill products, starches and starch products
DA	15.7	Manufacture of prepared animal feeds
DA	15.81	Manufacture of bread; manufacture of fresh pastry goods and cakes
DA	15.82	Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes
DA	15.83	Manufacture of sugar
DA	15.84	Manufacture of cocoa; chocolate and sugar confectionery
DA	15.85 -15.89	Manufacture of macaroni, noodles, couscous and similar farinaceous products, processing of tea and coffee, manufacture of condiments and seasonings, homogenised food preparations and dietetic food, other food products n.e.c.
DA	15.9	Manufacture of beverages
DA	16.0	Manufacture of tobacco products
DB	17.1 - 17.3	Preparation and spinning of textile fibres, textile weaving, finishing of textiles
DB	17.4 - 17.7	Manufacture of made-up textile articles, except apparel, manufacture of other textiles, knitted and crocheted fabrics and knitted and crocheted articles
DB	18	Manufacture of wearing apparel; dressing and dyeing of fur
DC	19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
DD	20.1	Sawmilling and planing of wood, impregnation of wood
DD	20.2	Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board, fibre board and other panels and boards
DD	20.3	Manufacture of builders' carpentry and joinery
DD	20.4	Manufacture of wooden containers
DD	20.5	Manufacture of other products of wood; manufacture of articles of cork, straw and plaiting materials
DE	21.11	Manufacture of pulp
DE	21.12	Manufacture of paper and paperboard
DE	21.2	Manufacture of articles of paper and paperboard
DE	22.1	Publishing
DE	22.2 + 22.3	Printing and service activities related to printing, reproduction of recorded media
DF	23	Manufacture of coke, refined petroleum products and nuclear fuel
DG	24.1 + 24.2	Manufacture of basic chemicals, pesticides and other agro-chemical products
DG	24.3	Manufacture of paints, varnishes and similar coatings, printing ink and mastics
DG	24.4	Manufacture of pharmaceuticals, medicinal chemicals and botanical products
DG	24.5	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations
DG	24.6 + 24.7	Manufacture of other chemical products and man-made fibres
DH	25.1	Manufacture of rubber products
DH	25.2	Manufacture of plastic products
DI	26.1	Manufacture of glass and glass products
DI	26.2 - 26.4	Manufacture of non-refractory ceramic goods other than for construction purposes; manufacture of refractory ceramic products, ceramic tiles and flags, bricks, tiles and construction products, in baked clay

SNI-92 Section	Group	Activity Title
DI	26.5 + 26.6	Manufacture of cement, lime and plaster and articles of concrete, plaster and cement
DI	26.7 + 26.8	Cutting, shaping and finishing of stone, manufacture of various other non-metallic mineral products
DJ	27.1	Manufacture of basic iron and steel and of ferro-alloys (ECSC)
DJ	27.2	Manufacture of tubes
DJ	27.3	Other first processing of iron and steel and production of non-ECSC ferro-alloys
DJ	27.4 + 27.5	Manufacture of basic precious and non-ferrous metals, casting of metals
DJ	28.1	Manufacture of structural metal products
DJ	28.2 + 28.3	Manufacture of tanks, reservoirs and containers of metal; manufacture of central heating radiators and boilers and steam generators, except central heating hot water boilers
DJ	28.4 + 28.5	Forging, pressing, stamping and roll forming of metal; powder metallurgy, treatment and coating of metals; general mechanical engineering
DJ	28.6	Manufacture of cutlery, tools and general hardware
DJ	28.7	Manufacture of other fabricated metal products
DK	29.1	Manufacture of machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines
DK	29.2	Manufacture of other general purpose machinery
DK	29.3	Manufacture of agricultural and forestry machinery
DK	29.4	Manufacture of machine-tools
DK	29.5	Manufacture of other special purpose machinery
DK	29.6	Manufacture of weapons and ammunition
DK	29.7	Manufacture of domestic appliances n.e.c.
DL	30.0	Manufacture of office machinery and computers
DL	31.1	Manufacture of electric motors, generators and transformers
DL	31.2	Manufacture of electricity distribution and control apparatus
DL	31.3	Manufacture of insulated wire and cable
DL	31.4	Manufacture of accumulators, primary cells and primary batteries
DL	31.5	Manufacture of lighting equipment and electric lamps
DL	31.6	Manufacture of electrical equipment n.e.c.
DL	32.1	Manufacture of electronic valves and tubes and other electronic components
DL	32.2	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy
DL	32.3	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods
DL	33.1	Manufacture of medical and surgical equipment and orthopaedic appliances
DL	33.2 + 33.3	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment
DL	33.4 + 33.5	Manufacture of optical instruments and photographic equipment, watches and clocks
DM	34.1	Manufacture of motor vehicles
DM	34.2	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers
DM	34.3	Manufacture of parts and accessories for motor vehicles and their engines
DM	35.1	Building and repairing of ships and boats
DM	35.2	Manufacture of railway and tramway locomotives and rolling stock
DM	35.3	Manufacture of aircraft and spacecraft
DM	35.4 + 35.5	Manufacture of motorcycles and bicycles, other transport equipment n.e.c.
DN	36.1	Manufacture of furniture
DN	36.2 + 36.3	Manufacture of jewellery and related articles, musical instruments
DN	36.4 - 36.6	Manufacture of sports goods, games and toys, miscellaneous manufacturing n.e.c.
DN	37	Recycling
E	40.1+40.3	Production and distribution of electricity, steam and hot water supply
E	40.2	Manufacture of gas; distribution of gaseous fuels through mains
E	41.0 + 90.001	Collection, purification and distribution of water, sewage disposal
F	45	Construction
G	50.2	Maintenance and repair of motor vehicles
G	other 50-52	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel; other wholesale trade and commission trade; retail trade; repair of personal and household goods
H	55	Hotels and restaurants

SNI-92

Section	Group	Activity Title
I	60.1	Transport via railways
I	60.21	Other scheduled passenger land transport
I	60.22	Taxi operation
I	60.23	Other land passenger transport
I	60.24	Freight transport by road
I	60.3	Transport via pipelines
I	61	Water transport
I	62	Air transport
I	63.1	Cargo handling and storage
I	63.21	Other supporting land transport activities
I	63.22	Other supporting water transport activities
I	63.23	Other supporting air transport activities
I	63.3	Activities of travel agencies and tour operators; tourist assistance activities n.e.c.
I	63.4	Activities of other transport agencies
I	64.1	Post and courier activities
I	64.2	Telecommunications
J	65	Financial intermediation, except insurance and pension funding
J	66	Insurance and pension funding, except compulsory social security
J	67	Activities auxiliary to financial intermediation
K	part of 70.2	Letting of one- or two-dwelling houses and leisure-houses
K	part of 70.2	Letting of multi-dwelling houses
K	part of 70.2	Letting of other premises
K	other 70	Real estate activities
K	71	Renting of machinery and equipment without operator and of personal and household goods
K	72	Computer and related activities
K	73	Research and development
K	74.1	Legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy; holdings
K	74.2 + 74.3	Architectural and engineering activities and related technical consultancy, technical testing and analysis
K	74.4	Advertising
K	74.5 - 74.8	Labour recruitment and provision of personnel, investigation and security activities, industrial cleaning, miscellaneous business activities n.e.c.
L	75	Public administration and defence; compulsory social security
M	80	Education
N	85.1	Human health activities
N	85.2	Veterinary activities
N	85.3	Social work activities
O	90 excl 90.001	Refuse disposal, sanitation and similar activities, excluding sewage disposal
O	91	Activities of membership organizations n.e.c.
O	92	Recreational, cultural and sporting activities
O	93	Other service activities
P	95	Private households with employed persons
Q	99	Extra-territorial organizations and bodies

Annex A.2 Classification used in the Swedish NAMEA, aggregated version

SNI-69 Group	Activity Title
11	Agriculture, hunting and related service activities
12	Forestry, logging and related service activities
13	Fishing
2	Mining and quarrying
31-33, 36	Manufacture of food, beverages, tobacco, textile, wood products and non-metallic mineral products
34	Manufacture of pulp, paper and paper products; publishing and printing
35 (excl. 353)	Manufacture of chemicals and chemical products, except petroleum refining
353	Manufacture of refined petroleum products
37	Manufacture of iron and steel etc.
38,39	Manufacturing of machinery and equipment
41	Electricity, gas and district heating
42, 92001	Water and wastewater treatment
5	Construction
71	Transport
83	Dwellings and premises
6, 72, 8 (excl. 83), 9 (excl. 92001)	Trade and services

Annex B.7. Emissions to air of As, Cr, Cu and Cd from different sources by kind of economic activity of industries, government services and private consumption in 1993. Kg[1)]

SNI92		As	Cr	Cu	Cd
01	Agriculture, hunting and related service activities	4	7	19	2
02	Forestry, logging and related service activities	0	0	2	0
05	Fishing, operation of fish hatcheries and fish farms	0	0	0	0
10+11+12	Mining of coal and lignite; extraction of peat etc.	0	0	1	0
13	Mining of metal ores	97	76	182	25
14	Other mining and quarrying	1	1	4	0
15	Manufacture of food products and beverages	6	5	30	1
16	Manufacture of tobacco products	0	0	0	0
17	Manufacture of textiles	0	0	3	0
18	Manufacture of wearing apparel; dressing, dying of fur	0	0	0	0
19	Tanning and dressing of leather; manufacture of luggage	0	0	0	0
20	Manufacture of wood and products of wood and cork	14	259	394	52
21	Manufacture of pulp, paper and paper products	49	317	541	66
22	Publishing, printing and reproduction of recorded media	0	0	1	0
23	Manufacture of coke, refined petrol. prod., nuclear fuel	1	1	6	27
24	Manufacture of chemicals and chemical products	4	2	10	1
25	Manufacture of rubber and plastic products	2	9	17	2
26	Manufacture of other non-metallic mineral products	41	67	119	14
261	*Manufacture of glass and glass products*	*15*	*16*	*5*	*9*
27	Manufacture of basic metals	788	10 595	5 836	308
271	*Manufacture of basic iron and steel*	*4*	*2 218*	*1 110*	*129*
272+3	*Other manufacture of basic metals*	*2*	*8 376*	*169*	*8*
28	Manufacture of fabricated metal products	0	0	5	0
29	Manufacture of machinery and equipment	0	1	6	0
30	Manufacture of office machinery and computers	0	0	1	0
31	Manufacture of electrical machinery and apparatus n.e.c.	0	0	0	5
32	Manufacture of radio, television etc.	0	0	1	0
33	Manufacture of medical, precision and optical instruments	0	0	0	0
34	Manufacture of motor vehicles, trailers and semi-trailers	1	1	7	0
35	Manufacture of other transport equipment	0	0	2	0
36	Manufacture of furniture; manufacturing n.e.c.	1	2	6	0
37	Recycling	0	18	0	0
27-36	Not elsewhere specified	0	1 073	160	0
40	Electricity, gas, steam and hot water supply	186	495	898	111
401, 403	*Prod., collection and distr. of electricity, steam, hot water*	*186*	*495*	*898*	*111*
402	*Manufacture of gas; distribution of gaseous fuels*	*0*	*0*	*0*	*0*
41+90001	Collection, purification and distr. of water, sewage disposa	0	0	0	0
45	Construction	2	2	10	1
G	Wholesale and retail trade; repairs of motor vehicles etc.	0	1	3	0
55	Hotels and restaurants	0	4	7	1
60	Land transport; transport via pipelines	0	0	1	0
601	*Transport via railways*	*0*	*0*	*1*	*0*
602	*Other land transport*	*0*	*0*	*0*	*0*
603	*Transport via pipelines*	*0*	*0*	*0*	*0*
61	Water transport	0	0	0	0
62	Air transport	0	0	0	0
63	Supporting and auxiliary transport activities	0	0	0	0
64	Post and telecommunications	0	0	0	0
J	Financial intermediation	0	1	1	0
K	Real estate, renting and business activities	3	6	19	2
75	Public adm. and defence; compulsory social security	0	0	0	0
80	Education	0	0	0	0
85	Health and social work	0	0	0	0
90 excl. 90001	Refuse disposal, sanitation, excluding sewage disposal	0	20	0	8
91	Activities of membership organization n.e.c.	0	1	2	0
92	Recreational, cultural and sporting activities	0	0	0	0
93	Other service activities	0	0	0	0
95	Private households with employed persons	0	0	0	0
	Governmental services	8	12	49	4
	Private consumption	70	834	1 351	172
	Total	1 278	13 850	9 719	807

1) Emissions from combustion refer to 1993, and emissions from industrial processes refer to 1995.

Annex C

Energy values

C.1 Energy values for different types of fuel as given by the Swedish EPA. MJ/unit of fuel

Type of fuel	Unit of fuel	Energy value GJ/ unit of fuel
Waste liquor	toe	41.87
Diesel	m^3	35.39
Fuel oil 1	m^3	35.59
Fuel oil, 2-5	m^3	38.94
Jet fuel	m^3	32.70
Paraffin	m^3	34.50
Coke	tons	28.05
Coke-oven gas	1,000 m^3	16.75
Coal	tons	26.50
LD-gas	1,000 m^3	8.37
Blast furnace gas	1,000 m^3	3.35
Petrol	m^3	31.40
Natural gas	1,000 m^3	38.88
Propane	tons	46.05
Waste	toe	41.87
Gaswork gas	1,000 m^3	16.75
Tall oil	m^3	38.94
Peat	toe	41.87
Wood fuel	toe	41.87
Other, non-nuclear fuel	toe	41.87

Emission factors

Table C.2 gives the general emission factors for SO_2, NO_x and CO_2 used in the calculations. In table C.3 some extra information used for the CO_2 calculations is given. In table C.4 the factors for calculating the metals are presented. They are not as detailed as the first three substances. Emission factors for specific plants are not included in this list. The data are the same as those used in the official statistics and the Swedish EPA are responsible for updating.

C.2 Emission factors for SO_2, NO_x and CO_2, for different type of fuels and sphere of use.

Type of fuel	Emission factors g SO_2/MJ	g NO_X/MJ	g CO_2/MJ	Sphere of use
Waste liquor	0.00	0.07	108.0	All consumption
Diesel	0.045	*	75.3	All consumption
Fuel oil 1	0.08	0.07	75.3	Housing, service e.t.c.
Fuel oil 1	0.04	0.07	75.3	Other consumption
Fuel oil, 2-5	0.24	0.17	76.2	Housing, service e.t.c.
Fuel oil, 2-5	0.24	0.17	76.2	Other consumption
Jet fuel	0.014	*	72.3	All consumption
Paraffin	0.014	*	73.1	All consumption
Coke	0.36	0.15	103.0	All consumption
Coke-oven gas	0.12	0.10	60.0	All consumption
Coal	0.36	0.20	90.7	All consumption
LD-gas	0.0003	0.10	199.9	All consumption
Blast furnace gas	0.005	0.10	103.0	All consumption
Petrol	0.01	*	72.6	All consumption
Natural gas	0.002	0.04	56.5	Housing, service e.t.c.
Natural gas	0.002	0.06	56.5	Other consumption
Propane	0.00	0.05	65.1	Housing, service e.t.c.
Propane	0.00	0.07	65.1	Other consumption
Waste	0.11	0.09	1)	All consumption assumes 50% purification
Gaswork gas	0.00	0.05	77.5	Housing, service e.t.c.
Gaswork gas	0.00	0.07	77.5	Other consumption
Tall oil	0.14	0.10	*	All consumption
Peat	0.22	0.19	1)	All consumption
Wood fuel	0.04	0.07	96.0	Housing, service e.t.c.
Wood fuel	0.04	0.12	96.0	Other consumption
Other, non-nuclear fuel	0.24	0.10	60.0	All consumption

* General emission factors are not used. Tall oil has no CO_2 factor.
1) See table C.3

C.3 Data used for calculating CO_2 emissions from waste and peat.

Type of fuel	Unit of fuel	Energy value GJ/unit of fuel	Emission factor g CO_2/MJ	Sphere of use
Waste	tons	9.52	32.7	Consumption in electricity, gas and heating power stations
Waste	tons	1.96	27.4	Other consumption
Peat	tons	9.91	107.3	Consumption in electricity, gas and heating power stations
Peat	tons	6.12	97.1	Other consumption

C.4 Emission factors for As, Cd, Cu, Cr, Hg, Ni, Pb, Se and Zn for different type of fuel and sphere of use.

Sphere of use and type of fuel	Emission factors, mg/GJ								
	As	**Cd**	**Cu**	**Cr**	**Hg**	**Ni**	**Pb**	**Se**	**Zn**
District heating									
Coal	3	0.5	8	4	1.5	8	25	3	10
Wood fuel	0.1	0.5	2	0.5	0.5	0.6	10	0.5	12
Peat	6	1.2	40	25	3	50	40	10	120
Domestic fuel oil	0.4	0.16	2	0.48	0.09	0.8	2.4	0.16	1.6
Heavy fuel oil	1.2	0.42	5.1	0.72	0.06	240	15	1.5	12
Industry									
Coal	3	0.5	8	4	2	8	25	3	10
Wood fuel	0.5	2	15	10	0.75	9	60	3	300
Peat	6	1.2	40	25	3	50	40	10	120
Domestic fuel oil	0.4	0.16	2	0.48	0.09	0.8	2.4	0.16	1.6
Heavy fuel oil	1.2	0.42	5.1	0.72	0.06	240	15	1.5	12
Other									
Coal	3	0.5	8	4	2	8	25	3	10
Wood fuel	1	4	30	20	0.75	18	120	6.5	600
Domestic fuel oil	0.4	0.16	2	0.48	0.09	0.8	2.4	0.16	1.6
Heavy fuel oil	1.2	0.42	5.1	0.72	0.06	240	15	1.5	12