A Monetary Valuation Weighting Method for Life Cycle Assessment Based on Environmental Taxes and Fees

by

Jessica Johansson

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Supervisors: Göran Finnveden and Peter Steen

Department of Systems Ecology
Stockholm University
S-106 91 Stockholm
Sweden

Abstract

Weighting in life cycle assessment (LCA) is a controversial subject due to its dependence upon value judgements. One of the issues that has to be dealt with is whose values that shall be reflected. In a democratic society, a fair candidate to put forward would be the government. In environmental economics taxes and fees set up by governments to protect natural resources and the environment are sometimes used as an approximation of the monetary value of these assets.

In this master thesis a new set of weighting factors for LCA, based on Swedish environmental taxes and fees will be presented. Weighting factors are derived for the most commonly used impact categories. The weighting factors are also combined with different sets of characterisation factors, in order to obtain one-step weighting factors that may be applied directly on inventory data. An estimation of the uncertainty in the valuation is obtained when alternative weighting factors are combined with different sets of characterisation factors.

Contents

1 Introduction

It has become widely acknowledged that the environmental problems are best handled if action can be taken to prevent the damage from occurring, rather than trying to restore the environment when the harm has already been done. Since it is impossible to completely avoid environmental impacts, it is important to put the efforts where they are likely to yield the most benefit. Although it may be easier to point out and do something about emissions from a production plant, it has become evident that much environmental damage stem from diffuse emissions made during other phases of the product life than the production stage. In order to be able to make sound decisions on which measures that should be taken, information is needed on environmental impacts from the products' entire life. Life cycle assessment (LCA) is a formalised tool that has been designed to meet those requirements.

Since the beginning of the 1990-ties the LCA-methodology has undergone rapid development. One issue that has been discussed is how to compare the different environmental impacts to each other, since an LCA-study rarely turns out in favour of the same alternative regarding all environmental impacts. Product A may for instance contribute more to eutrophication than product B does, while product B may contribute more to acidification than product A. Which alternative shall then be chosen? The answer depends on which environmental problem that is considered to be worst, or seen from a different angle, which environmental function that is considered to be most valuable. The ranking of different environmental impacts is a matter of subjective value judgements, and who shall have the legitimacy to make such decisions? There are no satisfactory answers to those questions within the LCA-community yet.

LCA is occupied with trying to map the interactions between the economic system and the ecological system within which it exists. The focus is on what is taken in from the ecological system in terms of resources and what is subsequently returned to it as emissions. Ecological economics is a transdiciplinary field of study, addressing the relationships between ecosystems and economic systems in a very broad sense, in order to develop an understanding of the entire system of humans and nature as a basis for policies for sustainability (Folke et al. 1994). One branch is, in parallel to LCA, trying to identify quantitative measures of the value of the environment. Although there are some serious difficulties there too, in finding good methods for doing so, the LCA-methodology might benefit from the achievements made concerning valuation. One method, sometimes used in environmental economics, is designed to catch revealed preferences of a society through its environmental taxes and fees.

1.1 Aim of the study

The aim of this study is to develop a new method for valuation within LCA, including a new set of valuation weighting factors for the most commonly used impact categories. In an attempt to find a method where the values of a majority of the Swedish population are reflected, I will use the Swedish environmental taxes and fees as a basis when developing the valuation weighting factors. I will also create one-step weighting factors by combining the valuation weighting factors derived with some existing characterisation methods for LCA. In so doing I will be able to draw some conclusions on the degree of uncertainty associated with the weighting factors, as the result from using different taxes or fees on the same set of characterisation factors can be compared.

2 Life cycle assessment

This chapter is devoted to a brief introduction to life cycle assessment. The presentation is mainly based on the publication ‘Life cycle assessment: what it is and how to do it’ from United Nations Environment Programme (UNEP) Industry and Environment (1996), to which the interested reader is referred for a more thorough review.

In a life cycle assessment (LCA) the environmental impacts of a good or service are investigated throughout its whole life cycle. The LCA shall cover the use of material and energy as well as all emissions made by the product system[1] in a cradle-to-grave perspective. As defined in the Nordic Guidelines on Life Cycle Assessment (Lindfors et al. 1995), this means that the product system is followed from the extraction and processing of raw material, through manufacturing, distribution, use, reuse, maintenance, recycling to final disposal, including all transports involved. Quantitative or qualitative information on emissions made, and material and energy used in all those phases are gathered and processed so that an assessment can be made on the total impact on the environment and on the resource base. An LCA does not involve economic or social impacts (Lindfors et al. 1995).

An LCA study can be a valuable support for various kinds of environmental decisions, such as the design or improvement of products and process, the development of business plans, the setting of ecolabeling criteria, the developing of policy strategies, and when making purchasing decisions.

The focus of an LCA may be either on a product, such as a car, or on a function, such as the transportation of one person from point A to point B. The integration of all environmental problems that occurs during a full life cycle of a product or function, can allow the substituting of one set of problems for another set of problems to be avoided. An LCA can help prevent problem shifting from one stage of the life cycle to another, from one sort of problem to another and from one location to another. One type of problem shifting, however not revealed by LCA, is the shifting of problems from one product to other products. This may occur, for instance, when contaminated materials are recycled into other products. To analyse this sort of problem a substance flow analyses might be more appropriate (UNEP 1996).

The LCA is always based on a so called functional unit. The functional unit is a reference unit for quantifying the performance of a product system. When for example comparing washing up by hand with using a dishwasher, the functional unit could be the washing-up needed by a four-person household for one year. This approach gives a *relative* indication of what potential damage the product system might impose. Thus an LCA can never tell what actual damage that is going to occur in the environment.

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[1] Product system, in this study, refers to all economic processes which constitute the life cycle of a good or service. Economic process are deliberate activities, creating a financial or utility value for those performing it.

There are several other environmental decision tools available addressing different aspects, for example risk analyses (RA) for hazardous chemicals and activities; environmental impact assessment (EIA) for new activities; and substance flow assessment (SFA) for substances. The different techniques should not be seen as competitive, but rather as complementary. (For a comparison of different environmental analysis tools, se e.g. Moberg 1999).

A standardised framework on how to perform an LCA is provided by the International Standards Organisation (ISO 1997a). According to this framework a life cycle assessment consists of four different, but interrelated phases, as illustrated in figure 2.1.

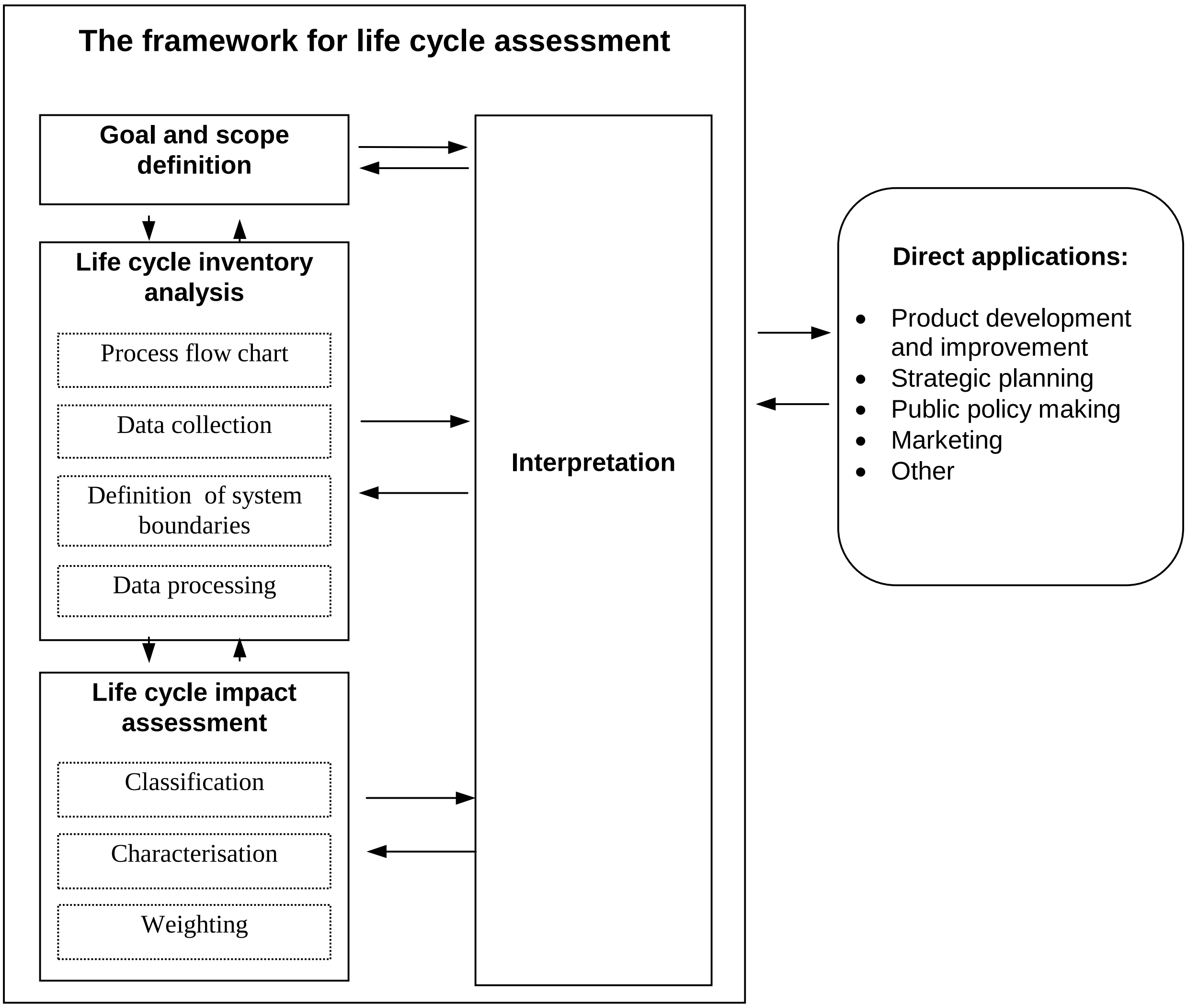

Figure 2.1. The phases of a life cycle assessment (modified from ISO 1997a).

The first phase is to set the goal and scope of the study. The second is to make an inventory where the different contributions to environmental impacts are quantified. The third is to assign these impacts to the type of problem they cause and to evaluate how serious the potential damage is. The fourth phase is to interpret the results and discuss the conclusions that can be drawn. Although a standard has emerged there are still areas of the LCA-technique in need for further development. This is especially true when it comes to the life cycle impact assessment.

Performing an LCA is an iterative process, where information revealed during the course of the study may impose a revision of earlier steps. As, for example, the most important processes are identified, the scope of the study may have to be altered. The process is repeated until the goal of the study is met.

In the following section, mainly based on the ISO-standard (ISO 1997a), the different phases of LCA will be described in some further detail. The emphasis is put on weighting, since that is the topic for this thesis.

2.1 Goal and scope definition

In the goal of an LCA study the intended application and the reasons for carrying out the study shall be clearly stated. It shall also be defined to whom the results produced are intended to be communicated.

The goal set in turn defines the scope needed for the study in order to meet that goal. In the scope the functions of the system under study are specified, and the functional unit, on which the investigation shall be based, is determined.

It is unfeasible to cover absolutely every aspect linked to the life of a product. Therefore the system boundaries have to be determined. That is, a decision concerning which unit processes to be included within the LCA has to be made. The data quality required to fulfil the goal of the study is also specified in the scope, addressing issues like time related coverage, geographical coverage, and consistency and reproducibility of the methods used. In comparative studies any differences between systems, regarding functional unit and methodological considerations shall be identified and reported.

2.2 Life cycle inventory analysis

The inventory analysis is the phase when data is collected and calculations are made in order to specify relevant inputs to and outputs from the product system. This work can be divided into four different substeps.

First, all processes involved in the life cycle of the product system have to be identified. It takes a lot of processes in order to produce a product – for example steel, plastics, electricity and capital goods. These are goods and services that require other goods and services, in turn dependent on products of other processes. Ultimately, all processes start with the extraction of raw materials and energy from the environment. After the transformation by various economic processes, all those inputs from the environment will eventually re-enter the environment as emissions to air, water and land. To clarify these often complex processes, a process flow chart is constructed.

Secondly, the data on each process is collected. This is the most time consuming and difficult task in performing an LCA. Data can be obtained from scientific literature, from published data files used by LCA practitioners, from industry and from government records. The data used should preferably be quantitative, but when it proves to difficult to find quantitative data a qualitative estimation will be made instead.

The third step is to, once again, define the system boundaries. This time it can be done more carefully with the information from the system flow chart and the collected data. This will give the LCA study a more manageable size, as processes that fall outside these boundaries can be left out. Boundaries need to be set separating the product system from the environment, from other product systems and from processes not taken into account in the product system.

Finally, the inputs and outputs from all processes are adjusted to relate to the functional unit. Aggregation of all data, through addition, then results in an inventory table. In the inventory table all economic inputs and outputs will have been translated into environmental inputs and outputs, in terms of resource extraction and emissions.

2.3 Life cycle impact assessment

As the inventory table often contains a vast number of figures, that are difficult to interpret intuitively, the need for a more formalised evaluation arises. The inventory table constitutes the input to the life cycle impact assessment. The life cycle impact assessment can be divided into at least three different sub-steps, as shown in figure 2.2.

First of all a classification is made where each post in the inventory table is assigned to the type of impact, on the resource base or on the environment, that it contributes to. The impact categories to be included in this classification are not completely agreed upon and there is some room for adjustment to fit the individual LCA-study (ISO 1997b). The impact categories considered in this study are listed in table 2.1. This list is based on a combination of the default lists presented by Udo de Haes (1996) and Lindfors et al. (1995). In these works a discussion on the selection and the definition of the impact categories can also be found. It can be noted that the chosen list is rather short. Udo de Haes (1996) suggests the additional input related impact category land, and output related impact categories like odour, noise, radiation and casualties. Another impact category proposed by Lindfors et al (1995) is habitat alterations and impacts on biological diversity. These additional categories are problematic to assess quantitatively in LCA, and for simplicity they are excluded from the present study. In an actual LCA there is however always an option to include qualitative information to be considered in the overall interpretation of the results.

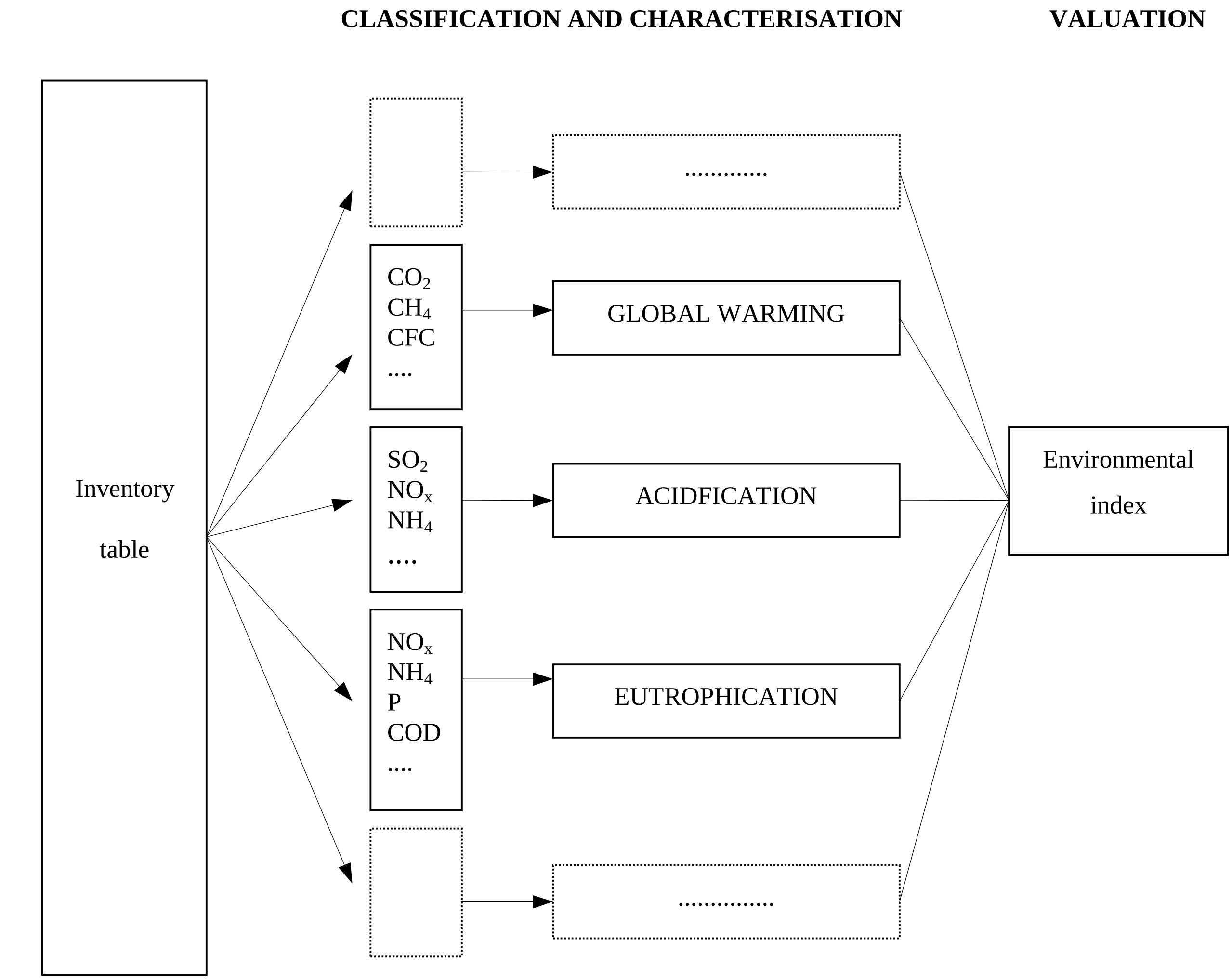

Figure 2.2. The steps involved in the life cycle impact assessment (modified from UNEP 1996).

Table 2.1. The impact categories considered in this study.

Impact category
Input related categories
Abiotic resources
Biotic resources
Output related categories
Global warming
Depletion of stratospheric ozone
Photo-oxidant formation
Acidification
Eutrophication
Ecotoxicological effects
Human health
Toxicological effects
Non-toxicological effects
Working environment
Outflows not followed to the system boundary between the tecnincal system and the environment

Many substances can contribute to more than one type of impacts, such as for instance emissions of NO_x that have an effect on eutrophication, acidification, photochemical oxidation as well as on human health. This may create an allocation problem. This topic is discussed by Lindfors et al. (1995) and Udo de Haes (1996).

In the next step, referred to as characterisation, the contributions to each environmental problem are quantified. Several models are available for this purpose. The models give equivalency factors, indicating how much a substance contributes to a problem compared to a reference substance. These models rely on scientific knowledge, but since there is still a lot that remain unknown regarding how ecosystems function, there is some uncertainty in the models as well as differences between models. As advancements are made in the environmental sciences the characterisation methods are further developed. The subjective choice of characterisation method may influence the final outcome of the LCA study.

The last step, that according to ISO (1997b) is optional, involves the weighting of the different environmental impacts against one another. For example: Is global warming more serious than acid rain? If so, how much more serious is it? Natural science alone cannot answer such questions, but ethical and ideological considerations are necessary as well (e.g. Finnveden, 1997). It is important to be explicit about which ethical considerations that the weighting rests upon. The weighting may result in a single score environmental index.

2.3.1 Different approaches to valuation and weighting

The weighting of one environmental impact in relation to another is based on values, values which by their nature are subjective. The question is whose values that shall be reflected. The answer depends on the ethical preferences and world-views of those answering the question. In an LCA this question should be openly addressed and answered in the goal and scope. (An extensive discussion about the ethics connected to valuation in LCA is provided by Finnveden 1996, summarised in Finnveden 1997).

There are several different approaches to weighting. One is to simply omit the weighting procedure, since it is not a compulsory component of LCA. If this option is chosen one has to be aware of that this may imply an implicit weighting when conclusions are draw from the LCA-study. A reason for using a formalised weighting procedure instead is to, as much as possible, make the values involved in the weighting explicit.

If a quantitative weighting is decided upon there are at least three families of methods available (based on Lindeijer, 1996):

1. Panel methods

2. Distance-to-target methods

3. Monetarisation methods

Panel methods

In the panel methods a group of people are asked to give ranks to the different impact categories. The panel can be constituted in different ways, including for example some sort of experts, politicians or stakeholders. Crucial to the outcome of these methods is, apart from the composition of the panel, also how the questions are being formulated and asked (Finnveden 1996).

The composition of the panel can reflect different ethical views. A panel consisting of scientists would correspond to a Platonic view on experts as being better suited than common people to make sound decisions, a view that to some may be seem undemocratic (Finnveden 1997). Such persons might instead prefer a panel consisting of representatives of the people, and if their view on representative democracy is positive these representatives could be elected politicians. Proponents of a strong proprietorship, maintaining that everyone should be entitled to decide for themselves, would probably prefer a panel constituted of stakeholders.

Distance-to-target methods

The distance-to-target methods relates the valuation weighting factors to some kind of target. The target can for instance be a politically decided environmental quality target. The mathematical relation between the valuation weighting factors and the targets differs among methods.

In analogy with the panel methods the ethical context of the distance-to-target methods depends on who is allowed to set the targets. If one is in favour of Platonic experts, the target-setting is left to scientists or other experts. If one holds a positive view on representative democracy, politically set targets may be used instead.

Monetarisation methods

Another way of handling values is to translate them into monetary terms. In economic science the market price is often taken to represent the least value of something. But for many environmental goods and services market prices are lacking, since they are not bought and sold on markets. In environmental economics efforts are being made to include the environmental goods and services into the societal economy by assigning them monetary values. The monetary values thus derived can be used as valuation weighting factors.

The ethical considerations associated with monetarisation methods depends on how the monetarisation is carried out. If a positive view is held on market economy as a system capable of exchanging information, then weighting methods which make use of market prices and other types of information derived directly from the market may seem reasonable (Finnveden 1997). A problem with such an approach, some would argue, is that only direct user values are accounted for while other values are left without notice. Those values may for example be caught through asking people about their willingness to either pay for the preservation of environmental values, or to accept environmental degradation.

2.4 Interpretation

In the interpretation phase of LCA the findings from the inventory analyses and the impact assessment are combined together in order to reach conclusions and recommendations, consistent with the goal and scope of the study (ISO 1997a). This phase may also involve the reviewing and revising of the goal and scope, as well as the nature and quality of the data collected.

3 Creation of valuation weighting factors

The valuation weighting method that shall be developed in this thesis is a monetarisation method based on the Swedish tax system. The method relies on two basic assumptions. The first is that the members of parliament represent the will of the people, and the second is that the environmental tax system represents the priorities of the parliament. Before starting to create valuation weighting factors, a short background to these assumptions will be given.

3.1 Representative democracy

The object of the political system can be defined as the authoritative distribution of values, and the legitimisation of this distribution (Larsson 1994). Every society needs institutions to regulate and solve conflicts about how common values shall be shared among different individuals and groups. In Sweden the political system is based on parliamentarism and representative democracy.

The view on how democracy shall be defined is constantly changing, from one time to another as well as from one person to another, but what we are concerned with here is how democracy is currently practised in Sweden.

Every fourth year a new parliament consisting of 349 members is elected by those in the country that are entitled to, and willing to, vote. Entitled to vote are men and women, over the age of eighteen, who are Swedish citizens. This means that many people living in Sweden lacks the right to influence the composition of the parliament and thus are not represented, for example many immigrants and young people. There are also a certain amount of people choosing not to vote. Historically the participation in the national elections has been high in Sweden, but in the election of 1998, the participation declined to 81 % (Gehrman 1999). This is still a comparably high figure, but nevertheless 19 % of the persons entitled to vote are not represented in the parliament. Whatever the reasons are for not voting, it inflicts on the legitimacy of the parliament as a representative of the people.

Another issue concerning the representation is the way in which the individual is represented in the parliament. In the Swedish system the emphasis is put on the representation of opinion and not on social representation. In other words it should not matter who is representing who, as long as they hold the same views in important questions. In this way a young man can represent an old woman and a civil servant may represent a farmer. The question about whether social representation ought to be more aimed at in addition to representation of opinion has received some attention in recent years. Although not stated in the constitution one form of social representation already occurs through the division of the country into constituencies, which creates a regional representation. Apart from that, focus has been put on the female representation, resulting in a share of 43 % of the seats in parliament now held by women

(Sveriges Riksdag 1998). But still, most members of parliament are middle-aged, professional politicians with little other work experience and of Swedish decent (Larsson 1994).

3.2 Environmental taxes and fees

Economics is usually defined as the management of scarce resources. For some resources however, such as environmental assets for instance, this management has been less successful. Crucial to our very existence is that the ecological system that we are a part of can continue to function and provide us with services such as climate regulation, water supply and nutrient cycling. The ecosystem life-support, is the primary value of the environment (Folke et al. 1994). These services can be viewed as possessing an infinite value, since we could not do without them (Costanza et al. 1997).

How come then, have we not managed to take better care of these essential assets? In answering this question it might be helpful to further systematise the secondary values provided by ecosystems, keeping in mind that these values depended on the fundamental functioning of the ecosystem (see e.g. Turner et al. 1994 and Folke et al. 1994).

Seen from an anthropocentric perspective the value of ecosystems can be divided into several subcategories (see e.g. Goulder and Kennedy 1997 and Turner et al. 1994). Following Turner et al. (1994), a first distinction can be made between use values and non-use values. Use values are derived from the actual use of the environment, or an intention to use it in the future. The use can be either direct as the harvesting of fish, or indirect as a recreational visit to the sea or the carbon fixing performed by plants. Non-use values are non-instrumental values that are attributed to objects without the intention of ever actually using them. Such values include the concern for, sympathy with, and respect for the rights or welfare of non-human beings. We may also attach a value to knowing that future generations will be able to enjoy environmental use and non-use values (Turner et al. 1994).

From this division it is easy to see that most of the values, except for direct use values, are beyond the scope of ordinary market transactions. Such things as flood-control benefits, water filtration services, and species-sustaining services offered by ecosystems are usually external to the parties involved in market decisions. This leads to a situation in which important social benefits are not considered in the market prices (Goulder and Kennedy 1997). A reason for this is that these benefits by their nature are public and that the ownership to them thereby is difficult to define. Consequently no one has any particular possibility to take responsibility for the environment, and this is one explanation to why it is not sufficiently cared for.

As the awareness of this problem has grown, policies have been developed in order to abate it. One possibility is to let the society assume ownership over the public goods and services. In this way the society can put a price on for example using the air as a recipient of waste gases. Thereby the external costs can be internalised and, at least in theory, allow production and consumption to be kept at optimal volumes. A convenient method for prising is to take out a tax or a fee that corresponds to the appreciated value of the environmental resource in question. This policy approach has found an increasing use in Sweden during the past decade.

What then determines the sizes of the Swedish environmental taxes and fees? A reasonable assumption would be that the environmental taxes are introduced with the ambition of reducing the environmental stress exercised by the subject of the tax. The size of the tax may then be influenced by the cost connected to the reduction of the environmental stress to a tolerable level. The size of a tax or fee does not reflect the total value of the concerned environmental asset, but rather a marginal value. They are the least we are willing to pay to avoid the environmental impact.

The tax level is set with the desired environmental quality in mind as well as other macroeconomic effects that may result from the tax. For instance there may not be a preparedness to jeopardise important industrial branches by imposing very high taxes on them. In line with this the Swedish carbon dioxide tax, for example, is lower for industrial production processes than for other activities. This may be seen as a subsidy to the industry.

Apart from being a means of control, taxes are also a means of raising money for the public budget. Behind the introduction of the carbon-dioxide tax, for example, there was also a strong fiscal motive (SOU 1989:83 cited in NV 1997a). The fiscal motives behind taxes does however not affect the valuation, because it is still a matter of priority to put a tax on something and to decide the size of that tax.

3.3 Development of valuation weighting factors

In order to create a valuation method for LCA the different environmental taxes and fees existing in the Swedish tax system are connected to the appropriate impact category. Information on existing environmental taxes and fees are mainly gathered from two reports from the Swedish Environmental Protection Agency: ‘Avgifter, skatter och bidrag med anknytning till miljövård’ (NV 1997b) and ‘Miljöskatter i Sverige - ekonomiska styrmedel i miljöpolitiken’ (NV 1997a). For the current rates of taxes and fees, as well as some background information about the taxes the governmental web-site ‘Hållbara Sverige’ (Regeringskansliet 1999) is used. In some cases it is also necessary to consult the actual statutes for information on the sizes of taxes and fees.

The taxes and fees are also adjusted into comparable units in terms of extraction from, and emissions to the environment. The impact categories considered are shown in table 2.1, and the units used are Swedish kronor per kilogram (SKr/kg) and Swedish kronor per megajoule (SKr/MJ). The resulting valuation weighting factors are shown in table 3.1.

Table 3.1. Valuation weighting factors derived from environmental taxes and fees existing in Sweden in 1998.

Impact category	Valuation weighting factor
Input related categories	
Abiotic resources	0.005 SKr/kg natural gravel
	0-0.14 SKr/MJ
Biotic resources	0-0.049 SKr/MJ
Output related categories	
Global warming	0.09-0.37 SKr/kg CO_2
Depletion of stratospheric ozone	600 SKr/kg ozone depleting substance
Photo-oxidant formation	10-100 SKr/kg benzene
Acidification	30 SKr/kg sulphur
	40 SKr/kg NO_2
Eutrophication	12 SKr/kg N leached
	40 SKr/kg NO_2
Ecotoxicological effects	20 SKr/kg pesticide
	30 000 SKr/kg cadmium
	10-100 SKr/kg benzene
	180-350 SKr/kg lead
Human health	
Toxicological effects	20 SKr/kg pesticide
	30 000 SKr/kg cadmium
	10-100 SKr/kg benzene
	180-350 SKr/kg lead
Non-toxicological effects	-
Working environment	-
Outflows not followed to the system boundary between the tecnincal system and the environm	0.25 SKr/kg landfilled waste (from 1 Jul 1999)

- indicates that no appropriate valuation weighting factor could be derived.

3.3.1 Abiotic resources

In order to increase the substitution of the natural gravel derived from glacifluvial deposits with other materials, a tax on natural gravel has been introduced (SFS 1995:1667). The goal is to reach a proportion of 70/30 between crushed granite rubble and natural gravel, in the production of ballast. In 1996,
47 % of the ballast produced originated from natural gravel, 44 % came from crushed granite rubble and 9 % from other material[1] (Regeringskansliet 1999). The main reason for the high proportion of natural gravel is its low cost. In the government bill preceding the tax it was estimated that a tax of 0.010 SKr/kg natural gravel would be required in order to reach the aimed effect (prop. 1995/96:87 cited in Regeringskansliet 1999). To prevent the premature closure of a large number of already existing gravel pits, the tax was set at 0.005 SKr/kg natural gravel.

Fitting in under abiotic resources are also the energy taxes. Fossil fuels used for heating or as motor fuel, as well as electric power, are being taxed (SFS 1994:1776). The tax rates are not proportional to the energy content of the fuel, the difference stemming from the 1970-ties and the

[1] Other materials could be till, excavation masses, recycled building material and recycled asphalt.

wish to steer from oil to other products (Regeringskansliet 1999). The size of the energy tax also depends on the application of the fuel, in that motor fuels are heavier taxed than fuel used for heating. There is also a differentiation according to environmental classes for petrol and oil. For electric power the tax differs depending on what it is used for and where in the country it is used.

Energy from fuels and electric power is taxed with up to 0.14 SKr/MJ. The tax amounts for different compounds as stated in the act (SFS 1994:1776) and converted into the common unit SKr/MJ, are shown in table 3.2.

Table 3.2. Energy taxes, as stated in the act SFS 1994:1776 and converted into the common unit SKr/MJ.

Energy carrier	Energy tax (original units)	Energy content*	Energy tax (SKr/MJ)
Petrol		31.4 MJ/l	
environmental class 2	3.61 SKr/l		0.11
environmental class 3	3.68 SKr/l		0.12
other petrol	4.27 SKr/l		0.14
Coal feules	316 SKr/1000 kg	27.2 MJ/kg	0.011
Petrolium coke	316 SKr/1000 kg	28.1 MJ/kg	0.012
Oil			
for the running of motor driven vehicles and vessels in private use		35.7 MJ/l	
environmental class 1	1614 SKr/m^3		0.045
environmental class 2	1840 SKr/m^3		0.052
environmental class 3	2138 SKr/m^3		0.060
for other purposes	743 SKr/m^3		0.021
Liquefied petrolium gas		MJ/kg	
for the running of motor driven vehicles and air crafts in private use	1.01 kr/l		0.041
for other purposes	145 SKr/1000 kg		0.0032
Natural gas and methane		38.9 MJ/m^3	
for the running of motor driven vehicles and for vessels and air crafts in private use	1678 SKr/1000 m^3		0.043
for other purposes	241 SKr/1000 m^3		0.0062
Electric power	0.152 SKr/kWh	1 kWh = 3.6 MJ	0.042
for the supplying of electric power, gas, heat and water	0.129 SKr/kWh		0.036
used in certain municipalities in the north of Sweden	0.096 SKr/kWh		0.027
used in industrial production processes and in profesional greenhouse cultivation	0 SKr/kWh		0

* Energifakta 1994

3.3.2 Biotic resources

Bio-fuels are in principle exempted from the energy tax, but since 1 January 1999 there is, however, a tax on raw pine-tree oil of 1785 SKr/m^3 or 0.049 SKr/MJ (SFS 1994:1776). The raw pine-tree oil, when tax-free, was profitable to use for heating purposes. This created an increased demand for it, which in turn raised the price. The increasing price disadvantaged the chemical industry which uses the pine tree oil as a raw material. The size of the tax corresponds to the total amount collected as energy tax and carbon-dioxide tax for regular heating oil (Regeringskansliet 1999).

3.3.3 Global warming

In order to decrease the emissions of carbon dioxide there is a tax on fossil fuels (SFS 1994:1776). The tax is set with respect to the carbon content of the fuels to on average 0.37 SKr/kg CO_2. For fuels used in industrial production processes the tax is reduced by 50 % to 0.185 SKr/kg CO_2 (Regeringskansliet 1999). The tax reduction for the industry may be regarded as a subsidy.

3.3.4 Depletion of stratospheric ozone

The use of ozone depleting substances is in principle prohibited in Sweden, but there is a possibility to apply for exemption (SFS 1995:636). If such an exemption is granted the user has to pay a fee of 600 SKr/kg ozone depleting substance used. There is no distinction made, affecting the size of the fee, between the different ozone depleting substances (personal communication with Maria Ujfalusi at the Swedish Environmental Protection Agency, 1998).

3.3.5 Photo-oxidant formation

Contributing to the formation of photo-oxidants are emissions of volatile organic compounds. One such compound that has an exemption fee on it is benzene, when occurring in high concentrations in petrol (SFS 1985:838). In the statute SNFS 1981:1 the fee is set to 10 Skr/m^3 petrol when the concentration of benzene is exceeding 5 % of the volume in petrol at 15° C.

The emission of benzene from a passenger car can be predicted in a model constructed by Westerlund (1988 cited in Boström 1992). According to this model the emission of benzene from a petrol fuelled car with 5 % benzene in the fuel and without catalytic cleaning is 100 mg/km. The emission from a car with catalytic cleaning is 10 mg/km. Assuming that the fuel consumption is 0.1 l/km the fee can be calculated to 10 SKr/kg emitted benzene from a car without catalytic cleaning and to 100 SKr/kg emitted benzene from a car with catalytic cleaning.

Benzene is also a well known carcinogen and in addition exposure to it can result in anaemia. Because of this it is hard to assess to what extent the exemption fee can be related to the photo-oxidant formation problem.

3.3.6 Acidification

Emissions of nitrogen and sulphur compounds are the main causes of the acidfication of soil and water. In order to reduce the emissions of sulphur there is a tax on the sulphur content in fossil fuels and peat of 30 SKr/kg sulphur (SFS 1994:1776). To get a reduction of the emissions of nitrogen compounds there is a fee on such emissions from energy production in stationary combustion plants (SFS 1990:613). The fee is set to 40 SKr/kg NO_2 (the sum of NO and NO_2 converted to NO_2). Nitrogen compounds also contribute to terrestrial and aquatic eutrophication, toxicological effects and to photo oxidant formation. This makes it difficult to say how much of the tax that actually addresses to the acidification problem.

3.3.7 Eutrophication

Emissions of nitrogen compounds causes both terrestrial and aquatic eutrophication. As mentioned above there is a fee of 40 SKr/kg NO_2 (the sum of NO and NO_2 converted to NO_2) emitted from energy production in stationary combustion plants (SFS 1990:613). It is difficult to state how much of the tax that shall be assigned to terrestrial eutrophication and how much of it that shall go to aquatic eutrophication or other effects.

The spreading of fertilisers on arable land contributes to the leakage of nutrients to aquatic ecosystems. To decrease the demand for fertilisers there is a tax of 1.80 SKr/kg nitrogen that the fertiliser contains if it is more than 2 % (SFS 1984:409). If a leakage of 15 % of the applied nitrogen is assumed (Bernes 1991), then the tax can be converted to 12 SKr/kg nitrogen leached.

3.3.8 Ecotoxicological effects

All pesticides sold in Sweden has to be registered at the National Chemicals Inspectorate, who decides if the pesticide shall be admitted for use in Sweden[2]. In order to decrease the use of them, there is a tax of 20 SKr/kg active substance in the permitted pesticides (SFS 1984:410). Pesticides used in the wood industry are exempted from the tax.

There is also a tax of 30 SKr/g of cadmium contained in phosphor fertilisers, to the extent that the content exceeds 5 g/1000 kg phosphor. This is 30 000 SKr/kg cadmium (SFS 1984:409).

The exemption fee on high concentrations of benzene in petrol (SFS 1985:838), mentioned in section 3.3.5 in connection to photo oxidant formation, can also be related to ecotoxicological effects. The fee is 10-100 SKr/kg emitted benzene (for calculations, see section 3.3.5).

Lead in petrol have been prohibited in Sweden since 1994, but there still exists an exemption fee for high levels of lead in petrol (SFS 1985:838). If the petrol contains more than 0.15 g/l the fee is 20 Skr/m^3 petrol with the octane number 93, and 40 Skr/m^3 petrol with the octane number 98 (SNFS 1981:1). The emissions of lead from leaded petrol varies a great deal depending on such things as the condition of the carburettor system, the manner of driving and the slope of the road (Oskarsson and Camner 1983). On average, 70-75 % of the combusted lead is emitted as

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[2] All pesticides admitted for use in Sweden, and that accordingly are subjects to the tax are listed in ‘Kemikalieinspektionenes förteckning över bekämpningsmedel m.m.’ (KEMI 1998). They can also be found in a searchable database, available on the Internet at http:/www.kemi.se/default.cfm?page=bkmregoff/default.cfm, which is the source used in this study (KEMI 1999).

inorganic lead and about 25 % is maintained in the carburettor system, motor oil and oil filter (Hirscheller and Gillbert 1964 cited in Oskarsson and Camner 1983). With a petrol consumption of 0.1 l/km, a lead content in the petrol of 0.15 g/l and an emission of 75 % of the lead, the emission of lead is 11.3 mg/km (Hirscheller and Gillbert 1964 cited in Oskarsson and Camner 1983). If 93 octane petrol is used the fee would correspond to 180 SKr/kg lead emitted, and if 98 octane petrol is used instead the fee would be 350 SKr/kg lead emitted.

3.3.9 Human health

The same substances that are toxic to many other organisms in the ecosystems are also toxic to humans. The substances that are treated in section 3.3.9 on ecotoxicological effects are also applicable on human toxicological effects. The valuation weighting factors derived are 20 SKr/kg active substance in pesticides, 30 000 SKr/kg cadmium, 10-100 SKr/kg benzene and 180-350 SKr/kg lead (For more comments and calculations, see section 3.3.9).

For non-toxicological effects and for working-environment I have not found any applicable taxes or fees.

3.3.10 Outflows not followed to the system boundary between the technical system and nature

A tax on landfilled wastes of 0.25 SKr/kg is planned to take effect 1 July 1999 (Press release from the Ministry of Finances 30 Apr 1998 and Boberg 1999). In Sweden much of the wastes produced are landfilled. A reason for this is that incentives to treat the wastes in a better way, from an environmental and resources management perspective, are lacking (Regeringskansliet 1999). The proposed tax would make reuse, recycling and other treatments seem more attractive. Exemption from the tax will be granted for waste from certain industrial branches for which there are no environmentally preferable alternatives to landfill, and for which it is not possible to lower the production of wastes (Press release from the Ministry of Finances 30 Apr 1998). Along with other instruments, the government find it reasonable to expect that the tax will cut the landfilling of wastes by half, within a period of ten years (Regeringskansliet 1999).

4 One-step weighting factors

The valuation weighting factors developed in section 3.3 can be used to value data directly from the life cycle inventory table. This will however only provide a few values and many extractions and emissions will remain unvalued. Following the principle that a contribution to an impact category can be considered equally harmful independently of what caused it, the value of one extraction or emission may be translated into another extraction or emission contributing to the same impact category, by means of characterisation factors. For example, an emission of 1 kg of methane is, according to IPCC (1995), equivalent to 56 kg of carbon-dioxide over a 20 year time frame. Emissions of carbon-dioxide has the value 0.37 SKr per kg, and thus, the emission of methane receives the value
(56 kg/kg * 0.37 SKr/kg) = 21 SKr/kg. The performance of such calculations results in weighting factors that include both the characterisation and the valuation sub-steps of impact assessment. These one-step weighting factors can then be used directly on the data in the life cycle inventory table.

In the ideal situation there would only exist one set of characterisation factors for each impact category, commonly agreed upon and accepted, to be used when creating the one-step weighting factors. At present this is however not the case, as there are still great uncertainties concerning the scientific knowledge underpinning the characterisation methods. The degree of scientific uncertainty varies among the different impact categories. For global warming there are the carbon-dioxide equivalents for green house gases provided by the IPCC (Intergovernmental Panel on Climate Change), which are fairly undisputed and commonly agreed upon. Toxicological effects on the other hand is an area where the uncertainty is considerable and where several methods are available, taking different aspects into account and giving different results.

For the creation of one-step weighting factors a number of characterisation methods have been selected. They are picked mainly from the Nordic Guideline of Life cycle assessment (Lindfors et al. 1995), but for abiotic resources and toxicological impacts more recently developed methods are chosen. Due to the uncertainty in the characterisation methods, more than one method is in some cases tested for the same impact category. How the calculations are performed is shown in the appendix, along with the complete lists of resulting one-step weighting factors.

The size of the one-step weighting factors will be determined by three elements. The first is how the tax or fee values the reference substance. The second is what weight that the characterisation method assigns to the reference substance, and the third is the weight that the characterisation method gives to the substance in question. The creation of one-step weighting factors will hopefully shed some light on how different valuation weighting factors compare to one-another as well as the uncertainty in the characterisation.

4.1 Abiotic resources

Exergy

For characterisation of the depletion of natural resources a method based on the exergies of the materials has been proposed by Finnveden and Östlund (1997). Exergy may be seen as a measure of the available energy. In all real world processes exergy is consumed as entropy is produced. According to the authors there are several reasons why exergy loss may be a relevant measure of depletion and use of resources. One is that useful energy (exergy) is the ultimately limiting resource, since with enough exergy any material could be acquired or mobilised. Another reason is that as energy and matter can not be destroyed, only transformed (excluding nuclear reactions), it is the usable energy and matter that are consumed and may be depleted. Usable energy is measured as exergy. Matter normally has to be concentrated, structured and ordered compared to the surroundings in order to be useful. An often used measure of disorder is entropy and entropy production may then be a useful measure of resource consumption (Finnveden and Östlund 1997). The sum of the entropy production $\sum \Delta S$ is related to the destruction of exergy E by

$$E = T_o \sum \Delta S,$$

where T_o is the temperature of the surroundings (Szargut et al. 1988 cited in Finnveden and Östlund 1997).

Finnveden and Östlund have calculated the chemical exergies of a few solid materials, mostly ores but also granite rock. It is here assumed that natural gravel consists mainly of granite, and on the basis of that and the tax on natural gravel of 0.005 SKr/kg, one-step weighting factors can be calculated as shown in table 4.1. The energy tax of 0-0.14 SKr/MJ may also be used. Listed in the table are maximum one-step weighting factors derived from the energy tax on petrol of 0.14 SKr/MJ. Using the energy tax yields a maximum of one order of magnitude larger values than when the tax on natural gravel is used.

Table 4.1. One-step weighting factors for abiotic resources, based on characterisation equivalency factors from Finnveden and Östlund (1997) and the taxes on natural gravel and energy.

	Characterisation factor	One-step weighting factors (SKr/kg)	
Material	Exergy content e_{ch} (MJ/kg ore)	based on 0.005 SKr/kg natural gravel	based on 0.14 SKr/MJ energy (max)
Aluminium ore	1.1E+00	1.7E-02	1.5E-01
Chromium ore	5.1E-01	8.0E-03	7.1E-02
Copper ore, type 1	6.3E-01	9.8E-03	8.8E-02
Copper ore, type 2	7.9E+00	1.2E-01	1.1E+00
Gold ore	8.3E+00	1.3E-01	1.2E+00
Iron ore	4.2E-01	6.6E-03	5.9E-02
Lead ore	5.6E-01	8.8E-03	7.8E-02
Nickel ore	8.8E+00	1.4E-01	1.2E+00
Phosphorous ore	2.8E-01	4.4E-03	3.9E-02
Platinum ore	5.8E-01	9.1E-03	8.1E-02
Zinc ore	1.9E+00	3.0E-02	2.7E-01
Lime	3.4E-02	5.3E-04	4.8E-03
Rock (= Granite)	3.2E-01	5.0E-03	4.5E-02
Sand	3.2E-02	5.0E-04	4.5E-03

Abiotic depletion potentials

Guinée and Heijungs (1995) suggest a method for the characterisation of natural resource use, covering both biotic and abiotic resources. The equivalency factors for abiotic resources are based on the depletion of stock resources, calculated as the yearly extraction of the resource times the ultimate reserve of the resource.

The ultimate reserve for a chemical element is obtained by multiplying the average concentration of the element in the earth's crust by the mass of the crust, adding reserves that might be present in the oceans and in the atmosphere. For fuels the ultimate reserves are based on the estimated fossil carbon content of the earth's crust. The ultimate reserves are achieved by multiplying the proven reserves of fossil fuels by the ratio of the estimated total carbon content to the total carbon content of the proven fossil fuel reserve.

Abiotic depletion potentials (ADPs), expressed as antimony-equivalents, are presented for most elements and for crude oil, natural gas, soft coal and hard coal. Since the energy tax is specified according to energy carriers, the taxes for the fuels concerned are used when calculating the one-step weighting factors. For oil a minimum and a maximum weighting factor is derived from 743 SKr/m^3 and 2138 SKr/m^3 oil, respectively. Assuming a density for oil of 840 kg/m^3 (Energifakta 1994), gives the valuation weighting factors 0.88 SKr/kg and
2.54 SKr/kg oil. The resulting one-step weighting factors can be expected to be somewhat incorrect since the taxes address oil ready for use, while the ADP refers to crude oil. The energy tax for natural gas is 0.241 SKr/m^3 or 1.678 SKr/m^3, depending on the purpose of use (see table 3.1). The ADP for natural gas is given in the unit kg/m^3. Multiplying the ADP by the tax yields a one-step weighting factor in SKr/kg, from which one-step weighting factors for the other substances can be derived. The energy tax for coal of 0.316 SKr/kg is combined with the ADPs for soft coal and hard coal.

Using 0.241 SKr/m^3 natural gas gives the lowest one-step weighting factors and 0.316 SKr/kg of hard coal gives the highest. Some of those weighting factors are shown in table 4.2. For comparison the same substances as shown in table 4.1 are shown here, but note that table 4.1 concerns ores, while table 4.2 concerns the pure elements. For the full set of one-step weighting factors, see appendix.

Table 4.2. One-step weighting factors for abiotic resources, based on abiotic depletion potentials (ADPs) from Guinée and Heijungs (1995) and the tax on energy for different fuels.

	Characteresation factor	One-step weghting factor (SKr/kg)	
Element	ADP	based on 0.241 SKr/m^3 natural gas (min)	based on 0.316 SKr/kg hard coal (max)
Aluminium	1.00E-08	7.53E-09	5.27E-07
Chromium	8.58E-04	6.46E-04	4.52E-02
Copper	1.94E-03	1.46E-03	1.02E-01
Gold	8.95E+01	6.74E+01	4.71E+03
Iron	8.43E-08	6.35E-08	4.44E-06
Lead	1.35E-02	1.02E-02	7.11E-01
Nickel	1.08E-04	8.13E-05	5.69E-03
Phosphorus	8.44E-05	6.36E-05	4.45E-03
Platinum	1.29E+00	9.72E-01	6.79E+01
Zinc	9.92E-04	7.47E-04	5.22E-02
Fuel			
Crude oil	4.36E-01	3.28E-01	2.30E+01
Natural gas*	3.20E-01	7.53E-01	1.69E+01
Soft coal	8.51E-03	6.41E-03	4.48E-01
Hard coal	6.00E-03	4.52E-03	3.16E-01

*The ADP for natural gas is given in kg/m^3 and the one-step weighting factor based on t natural gas is given in SKr/m^3. Expressed per kg, this one-step weighting factor is 0.753

One-step factors derived from the energy tax on hard coal are two orders of magnitude larger than those derived from the tax on natural gas. Per kg, the energy tax values natural gas almost the same as coal, 0.321 SKr/kg for natural gas and 0.316 SKr/kg for coal. The difference in one-step weighting factors reflects the difference between the characterisation factors for natural gas and hard coal.

4.2 Global warming

For global warming the IPCC presents global warming potentials (GWPs) that can be used as characterisation factors (IPCC 1995). They are calculated as the relative radiative impact from the release of a trace gas over a time horizon in a constant background atmosphere. The global warming potential for a substance, expressed as CO_2-equivalents, differs depending on the time frame chosen. Values for 20, 100 and 500 years are presented, with a typical uncertainty of ±35 %.

The tax on carbon-dioxide emissions of 0,37 SKr/kg collected from households is combined with GWPs for the different time horizons, producing the one-step weighting factors shown in table

4.3. Slightly lower weighting factors are achieved if the 0.185 SKr/kg CO_2 tax collected from the industry is used instead (see appendix).

Table 4.3. One-step weighting factors for global warming, based on the global warming potentials (GWPs) for different time frames from IPCC (1995) and on the tax on the carbon dioxide content of fossil fuels.

	20 years		100 years		500 years	
Trace gas	GWP	One-step weighting factor (SKr/kg) based on 0.37 SKr/kg CO_2	GWP	One-step weighting factor (SKr/kg) based on 0.37 SKr/kg CO_2	GWP	One-step weighting factor (SKr/kg) based on 0.37 SKr/kg CO_2
Carbon dioxide	1	0.4	1	0.4	1	0.4
HFC-23	9100	3400	11700	4330	9800	3600
HFC-32	2100	780	650	240	200	70
HFC-41	490	180	150	56	45	17
HFC-43-10mee	3000	1000	1300	480	400	100
HFC-125	4600	1700	2800	1000	920	340
HFC-134	2900	1100	1000	400	310	110
HFC-134a	3400	1300	1300	480	420	160
HFC-152a	460	170	140	52	42	16
HFC-143	1000	400	300	100	94	35
HFC-143a	5000	2000	3800	1400	1400	520
HFC-227	4300	1600	2900	1100	950	350
HFC-236fa	5100	1900	6300	2300	4700	1700
HFC-245ca	1800	670	560	210	170	63
Chloroform	14	5.2	4	1	1	0.4
Methylene chloride	31	11	9	3	3	1
Sulphur hexaflouride	16300	6030	23900	8840	34900	12900
Perflouromethane	4400	1600	6500	2400	10000	4000
Perflouroethane	6200	2300	9200	3400	14000	5200
Perflouropropane	4800	1800	7000	3000	10100	3740
Perflourobutane	4800	1800	7000	3000	10100	3740
Perflouropentane	5100	1900	7500	2800	11000	4100
Perflourohexane	5000	2000	7400	2700	10700	3960
Perflourocyclobutane	6000	2000	8700	3200	12700	4700
Methane	56	21	21	7.8	6.5	2.4
Nitrous oxide	280	100	310	120	170	63
Triflouroidomethane	<3	<1	<1	<0,4	<1	<0,4

4.3 Depletion of stratospheric ozone

Since the exemption fee on ozone depleting substances is undifferentiated, a weighting factor of 600 SKr/kg for all the ozone depleting substances will have to be used regardless of its ozone depletion potential.

4.4 Photo-oxidant formation

The formation of ozone is usually the only photo-oxidant formation considered in LCA. The formation of ozone is enhanced in the presence of nitrogen-oxides and volatile organic compounds (VOCs). Two methods for characterisation of emissions of VOCs shall be tested here. They are both based on the concept of POCP (Photochemical Ozone Creation Potentials). For calculating the POCPs a model where the chemistry of two air parcels following a trajectory are used (Lindfors et al. 1995). One of the air parcels contains only background concentrations, while the other also contains an extra emission of the studied compound. The ozone formation in the two parcels is then compared. The two methods are based on slightly different approaches and data sets. In both cases the POCPs are expressed as ethene-equivalents.

In the approach by Finnveden et al. (1992 cited in Lindfors et al. 1995) three sets of POCPs are presented for 73 substances. One set is calculated as the maximum difference in concentration between the two air parcels. A second set is calculated as the average ozone contribution with an ordinary Swedish background during 0-4 days. And a third set is calculated as the average ozone contribution with a high NO_x background during 0-4 days. The exemption fee for high levels of benzene in petrol of 100 SKr/kg is applied on each of these sets of POCPs. The results for a selection of the substances are shown in table 4.4. For the rest of the substances and for minimum values derived from using 10 SKr/kg benzene, se appendix.

Table 4.4. One-step weighting factors for photo-oxidant formation based on photochemical ozone creation potentials (POCPs) from Finnveden et al. (1992) and on the exemption fee for high contents of benzene in petrol.

	Maximal difference in concen-tration		Average contribution, ordinary Sweedish background during 0-4 days		Average contribution, high NO_x background during 0-4 days	
	Characteri-sation factor	One-step weighting factor	Characteri-sation factor	One-step weighting factor	Characteri-sation factor	One-step weighting factor
Substance	POCP	based on 100 SKr/kg benzene	POCP	based on 100 SKr/kg benzene	POCP	based on 100 SKr/kg benzene
ethane	0.173	55	0.126	31	0.121	38
propane	0.604	191	0.503	125	0.518	163
n-heptane	0.791	250	0.518	129	0.592	186
methanol	0.165	52	0.213	53	0.178	56
ethanol	0.446	141	0.225	56	0.317	100
acetone	0.173	55	0.124	31	0.160	50
methyl ethyl ketone	0.388	122	0.178	44	0.346	109
ethyl acetate	0.295	93	0.294	73	0.286	90
acetylene	0.273	86	0.368	92	0.291	92
benzene	0.317	100	0.402	100	0.318	100
toluene	0.446	141	0.470	117	0.565	178
m-xylene	0.583	184	0.474	118	0.884	278
p-xylene	0.612	193	0.472	117	0.796	250
1,2,4-trimethylbenzene	0.683	215	0.330	82	0.938	295
formaldehyde	0.424	134	0.261	65	0.379	119
propionaldehyde	0.655	207	0.170	42	0.652	205

In the other approach suggested by Heijungs et al. (1992 cited in Lindfors et al. 1995), data from UNECE (1991) is used to calculate POCPs as the contribution to ozone formation at peak ozone concentration. The data are averages for three different trajectories in Europe. POCPs for 70 substances are presented. Applying the exemption fee for benzene on the POCPs for the same substances as shown in table 4.4 gives the result shown in table 4.5. For the full set of one-step weighting factors see appendix.

Table 4.5. One-step weighting factors for photo-oxidant formation based on photochemical ozone creation potentials (POCPs) from Heijungs et al. (1992) and on the exemption fee for high contents of benzene in petrol.

	Characterisation factor	One-step weighting factor (SKr/kg)	
Substance	POCP as average from three different trajectories in Europe	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene
ethane	0.082	4	43
propane	0.420	22	222
n-heptane	0.529	28	280
methanol	0.123	7	65
ethanol	0.268	14	142
acetone	0.178	9	94
methyyl-ethylketone	0.473	25	250
ethylacetate	0.218	12	115
acetylene	0.168	9	89
benzene	0.189	10	100
toluene	0.563	30	298
m-xylene	0.993	53	525
p-xylene	0.888	47	470
1,2,4-trimethylbenzene	1.200	63	635
formaldehyde	0.421	22	223
propionaldehyde	0.603	32	319

4.5 Acidification

For the characterisation of acidification a method suggested by Finnveden et al. (1992 cited in Lindfors et al. 1995) is used. The method is based on the amount of protons released in a terrestrial system. The method is intended primarily for terrestrial systems in Northern and Central Europe. As the acidifying effect of nitrogen compounds may vary with the composition of the soil, a minimum and a maximum scenario for those compounds are used. The characterisation factors, expressed as SO_2-equivalents, are combined with the 30 SKr/kg tax on sulphur and with the 40 SKr/kg fee on NO_x. This is shown in table 4.6.

It may be noted that using the NO_x fee gives one-step weighting factors that are about four times higher than those produced when the sulphur tax is used. This may indicate that account has been taken to that NO_x causes other problems besides acidification. For valuation of acidification the best option might be to use the one-step weighting factors derived from the sulphur tax.

Table 4.6. One-step weighting factors for acidification based on SO_2- equivalents from Finnveden et al. (1992) and the taxes on the sulphur content in fossil fuels and on NO_x emissions from stationary combustion plants.

	Min. scenario			Max. scenario		
	Characterisation factor	One-step weighting factor (SKr/kg)		Characterisation factor	One-step weighting factor (SKr/kg)	
Substance	SO_2-equivalents	based on 30 SKr/kg S	based on 40 SKr/kg NO_2	SO_2-equivalents	based on 30 SKr/kg S	based on 40 kr/kg NO_2
SO_2	1	15	0	1	15	57
HCl	0.88	13	0	0.88	13	50
NOx	0	0	0	0.7	10	40
NH_3	0	0	0	1.88	28	107

4.6 Eutrophication

For characterisation of eutrophication Finnveden et al (1992 cited in Lindfors et al. 1995) suggests a method where terrestrial eutrophication and aquatic eutrophication are separated into two different subcategories. For terrestrial eutrophication all emissions of nitrogen are aggregated, since nitrogen is the limiting nutrient for most terrestrial systems in Europe and North America. Using the fee on emissions of NO_x of 40 SKr/kg NO_2 gives a one-step weighting factor of 130 Skr/kg emitted nitrogen. It is then assumed that the fee is only intended for the nitrogen content in the nitrogen-oxides.

Aquatic eutrophication is measured as the amount of oxygen consumed when mineralising the organic material produced from the emitted nutrients. Different scenarios are developed depending on if the limiting nutrient of the system is nitrogen or phosphorous and if N-emissions to air are included or not (see table 4.7). In the table 4.8 the maximum scenario has been used for calculating the one-step weighting factors, but these weighting factors could easily be transferred to the other scenarios. The tax on nitrogen in fertilisers of 12 SKr/kg nitrogen leached, as well as the fee of 40 SKr/kg NO_2, are used for this calculation

Table 4.7. Oxygen consumption for releases of nutrients for different scenarios from Finnveden et al. (1992).

	N to air	P-limited	N-limited	N-limited + N to air	Maximun
Substance	g O_2/g	g O_2/g	g O_2/g	g O_2/g	g O_2/g
N to air	20	0	0	20	20
NO_x to air	6	0	0	6	6
NH_3	16	0	0	16	16
N to water	0	0	20	20	20
NO_3^- to water	0	0	4.4	4.4	4.4
NH_4^+ to water	0	0	15	15	15
P to water	0	140	0	0	140
PO_4^{3-}	0	46	0	0	46
C O D	0	1	1	1	1

Table 4.8. One-step weighting factors for aquatic eutrophication based on a maximum scenario for oxygen consumption from Finnveden et al. (1992) and the tax on nitrogen in fertiliser and the fee on NO_x emissions from stationary combustion plants.

	Characterisation factors	One-step weighting factor (SKr/kg)	
Substance	Maximum g O_2/g	based on 12 SKr/kg N to water	based on 40 SKr/kg NO_2 to air
N to air	20	12	130
NO_x to air	6	4	40
NH_3	16	9.6	110
N to water	20	12	130
NO_3^- to water	4.4	2.6	29
NH_4^+ to water	15	9	100
P to water	140	84	930
PO_4^{3-}	46	28	310
C O D	1	0.6	7

As for acidification, using the NO_x fee gives higher one-step weighting factors for eutrophication than the nitrogen tax does. Assuming that the NO_x fee is intended to abate other problems than eutrophication as well, and that the nitrogen tax is more specifically aimed to target eutrophication, this difference may be explained. This suggests that the one-step weighting factors derived from the nitrogen tax gives the more precise valuation of eutrophication .

4.7 Ecotoxicological effects

As mentioned before toxicological effects are difficult to assess. The toxicological effects depend on many things, such as the concentration of the substance that the organism is exposed to, and the route of exposure. There may also be different degrees of sensitivity towards the same substance among different organisms. Another thing determining the damage imposed by a chemical is its fate in the environment, i.e. how long it stays there before it is degraded, what the degradation products are and how it is transferred between different environmental compartments such as air, soil and water.

Analysing the effects of chemical substances releases requires a lot of data, which is often far from easily obtained. Out of the approximately ten million known substances, about 20 000 - 60 000 are in commercial use in the industrialised countries (Thunberg 1992). Even for the most commonly used chemicals many features determining their toxicological properties remain unknown.

Uniform System for the Evaluation of Substances

The Uniform System for the Evaluation of Substances (USES) is a computer model developed at the Dutch National Institute of Public Health and Environment (RIVM). USES is a multi-media model that has been designed for quantitative risk assessment of chemical substances. The version 1.0 of USES is used by Guinée et al. (1996) for computing characterisation factors for ecotoxicological effects. The characterisation of ecotoxicological effects is based on the predicted environmental concentration divided by a no adverse effect concentration. Characterisation factors for aquatic and terrestrial ecotoxicity are presented. A further development of this work, using the 2.0 version of USES is expected during the spring of 1999. While awaiting the results of these new efforts I choose not to use the old figures in my calculations.

Critical Surface-Time 95

Jolliet and Crettaz (1997) suggest a method for the characterisation of ecotoxicological effects within the Critical Surface-Time 95 methodology for life cycle impact assessment. The ecotoxicity potentials in this approach are based on the assumption that two emissions are equivalent if they generate their respective no effect concentration (NEC) during one year in the entire ecosystem considered. The effect is assumed to be linear both with concentration and polluted volume. Thus, a concentration of a pollutant of 0.5 mg/m^3 in a volume of 1000 m^3 is considered to have the same effect as a concentration of 1 mg/m^3 in a volume of 2000 m^3.

Fate and exposure are taken into account by the degradation, dilution, inter-media transfer and food chain/bioconcentration routes. The mean residence time of the substance in the medium per height of dilution is also considered.

For the aquatic ecotoxicity potentials (AEPs) the reference substance is zinc emitted to water. When determining the NEC, extrapolation factors of 100 is used if three LC_{50} are available (for algae, crustacean and fish) and of 1000 if less than three LC_{50} are available. Only surface fresh water is considered.

The reference substance for the terrestrial ecotoxicity potentials (TEPs) is zinc emitted to soil. The NECs are based on the LC_{50} of earth worms with an extrapolation factor of 1000. Where no data is available for earth worms, terrestrial ecotoxicity is extrapolated on the basis of the LC_{50} for Tubifex worms in water.

AEPs are presented for emissions of eight metals to water, soil and air and for emissions of oil, phenol, phosphate and BOD to water. In order to obtain one-step weighting factors, the AEPs for water emissions are combined with the 20 SKr/kg tax on pesticides for copper used as an anti fouling agent under boats. The AEPs for emissions to soil are combined with the 30 000 SKr/kg tax on cadmium in phosphor fertilisers. For emissions to air the AEPs are combined with the 180-350 SKr/kg fee on high contents of lead in petrol. The one-step weighting factors, along with the AEPs, are shown in tables 4.9-4.10.

Table 4.9 One-step weighting factors for aquatic ecotoxicity based on aquatic ecotoxicity potentials (AEPs) for emissions to water from Jolliet and Crettaz (1997) and the tax on the active substance in pesticides.

	Characterisastion factor	One-step weighting factor (SKr/kg)
Substance	AEP emission to water	based on 20 kr/kg copper
Oil	1.3E-01	5.0E-01
Phenol	1.5E+01	5.9E+01
Phosphate	1.0E-02	3.8E-02
B O D	1.3E-04	5.0E-04
Arsenic	5.2E-01	2.0E+00
Cadmium	5.2E+02	2.0E+03
Chromium	2.6E+00	1.0E+01
Copper	5.2E+00	2.0E+01
Lead	5.2E+00	2.0E+01
Mercury	1.3E+03	5.0E+03
Nickel	7.9E-01	3.0E+00
Zinc	1.0E+00	3.8E+00

Table 4.10. One-step weighting factors for aquatic ecotoxicity for metals released to soil and air. The aquatic ecotoxicity potentials (AEPs) for emissions to soil from Jolliet and Crettaz (1997) are combined with the tax on the cadmium content in phosphor fertiliser. Their AEPs for emissions to water are combined with the exemption fee for high levels of lead in petrol.

	Emission to soil		Emission to air		
	Characterisastion factor	One-step weighting factor (SKr/kg)	Characterisation factor	One-step weighting factor (SKr/kg)	
Substance	AEP	based on 30000 SKr/kg cadmium	AEP	based on 180 SKr/kg lead	based on 350 SKr/kg lead
Arsenic	2.4E-01	3.0E+01	7.8E-02	1.1E+01	2.1E+01
Cadmium	2.4E+02	3.0E+04	7.9E+01	1.1E+04	2.2E+04
Chromium	1.2E+00	1.5E+02	3.9E-01	5.5E+01	1.1E+02
Copper	2.0E+00	2.5E+02	6.6E-01	9.3E+01	1.8E+02
Lead	3.9E+00	4.9E+02	1.3E+00	1.8E+02	3.5E+02
Mercury	6.0E+02	7.5E+04	2.0E+02	2.8E+04	5.4E+04
Nickel	3.6E-01	4.5E+01	1.2E-01	1.7E+01	3.3E+01
Zinc	2.3E-01	2.9E+01	7.6E-02	1.1E+01	2.1E+01

TEPs for nine metals emitted to soil and air are presented. One-step weighting factors for soil emissions are gained by using the 30 000 SKr/kg tax on cadmium in phosphor fertilisers. For air emissions the TEPs are combined with the fee on high lead contents in petrol of 180-350 SKr/kg. The result is shown in table 4.11.

Table 4.11. One-step weighting factors for terrestrial ecotoxicity for metals released to soil and air. The terrestrial ecotoxicity potentials (TEPs) for emissions to soil from Jolliet and Crettaz (1997) are combined with the tax on the cadmium content in phosphor fertiliser. Their TEPs for emissions to water are combined with the exemption fee for high levels of lead in petrol.

	Emission to soil		Emission to air		
	Caracterisation factor	One-step weighting factor (SKr/kg)	Caracterisation factor	One-step weighting factor (SKr/kg)	
Substance	TEP	based on 30000 SKr/kg cadmium	TEP	based on 180 SKr/kg lead	based on 350 SKr/kg lead
Arsenic	2.3E+00	7.2E+03	7.5E-01	1.0E+03	2.0E+03
Cadmium	9.6E+00	3.0E+04	3.1E+00	4.3E+03	8.5E+03
Chromium	2.6E-01	8.1E+02	8.0E-02	1.1E+02	2.2E+02
Cobalt	2.6E-01	8.1E+02	8.0E-02	1.1E+02	2.2E+02
Copper	4.2E-01	1.3E+03	1.4E-01	1.9E+02	3.8E+02
Lead	4.1E-01	1.3E+03	1.3E-01	1.8E+02	3.5E+02
Mercury	1.8E+01	5.7E+04	5.9E+00	8.2E+03	1.6E+04
Nickel	1.1E+00	3.4E+03	3.5E-01	4.8E+02	9.4E+02
Zinc	1.0E+00	3.1E+03	3.3E-01	4.6E+02	8.9E+02

AEPs and TEPs are also given for around twenty pesticides applied on agricultural soil. Since all pesticides registered for use in Sweden are taxed with 20 SKr/kg active substance, it could be argued that all pesticides, within the range of toxicity of the registered pesticides, should be assigned the weight 20 SKr/kg. The more toxic substances could then be compared to the most toxic and pesticide registered in Sweden. Another approach could be to derive a maximum and a minimum value from combining the toxicity potentials with the 20 SKr/kg for the most toxic and the least toxic pesticide allowed. This is done in tables 4.12-4.13.

The tax on pesticides is a very blunt one, and the valuation in it is quite weak. Since there is a large span between the most toxic and the least toxic pesticide, the resulting one-step weighting factors differ a lot. For aquatic ecotoxicity the difference is eight orders of magnitude between the minimum and the maximum one-step weighting factors.

Table 4.12. One-step weighting factors for aquatic ecotoxicity from pesticides applied to the field. The one-step weighting factors are based on aquatic ecotoxicity potentials (AEPs) from Jolliet and Crettaz (1997) and on the tax on the active substance in pesticides. The tax is applied to the least and the most toxic pesticides approved for use in Sweden, thus producing minimum and maximum values for each pesticide. Note that all pesticides allowed for use in Sweden are in reality taxed with 20 SKr/kg.

	Caracterisation factor	One-step weighting factor (SKr/kg)	
Substance	AEP per kg pesticide applied to the field	based on 20 SKr/kg glufosinate	based on 20 SKr/kg cypermethrin
Atrazin	1.4E-01	1.2E+06	6.5E-02
Chloromequat	3.6E-05	3.1E+02	1.7E-05
Chlorothalonil	1.2E-02	1.0E+05	5.6E-03
Cypermethrin*	4.3E+01	3.7E+08	2.0E+01
Cyprocanazol	3.8E-02	3.3E+05	1.8E-02
Diflufenican*	9.9E-05	8.6E+02	4.6E-05
Diquat*	6.8E-03	5.9E+04	3.2E-03
D N O C (potatoes)	1.5E-01	1.3E+06	7.0E-02
Dinoseb (potatoes)	1.9E+00	1.7E+07	8.8E-01
Fenpiclonil*	5.9E-03	5.1E+04	2.7E-03
Fluroxipyr*	1.0E-03	8.7E+03	4.7E-04
Flusilazole	2.2E-03	1.9E+04	1.0E-03
Glufosinate* (potatoes)	2.3E-06	2.0E+01	1.1E-06
Glyphosate*	2.6E-04	2.3E+03	1.2E-04
Hexacanazole	5.9E-04	5.1E+03	2.7E-04
Ioxynil*	7.3E-04	6.3E+03	3.4E-04
Isoproturon*	1.2E-02	1.0E+05	5.6E-03
Lindane	2.7E-02	2.3E+05	1.3E-02
Mecoprop-P*	4.4E-05	3.8E+02	2.0E-05
Pirimcarb*	7.9E-04	6.9E+03	3.7E-04
Simazine	1.4E-02	1.2E+05	6.5E-03
Tebucanazole	1.5E-03	1.3E+04	7.0E-04
Trimexapac-ethyl*	4.6E-03	4.0E+04	2.1E-03

* Pesticides admitted for use in Sweden, taxed with 20 SKr/kg.

Table 4.13. One-step weighting factors for terrestrial ecotoxicity from pesticides applied to the field. The one-step weighting factors are based on terrestrial ecotoxicity potentials (TEPs) from Jolliet and Crettaz (1997) and on the tax on the active substance in pesticides. The tax is applied to the least and the most toxic pesticides admitted for use in Sweden, thus producing minimum and maximum values for each pesticide. Note that all pesticides admitted for use in Sweden are in reality taxed with 20 SKr/kg.

	Caracterisation factor	One-step weighting factor (SKr/kg)	
Substance	TEP per kg pesticide applied to the field	based on 20 SKr/kg glyphosate	based on 20 SKr/kg primicarb
Atrazin	3.1E-02	3.3E+04	2.4E+02
Carbendazim	2.0E-03	2.1E+03	1.5E+01
Chloromequat	1.1E-05	1.2E+01	8.5E-02
Chlorothalonil	3.5E-03	3.7E+03	2.7E+01
Cypermethrin*	5.2E-04	5.5E+02	4.0E+00
Cyprocanazol	9.2E-04	9.7E+02	7.1E+00
Diflufenican*	4.0E-04	4.2E+02	3.1E+00
D N O C (potatoes)	2.7E-03	2.8E+03	2.1E+01
Dinoseb (potatoes)	7.7E-04	8.1E+02	5.9E+00
Fenpiclonil*	1.0E-02	1.1E+04	7.7E+01
Fenpropidin	3.8E-04	4.0E+02	2.9E+00
Flusilazole	2.7E-03	2.8E+03	2.1E+01
Glufosinate* (potatoes)	3.9E-04	4.1E+02	3.0E+00
Glyphosate*	1.9E-05	2.0E+01	1.5E-01
Ioxynil*	1.9E-04	2.0E+02	1.5E+00
Isoproturon*	2.0E-05	2.1E+01	1.5E-01
Lindane	1.8E+00	1.9E+06	1.4E+04
Mecoprop-P*	1.8E-03	1.9E+03	1.4E+01
Pirimcarb*	2.6E-03	2.7E+03	2.0E+01
Tebucanazole	1.9E-04	2.0E+02	1.5E+00

* Pesticides admitted for use in Sweden, taxed with 20 SKr/kg.

4.8 Human health

The characterisation of human toxicological effects has a lot in common with the characterisation of ecotoxicological effects. However, in human toxicology the focus is on health effects on individuals and not on the survival or not of populations, as is the case within ecotoxicology.

Since there are no taxes applicable on non-toxicological effects on human health or on working-environment, they are not treated here.

Uniform System for the Evaluation of Substances

Using the USES model, mentioned above, equivalency factors for human toxicological effects can be achieved as well. Human toxicity potentials (HTPs) derived from the version 1.0 of USES are presented by Guinée et al (1996). The HTPs are based on a margin of safety, which is defined as the acceptable daily intake divided by the predicted daily intake. A further development of the HTPs is expected in the spring of 1999, and I choose not to use the old figures in my calculations.

Critical Surface-Time 95

CST 95 also provides a methodology for characterising human toxicological effects based on the same concept as for ecotoxicity (Jolliet and Crettaz 1997). The human toxicity potentials (HTP) are obtained by dividing the exposure efficiency of the pollutant, i.e. the fraction of the emission that is taken up by humans, by its reference dose, which is the currently accepted non-toxic dosage. The overall HTPs are calculated as the sum of the toxicity potential in the initial medium, the toxicity potential through transfer in food and the toxicity potential for all inter-media transfers. HTPs are calculated for emissions of 52 substances into indoor and outdoor air, water and soil, including subsequent intake by diet. The reference substance is lead in air, taking only the inhalation route of exposure into account.

In order to create one-step weighting factors, HTPs for emissions to outdoor air are combined with the exemption fees for high contents of benzene (10-100 SKr/kg) and lead (180-350 SKr/kg) in petrol (table 4.14). The one-step weighting factors based on benzene are five orders of magnitude larger than those based on lead. This is due to that the characterisation method judges lead much more dangerous than the same amount of benzene. Society through the fees on the other hand, assigns them almost the same weights.

Table 4.14. One-step weighting factors for human toxicity for emissions to outdoor air. They are based on human toxicity potentials (HTPs) from Jollier and Crettaz (1997) and on the exemption fees on high levels of benzene and lead in petrol.

	Characterisation factor	One-step weighting factor (SKr/kg)	
Substance	HTP emission to air	based on 100 SKr/kg benzene	based on 350 SKr/kg lead
Carbon monoxide	1.4E-04	1.2E+00	2.1E-05
Nitrogen oxide	2.0E-03	1.7E+01	3.0E-04
Sulfur dioxide	7.5E-03	6.3E+01	1.1E-03
Particles	7.5E-03	6.3E+01	1.1E-03
Formaldhyde	9.9E-03	8.3E+01	1.5E-03
Aldehyde	8.7E-03	7.3E+01	1.3E-03
Benzene	1.2E-02	1.0E+02	1.8E-03
Arsenic	9.0E+03	7.5E+07	1.4E+03
Cadmium	1.9E+04	1.6E+08	2.9E+03
Chromium	3.7E+03	3.1E+07	5.6E+02
Cobalt	1.3E+04	1.1E+08	2.0E+03
Copper	1.5E+02	1.2E+06	2.2E+01
Lead*	2.3E+03	1.9E+07	3.5E+02
Mercury	4.6E+04	3.8E+08	7.0E+03
Nickel	3.7E+02	3.1E+06	5.6E+01
Selenium	6.4E+04	5.3E+08	9.7E+03
Tin	9.0E+00	7.5E+04	1.4E+00
Zinc	2.7E+01	2.3E+05	4.1E+00

* If only the inhalation route of exposure is taken into account, the HTP is equal to

To build one-step weighting factors for water emissions the 20 SKr/kg tax on pesticides for copper as an anti-fouling agent on boats is used as shown in table 4.15.

Table 4.15. One-step weighting factors for human toxicity for emissions to water. They are based on human toxicity potentials (HTPs) from Jolliet and Crettaz (1997) and the tax on the active substance in pesticides for copper as an anti-fouling agent.

	Characterisation factor	One-step weighting factor (SKr/kg)
Substance	HTP emission to water	based on 20 SKr/kg copper
Flouride	4.5E-02	4.1E+01
Sulfide	2.1E+00	1.9E+03
Nitrate	8.5E-04	7.7E-01
Phosphate	3.2E-06	2.9E-03
Phenol	5.2E-02	4.7E+01
B O D	2.2E-02	2.0E+01
Arsenic	1.5E+00	1.4E+03
Cadmium	3.2E+00	2.9E+03
Chromium	6.2E-01	5.6E+02
Cobalt	2.2E+00	2.0E+03
Copper	2.2E-02	2.0E+01
Lead*	8.6E-01	7.8E+02
Mercury	7.8E+00	7.1E+03
Nickel	6.2E-02	5.6E+01
Selenium	1.1E+01	9.9E+03
Tin	1.5E-03	1.4E+00
Zinc	3.2E-03	2.9E+00

*If only the inhalation route of exposure is taken into account, the HTP is equal to 1.

For soil emissions of heavy metals, taken up by edible crops respective non-edible crops (e.g. biomass for energy production), the 30 000 SKr/kg tax on cadmium in phosphor fertiliser is used (table 4.16).

Table 4.16. One-step weighting factors for human toxicity for emissions to soil, taken up by non-edible crop and edible crop, respectively. The one-step weighting factors are based on human toxicity potentials (HTPs) from Jolliet and Crettaz (1997) and the tax on the cadmium content in phosphor fertiliser.

	Emission to soil			
	Characterisation factor	One-step weighting factor (SKr/kg)	Characterisation factor	One-step weighting factor (SKr/kg)
Substance	HTP non-edible crops	based on 30000 SKr/kg cadmium	HTP edible crops	based on 30000 SKr/kg cadmium
Arsenic	7.0E-01	1.4E+04	7.9E+04	1.5E+04
Cadmium	1.5E+00	3.0E+04	1.6E+05	3.0E+04
Chromium	2.9E-01	6.0E+03	3.2E+04	5.9E+03
Cobalt	1.0E+00	2.1E+04	1.1E+05	2.1E+04
Copper	9.0E-03	1.8E+02	1.3E+03	2.3E+02
Lead*	6.0E-01	1.2E+04	2.0E+04	3.7E+03
Mercury	3.6E+00	7.4E+04	4.0E+05	7.4E+04
Nickel	2.9E-02	6.0E+02	3.2E+03	5.9E+02
Selenium	5.0E+00	1.0E+05	5.6E+05	1.0E+05
Tin	7.0E-04	1.4E+01	7.8E+01	1.4E+01
Zinc	7.0E-04	1.4E+01	2.3E+02	4.3E+01

*If only the inhalation route of exposure is taken into account, the HTP is equal to 1.

Emissions of pesticides are in principle all worth 20 SKr/kg, according to the current taxes in Sweden. For the more toxic substances than those used in Sweden it is possible that the damage would be considered to be worth more than 20 SKr/kg. Among the substances for which HTPs are provided, diquat is the most toxic pesticide registered for use in Sweden. Using another approach minimum and maximum values could be derived instead by combining the highest and the lowest HTPs for pesticides registered in Sweden with 20 SKr/kg, as shown in table 4.17.

As mentioned earlier, the bluntness of the tax on pesticides causes the one-step weighting factors to differ greatly, depending on which pesticide they are based on.

Table 4.17. One-step weighting factors for human toxicity for emissions to agricultural soil, taken up by non-edible crops and edible crops, respectively. The one-step weighting factors are based on human toxicity potentials (HTPs) from Jolliet and Crettaz (1997) and the tax on the active substance in pesticides.

	Emission to agricultural soil					
	Characterisation factor	One-step weighting factor (SKr/kg)		Characterisation factor	One-step weighting factor (SKr/kg)	
Substance	HTP non-edible crop	based on 20 SKr/kg diquat	based on 20 SKr/kg fluroxypyr	HTP edible crop	based on 20 SKr/kg ioxynil	based on 20 SKr/kg glyphosate
Amitrole	3.4E-01	4.0E+03	1.2E+07	3.4E-01	1.3E+00	9.2E+03
Atrazin	2.9E-03	3.4E+01	1.0E+05	3.2E+00	1.3E+01	8.6E+04
Carbendazim	1.1E-03	1.3E+01	3.9E+04	1.1E+01	4.2E+01	2.9E+05
Chloromequat	2.0E-04	2.4E+00	7.0E+03	7.7E+00	3.0E+01	2.1E+05
Cholrothalonil	3.4E-03	4.0E+01	1.2E+05	5.9E+00	2.3E+01	1.6E+05
Chlorpyrifos	1.0E-03	1.2E+01	3.5E+04	1.0E-03	3.9E-03	2.7E+01
Cypermethrin*	2.0E-04	2.4E+00	7.0E+03	5.9E-02	2.3E-01	1.6E+03
Diflufenican*	1.7E-05	2.0E-01	6.0E+02	1.3E+00	5.1E+00	3.5E+04
Diquat*	1.7E-03	2.0E+01	6.0E+04	7.4E-02	2.9E-01	2.0E+03
D N O C	6.7E-03	7.9E+01	2.4E+05	4.7E-01	1.8E+00	1.3E+04
Dinoseb	6.8E-03	8.0E+01	2.4E+05	1.5E+00	5.9E+00	4.1E+04
Ethephon	9.8E-07	1.2E-02	3.4E+01	2.3E+00	9.0E+00	6.2E+04
Fenpiclonil*	7.9E-04	9.3E+00	2.8E+04	7.9E-04	3.1E-03	2.1E+01
Fluroxypyr*	5.7E-07	6.7E-03	2.0E+01	3.0E-01	1.2E+00	8.1E+03
Flusilazole	1.3E-02	1.5E+02	4.6E+05	4.5E+01	1.8E+02	1.2E+06
Glufosinate*	9.0E-06	1.1E-01	3.2E+02	1.7E+01	6.5E+01	4.5E+05
Glyphosate*	4.2E-05	4.9E-01	1.5E+03	7.4E-04	2.9E-03	2.0E+01
Hexacanazole	2.5E-04	2.9E+00	8.8E+03	4.7E+01	1.8E+02	1.3E+06
Ioxynil*	5.4E-06	6.4E-02	1.9E+02	5.1E+00	2.0E+01	1.4E+05
Isoproturon*	2.2E-05	2.6E-01	7.7E+02	1.4E+00	5.5E+00	3.8E+04
Lindane	1.4E-01	1.6E+03	4.9E+06	1.4E-01	5.5E-01	3.8E+03
Mecoprop-P*	4.9E-05	5.8E-01	1.7E+03	3.5E-01	1.4E+00	9.5E+03
Methiocarb	1.0E-02	1.2E+02	3.5E+05	1.0E-02	3.9E-02	2.7E+02
Paraquat	2.5E-03	2.9E+01	8.8E+04	2.5E-03	9.8E-03	6.8E+01
Pentachlorophenol	3.9E-03	4.6E+01	1.4E+05	3.9E-03	1.5E-02	1.1E+02
Pirmicarb*	5.4E-04	6.4E+00	1.9E+04	6.0E-01	2.4E+00	1.6E+04
Simazine	5.2E-03	6.1E+01	1.8E+05	1.2E+00	4.6E+00	3.2E+04
Tebucanozole	1.7E-06	2.0E-02	6.0E+01	1.8E-02	7.1E-02	4.9E+02

* Pesticides admitted for use in Sweden, taxes with 20 SKr/kg.

EDF's Toxicity Equivalence Potentials

The EDF (Environmental Defence Fund) is a non-profit organisation working in USA. They have developed a set of toxicity equivalence potentials (TEPs) for use in LCA (EDF 1999). The TEPs are derived using CalTOX, which is a multimedia fugacity model, to estimate the dose that an individual could receive after a unit amount of a chemical is released to air or water.

The CalTOX model predicts the concentrations of a chemical in the compartments air, plants, ground-surface soil, root zone soil, vadose zone soil, surface water and sediments, that result from a continuos release of a pollutant into a generic environment. Account is taken to transport and transformation processes that can affect the pollutant. The model combines this data with information on exposure pathways to estimate the total cumulative dose taken in by an individual. The region being modelled is the United States assumed as a closed control volume.

TEPs are presented for releases to air and water, separating between cancer effects and non-cancer effects. The reference substance for carcinogenic chemicals is pounds of benzene and for non-carcinogenic chemicals it is pounds of toluene. In order to make the TEPs usable in my calculations they are converted from pounds into kilograms.

TEPs for human cancer risks from releases to air are presented for 129 substances. For those substances one-step weighting factors are created by combining them with the exemption fees on high levels of benzene and lead in petrol, which are 10-100 SKr/kg emitted benzene and 180-350 SKr/kg emitted lead. The 20 SKr/kg tax on the active substance in pesticides for the weed-killer cyanazin is also used. Cyanazin is the only pesticide among the 129 substances admitted for use in Sweden. The results for a small selection of the substances can be seen in table 4.18, while the rest are listed in appendix.

Table 4.18. One-step weighting factors for human cancer risks from emissions to air, based on toxicity equivalence potentials (TEPs) from EDF (1999) and the exemption fees on high levels of benzene and lead in petrol and the tax on the active substance in pesticides.

	Characterisation factor	One-step weighting factor (SKr/kg)		
Substance	Cancer TEP emission to air	based on 100 SKr/kg benzene	based on 350 SKr/kg lead	based on 20 SKr/kg cyanazin
Alpha-lindane	2.8E+01	6.2E+03	1.4E+03	1.1E+02
Arsenic	2.1E+02	4.7E+04	1.1E+04	8.5E+02
Atrazine	2.1E-01	4.7E+01	1.1E+01	8.5E-01
Benzene	4.5E-01	1.0E+02	2.3E+01	1.8E+00
Cadmium	5.0E+01	1.1E+04	2.6E+03	2.0E+02
Chroumium	1.9E+01	4.1E+03	9.6E+02	7.4E+01
Cyanazine	5.0E+00	1.1E+03	2.6E+02	2.0E+01
D D T	1.1E+02	2.5E+04	5.8E+03	4.5E+02
Formaldehyde	1.4E-03	3.0E-01	7.0E-02	5.4E-03
Lead	6.8E+00	1.5E+03	3.5E+02	2.7E+01
Nickel	3.8E-01	8.4E+01	1.9E+01	1.5E+00
Vinylchoride	6.8E-01	1.5E+02	3.5E+01	2.7E+00

TEPs are given for 123 carcinogens emitted to water. Since there is no initial emission compartment for soil, I consider such emissions to be emitted to water. The only tax or fee that could be used for the calculation of one-step weighting factors is the tax on the active substance in pesticides of 20 SKr/kg for cyanazine. I am however unsure of if the applied pesticide should be considered to be emitted to air or to soil. The one-step weighting factors for a few of the 123 substances are shown in table 4.19, and the rest can be found in appendix.

Table 4.19. One-step weighting factors for human cancer risks from emissions to water, based on toxicity equivalency potentials (TEPs) from EDF (1999) and the tax on the active substance in pesticides for cyanazin.

	Characterisation factor	One-step weighting factor (SKr/kg)
Substance	Cancer TEP emission to water	based on 20 SKr/kg cyanazin
Alpha-lindane	1.3E+02	6.3E+02
Arsenic	4.3E+02	2.1E+03
Atrazine	5.9E-03	2.8E-02
Benzene	4.5E-01	2.2E+00
Cadmium	7.7E-01	3.7E+00
Cyanazine	4.2E+00	2.0E+01
D D T	7.7E+02	3.7E+03
Formaldehyde	1.3E-04	6.3E-04
Lead	5.9E+00	2.8E+01
Vinylchloride	2.3E+00	1.1E+01

TEPs for non-cancer toxicological effects are presented for 244 substances emitted to air. From these one-step weighting factors are created by combining them with the fees on high levels of benzene and lead in petrol of 10-100 SKr/kg benzene and 180-350 SKr/kg lead, respectively. It is difficult to say which of the pesticides included among the 244 substances that are emitted to air. Here I assume that all of them, except copper that is used as an anti-fouling agent under boats, are. One-step weighting factors are derived from using the 20 SKr/kg tax on pesticides for the least toxic and the most toxic pesticides admitted for use in Sweden, thus producing minimum and maximum values. The least toxic pesticide is malathion used against flea and lice on horses and cattle, and the most toxic one is diazinon used against vermin in outdoor cultivation (table 4.20).

Table 4.20. One-step weighting factors for non-cancer toxicological human health risks from substances emitted to air. They are based on toxicity equivalency potentials (TEPs) from EDF (1999) and the exemption fees on high levels of benzene and lead in petrol and the tax on the active substance in pesticides. One-step weighting factors derived from using the least and the most toxic pesticide admitted for use in Sweden are shown (copper as a pesticide is used as an anti-fouling agent under boats and is here assumed to be emitted to water only).

	Characterisation factor	One-step weighting factor (SKr/kg)			
Substance	Non-cancer TEP emission to air	based on 100 SKr/kg benzene	based on 350 SKr/kg lead	based on 20 SKr/kg diazinon	based on 20 SKr/kg malathion
Alpha-lindane	2.7E+01	3.5E+02	1.6E-02	3.9E-01	2.2E+03
Arsenic	2.5E+04	3.2E+05	1.5E+01	3.5E+02	2.0E+06
Atrazine	6.4E-01	8.2E+00	3.8E-04	9.1E-03	5.2E+01
Benzene	7.7E+00	1.0E+02	4.6E-03	1.1E-01	6.3E+02
Cadmium	1.4E+06	1.8E+07	8.1E+02	1.9E+04	1.1E+08
Chromium	1.0E+05	1.4E+06	6.2E+01	1.5E+03	8.5E+06
Copper*	3.0E+05	3.9E+06	1.8E+02	4.3E+03	2.5E+07
Cyanazine*	7.3E+01	9.4E+02	4.3E-02	1.0E+00	5.9E+03
D D T	7.3E+04	9.4E+05	4.3E+01	1.0E+03	5.9E+06
Diazinon*	1.4E+03	1.8E+04	8.1E-01	1.9E+01	1.1E+05
Formaldehyde	3.2E+00	4.1E+01	1.9E-03	4.5E-02	2.6E+02
Lead	5.9E+05	7.6E+06	3.5E+02	8.4E+03	4.8E+07
Malathion*	2.5E-01	3.2E+00	1.5E-04	3.5E-03	2.0E+01
Metribuzin*	7.3E+00	9.4E+01	4.3E-03	1.0E-01	5.9E+02
Nickel	4.3E+03	5.5E+04	2.5E+00	6.1E+01	3.5E+05
Vinylchloride	5.0E+01	6.5E+02	3.0E-02	7.1E-01	4.1E+03

* Pesticides admitted for use in Sweden, taxed with 20 SKr/kg.

For non-cancer risks from emissions to water TEPs for 242 substances are presented. One-step weighting factors are built from the 20 SKr/kg tax on the active substance in pesticides for the least and the most toxic pesticides. The least toxic pesticide is malathion used against lice and fleas on horses and cattle, and the most toxic is copper used as an anti-fouling agent under boats. One-step weighting factors are also derived from the tax of 30 000 SKr/kg cadmium in phosphor fertilisers (table 4.21).

Table 4.21. One-step weighting factors for non-cancer impacts on human health from substances emitted to water. They are based on toxicity equivalency factors (TEPs) from EDF (1999), the tax on the active substance in pesticides for copper and malathion and the tax on the cadmium content in phosphor fertilisers.

	Characterisation factor	One-step weighting factor (SKr/kg)		
Substance	Non-cancer TEP emission to water	based on 20 kr/kg copper	based on 20 SKr/kg malathion	based on 30 000 SKr/kg cadmium
Alpha-lindane	1.5E+02	9.6E-03	5.1E+02	2.8E+00
Arsenic	2.7E+04	1.7E+00	9.1E+04	4.9E+02
Atrazine	1.9E-02	1.2E-06	6.5E-02	3.5E-04
Benzene	5.0E+00	3.2E-04	1.7E+01	9.2E-02
Cadmium	1.6E+06	1.0E+02	5.5E+06	3.0E+04
Copper*	3.1E+05	2.0E+01	1.1E+06	5.8E+03
Cyanazine*	5.0E+01	3.2E-03	1.7E+02	9.2E-01
D D T	5.0E+05	3.2E+01	1.7E+06	9.2E+03
Diazinon*	1.1E+03	7.2E-02	3.8E+03	2.1E+01
Formaldehyde	3.0E-01	1.9E-05	1.0E+00	5.6E-03
Lead	2.5E+05	1.6E+01	8.6E+05	4.7E+03
Malathion*	5.9E+00	3.8E-04	2.0E+01	1.1E-01
Metribuzin*	7.7E+00	4.9E-04	2.6E+01	1.4E-01
Nickel	5.9E+03	3.8E-01	2.0E+04	1.1E+02
Vinyl chloride	2.6E+03	1.7E-01	8.9E+03	4.8E+01

* Pesticides admitted for use in, taxed with 20 SKr/kg.

5 Discussion

The valuation weighting method presented here is based on decisions taken by the Swedish parliament. This corresponds to the view that the people, represented by a democratically elected assembly, are the ones who should have the right to decide the priority between different environmental issues.

A characterising aspect of decisions of this kind is the great uncertainty connected to them (see e.g. Hansson 1996 for an extensive discussion). Since the object is our fundamental life support systems it is of utmost importance that the decisions made are sound, taking as many aspects and linkages into consideration as possible. Among the complexities that have to be dealt with is how the rights of future generations can be safeguarded. How can we judge what is a good environment according to their values? Another uncertainty lies in that it is difficult to assess the real consequences of a disturbance of the environment, since we have limited knowledge about the functioning of ecosystems. There may also be environmental threats that we do not know of yet.

If one doubts the ability of politicians to make well-informed decisions on such complicated topics, one might feel that experts would instead be preferred for the task. I will however not try to settle who is better suited for making this kinds of decisions than the other. Ideally perhaps, the politicians would be able to compile the advises given by experts and take balanced decisions based on that synthesis.

Even if one is in favour of the idea of democratically taken decisions, one could be doubtful to whether the democracy works satisfactory in reality. One issue is how well the people are being represented. But in spite of the shortcomings of democracy in practice, the Swedish parliament is by most people in the Swedish society perceived of as a legitimate body for taking decisions on behalf of the Swedish people. In this sense the parliament can be seen as a representative of the will of the people.

The next question that might be raised is if the taxes and fees can be taken to represent a valuation of the environment. To this question there is unfortunately no straight forward answer. The following discussion may shed some light on the pros and cons of making the assumption that it is possible to do so.

5.1 Valuation weighting factors

The concept of using environmental taxes and fees to represent the value of environmental and natural resources is adopted from the field of environmental economics, where this is a commonly used method. The values obtained from the taxes and fees are then fit in to the framework of LCA by assigning them into their corresponding impact categories.

It is important to remember that other instruments of public control, such as different rules and regulations, grants and information, are used in society besides taxes and fees. This means that the fact that an environmental impact lacks a tax or a fee does not necessarily imply that it is perceived to have no value. Most often a combination of several control instruments is used, and then the size of the tax or fee does not reveal the whole value, but could be regarded as a minimum value instead. According to Arrow et al. (1995) environmental legislation and market-based incentives to reduce environmental impacts often ignore international and intergenerational consequences. This too indicates that the taxes and fees may be to low.

For resources, a difficulty arises in that they already possess a market value. Thus, any attempt to control the behaviour on this market, by means of a tax, can be viewed as only a complement to the market forces.

The taxes on energy varies among different energy sources and applications. One of the reasons for this may be that a steering concerning other environmental impacts than pure energy consumption is aimed at. Since it is not energy consumption as such that constitutes a problem but rather how the energy is derived, this is not so strange. Apart from this some activities, such as industrial production, are being subsidised. Where subsidies of this kind are present it may be assumed that a weighting between the environmental impacts and the benefits from the activity being subsidised has already been done. This means that the value assigned to the environmental damage from the subsidised activity, through the tax put on it, can not automatically be transferred into other situations where the same environmental damage occurs. The best thing to do in these situations is probably to choose the unsubsidised tax for the valuation. In the case of the carbon-dioxide tax this would mean selecting the tax collected from households rather than the reduced tax collected from the industry.

Some of the taxes and fees address more than one environmental problem, and this creates an allocation problem when trying to divide them into impact categories. The most apparent case is the fee on nitrogen-oxides which applies to several impact categories. For these impact categories there are however other taxes and fees that can be used. The creation of one-step weighting factors shows that the nitrogen-oxide fee produces higher weighting factors than do the complementing taxes for these impact categories. In this case the way around the allocation may be to choose a tax with a more narrow scope, like the sulphur tax for acidification or the nitrogen tax for eutrophication.

For toxic substances the difficulty lies in allocating between ecotoxicological effects and effects on human health. For benzene an allocation may also have to be done to photo-oxidant formation, although using benzene for this impact category is questionable.

Another way of approaching the allocation problem is to look more in to the motives behind the taxes and fees, by examining the preparatory works that preceded the legislation. In this way it could be found out which environmental problems the legislator had in mind when introducing a tax or a fee. In addition this would probably reveal what social and economic considerations that has been taken, thus allowing subsidies to be identified. This would be topic for further research in the future development of this method.

Exemptions from taxes, taxes complementing market prices and the existence of other control instruments suggest that the values derived from taxes and fees may be to low, and there is also a risk that the values may get distorted. But they may still provide a coarse guidance, where the environmental taxes and fees can be seen as a minimum value of what the environment is worth. Probably they can indicate the relative weights assigned to different environmental functions, which is the most important feature for LCA-purposes.

All taxes and fees are not given in the same units of extraction from, or emissions to nature, that would have been preferable from an LCA point of view. The conversions that have been made in order to accomplish such uniform units may be a source of errors. This is especially true for the estimations of emissions of lead and benzene from petrol, but also for nitrogen leakage from fertilisers.

Using taxes and fees yields a fairly complete valuation method, where for most of the effect categories it is possible to get valuation factors from at least one tax or fee. There are also impact categories that completely lack corresponding taxes, and this is of course a weakness in the method. The land use, biodiversity and non-toxicological effects categories are known to be hard to assess within LCA, and they are presently not covered by this valuation method either.

The question is whether these impact categories should at all be included in LCA, given the considerable difficulty in finding good forms for doing so. On the one hand, their inclusion may just be sending out the wrong signals, implying that LCA is the all encompassing tool and that there is no need for any complementary environmental information. Since these impact categories are rarely considered in actual LCA-studies there is a risk that important issues are forgotten when the results are used. On the other hand it would be desirable if a more complete picture could be obtained through gathering all environmental information in the same place, within the LCA. This would require that better methods for assessing the problematic impact categories are developed. Perhaps it is not always possible to find quantitative methods for doing so. This might reveal a need for a new formalised procedure for handling qualitative information alongside with the quantitative one in LCA.

5.2 One-step weighting factors

The valuation weighting factors cover only a few substances, although important ones. In order to achieve a valuation of many more substances, these valuation factors may be combined with characterisation factors. The underlying assumption is that a contribution to an impact category is considered to be equally harmful independently of which substance that caused it. This seems logic and it is also common practice in the field of life cycle assessment.

A question that might be raised is however if it is legitimate to use the taxes in this way, since they were originally only intended for precisely those substances that they address. Before deciding the size of the tax, the benefit from the activity, causing for example an emission, has probably been assessed in relation to the impact from that emission. This would imply that a tax on one substance cannot automatically be translated into a valuation of another substance causing the same impact, or even to another activity producing the same emission. But since all exemptions from taxes are considered to be subsidies, as discussed above, this should not be a problem. A tax on the emission is an expression of the least that the society is willing to accept to let somebody emit the pollutant. The fact that some activities are granted an exemption from the tax does not affect the valuation.

Another conclusion would be that in a valuation method built on taxes, it is not only the environmental impacts that are taken into account, but also other economic aspects. Consequently the taxes and fees should then be considered as minimum values of what the environment is appreciated to be worth.

The uncertainty in the characterisation methods further complicates the matter. Suppose that the effects of the substance being taxed are rather well known. Aided by a characterisation method, the value derived from the tax is then transferred to a substance of less known effects. Provided that the characterisation method produces a faulty equivalency factor, this substance gets the wrong value. But the characterisation methods hopefully represent our best knowledge. So even if a tax was to be set on the less studied substance, it would probably be based on the same faulty information.

Some of the taxes and fees do however not appear to have been subjects to any such closer considerations as to which effects that they will have on the environmental problems concerned. An example of this is the tax on the active substance in pesticides, where no distinction is made, based on how toxic the pesticides are, affecting the size of the tax. Although some steering can be obtained by not admitting certain pesticides for use. Blunt taxes like this may lead to sub-optimisations. On the other hand, the scientific uncertainty that prevails in the toxicological field may suggest that non-specific taxes are advisable, since we do not really know the effects of toxic releases.

The one-step weighting factors presented in this study are only examples. Anyone who wishes to use this valuation method is encouraged to find the characterisation methods that are best suited for her studied system, since different characterisation methods cover slightly different scenarios and substances. In cases where more than one tax or fee is applicable the one that seems most appropriate for the situation at hand should be chosen. In situations where the best choices are less obvious the best option may be use different characterisation methods or taxes, from which maximum and minimum values can be derived instead.

This valuation method has been tested in a brief case-study on fuels for district heating, made by Åsa Moberg (1999). The studied fuels are *Salix*, forest residues, natural gas and wastes. From the study it can be concluded that the method is practical to use and gives reasonable results.

The valuation method developed here is flexible, in the sense that it can easily incorporate changed values expressed as altered, or new taxes. It can also be adjusted to reflect the values in another country by taking the taxes and fees existing there instead. In the future when there might be further harmonisation of the environmental taxes within the European Community, those taxes could be used to get values valid for all the member states.

5.3 Concluding remarks

The quantitative valuation of the environment and the availability of natural resources is a difficult task, and so far good methods for doing so are lacking (Finnveden 1999). Because of the value-dependent nature the problem, there will probably never be consensus on which one method to be preferred. The method presented here is an attempt to use a consequent approach in collecting the values, in that they are derived exclusively from taxes and fees. It should be seen as a basis for further development. As environmental taxes and fees gets more widely used, the method can get more complete. As in any other method currently available, there will always be imperfections in this mode of valuation, and it is up to anyone who needs to use a valuation method to decide if the assumptions made here are compatible with her/his world-view and ethical conviction.

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References

Arrow, K., Bolin, B., Costanza, R., Dasgupta, P., Folke, C., Holling, C. S., Jansson, B.-O., Levin, S., Mäler, K.-G., Perrings, C. and Piementel, D., 1995: Economic Growth, Carrying Capacity, and the Environment. *Science*, 269, 520-521.

Bernes, C., 1991: Spridning och läckage av växtnäring. *In: Sveriges Nationalatlas, Miljön*, pp. 70-73. Bokförlaget Bra Böcker, Höganäs, Sweden.

Boberg, H., (fi.registratorfinance.ministry.se) 17 Mar 1999: *Ang:* .E-mail to J. Johansson (johansson@fms.ecology.su se).

Boström, C.-E., 1992: Emissions and environmental effects of gasoline. *In: Hälsorisker med bensin*. *Rapport från minisymposium 12 november 1991 Solna*, Kemikalieinspektionen, Solna, Sweden. Rapport från Kemikalieinspektionen 6/92.

EDF (Environmental Defence Fund), 1999: *EDF's Risk Scoring System* (online), and connected pages. Bill_Pease@edf.org, New York.
Available from: http:/www.scorecard.org/env-releases/def/tep_gen.html
(Accessed 17 Jan 1999).

Energifakta, 1994: *Energiinnehåll och densitet för bränslen.* AB Svensk Energiförsörjning, Stockholm, Sweden.

Finnveden, G., Andersson-Sköld, Y., Samuelsson, M.-O., Zetterberg, L. and Lindfors, L.-G., 1992: Classification (Impact Analysis) in Connection with Life Cycle Assessments - A Preliminary Study. *In: Product Life Cycle Assessment.* 172-231.

Finnveden, G., 1996: *Valuation Methods within the Framework of Life Cycle Assessment.* IVL Rapport B1231, Stockholm, Sweden.

Finnveden, G., 1997: Valuation Methods Within LCA - Where are the Values? *The International Journal of Life Cycle Assessment*, 2 (3), 163-169.

Finnveden, G., and Östlund, P., 1997: Exergies of natural resources in life-cycle assessment and other applications. *Energy,* 22 (9), 923-931.

Finnveden, G., 1999: *A critical Review of Operational Valuation/Weighting Methods for Life Cycle Assessment.* Draft intended for AFN, the Swedish Waste Research Council, Swedish EPA.

Folke, C., Hammer, M., Costanza, R. and Jansson, A.M., 1994: Investing in natural capital - why, what, and how? *In:* A.M. Jansson, M. Hammer, C. Folke and R. Costanza, eds. *Investing in Natural Capital. The Ecological Economics Approach to Sustainability.* Island Press, Washington, USA.

Heijungs, R. Guinée, J. B., Huppes, G., Lankreijer, R. M., Udo de Haes, H. A., Wegener Sleeswijk, A., Ansems, A. M. M., Eggels, P. G., van Duin, R. and Goede, H. P., 1992: *Environmental Life Cycle Assessment of Products. Guide and Backgrounds*. October 1992. CML, Leiden University, Leiden, The Netherlands.

Gehrman, M. (maud.gehrman@riksdagen.se), 10 Feb 1999: Ang: valdeltagende. E-mail to J. Johansson (johansson@fms.ecology.su.se).

Goulder, L. H. and Kennedy, D., 1997: Valuing Ecosystem Services: Philosophical Bases and Empirical Methods. *In:* G. C. Daily, ed. *Nature's Services. Societal Dependence on Natural Ecosystems.* Island Press, Washington, USA.

Guinée, J. B. and Heijungs, R., 1995: A proposal for the definition of resource equivalency factors for use in product Life-Cycle Assessment. *In* J. B. Guinée, *Development of a methodology for environmental life-cycle assessment of products with a case study on margarines*. Thesis (PhD). Leiden University, The Netherlands.

Guinée, J. B., Heijungs, R., van Oers, L., van de Meent, D., Vermeire, T. and Rikken, M., 1996: *LCA impact assessment of toxic releases; Generic modelling of fate, exposure and effect for ecosystems and human beings with data for about 100 chemicals.* Product Policy 1996/21. Dutch Ministry of Housing, Spatial Planning and Environment, The Hague, The Netherlands.

Hansson, S. O., 1996: Decision making under great uncertainty. *Philosophy of the Social Sciences,* 26 (3), 369-387.

IPCC (Intergovernmental Panel on Climate Change), 1995: *Climate Change 1995; The Science of Climate Change.* Cambridge University Press.

ISO, 1997a: *Environmental management - Life cycle assessment - Principles and framework.* International Standard ISO 14040.

ISO, 1997b: *Environmental management - Life cycle assessment - Life cycle impact assessment.* Committee draft ISO/CD 14042.2.

Jolliet, O. and Crettaz, P., 1997: *Critical Surface-time 95; A life cycle impact assessment methodology including fate and exposure*. Swiss Federal Institute of Technology, Institute of Soil and Water Management, Lausanne, Switzerland.

KEMI (Kemikalieinspektionen) 1998: *Kemikalieinspektionens förteckning över bekämpningsmedel m.m. 1998.* Kemikalieinspektionen, Solna, Sweden.

KEMI (Kemikalieinspektionen) 1999: *Bekämpningsmedelsregistret* (online). Kemikalieinspektionen, Solna, Sweden. Avalilable from: http:www.kemi.se/default.cfm?page=bkmregoff/default.cfm (Accessed 21 Jan 1999).

Larsson, T., 1994: *Det svenska statsskicket.* 2nd ed. Studentlitteratur, Lund, Sweden.

Lindfors, L-G., Christiansen, K., Hoffman, L., Virtanen., Y., Juntilla, V., Hanssen, O. J., Rönning, A., Ekvall, T. and Finnveden, G., 1995: *Nordic Guidelines on Life-Cycle Assessment.* Nord 1995:20 Nordic Council of Ministers, Copenhagen, Denmark.

Moberg, Å., 1999: *Environmental systems analysis tools - differences and similarities; including a brief case study on heat production using Ecological footprint, MIPS, LCA and exergy analysis.* Thesis (MSc). Stockholm University, Sweden.

NV (Naturvårdsverket), 1997a: Report 4702, *Avgifter, skatter och bidrag med anknytning till miljövård*. Naturvårdsverket förlag, Stockholm, Sweden.

NV (Naturvårdsverket), 1997b: *Miljöskatter i Sverige - ekonomiska styrmedel i miljöpolitiken.* Naturvårdsverket förlag, Stockholm, Sweden.

Oskarsson, A., and Camner, P., 1983: Hälsoeffekter av bly i bensin: En litteraturöversikt. Statens naturvårdsverk, Solna, Sweden. SNV PM: 1661.

Press release from the Ministry of Finances 30 Apr 1998: *Regeringen anmäler förslag om avfallsskatt till kommissionen* (online). Available from: http:www.regeringen.se/databas/press-8939649.htm (Accessed 4 May 1998).

Prop. (Regeringens proposition) 1995/96:87: *Lag om skatt på naturgrus*.

Regeringskansliet, 1999: *Vägar till Hållbara Sverige* (online). Regeringskansliet, Stockholm, Sweden. Available from: http://www.hallbarasverige.gov.se/vagar_till/index.htm (Accessed 15 Feb 1999).

SFS (Svensk Författningssamling) 1984:409: *Lag om skatt på gödselmedel.*

SFS (Svensk Författningssamling) 1984:410: *Lag om skatt på bekämpningsmedel.*

SFS (Svensk Författningssamling) 1985:838: *Förordning om motorbensin.*

SFS (Svensk Författningssamling) 1990:613: *Lag om miljöavgift på utsläpp av kväveoxider vid energiproduktion.*

SFS (Svensk Författningssamling) 1994:1776: *Lag om skatt på energi.*

SFS (Svensk Författningssamling) 1995:636: *Förordning om ämnen som bryter ned ozonskiktet.*

SFS (Svensk Författningssamling) 1995:1667: *Lag om skatt på naturgrus.*

SNFS (Statens naturvårdsverks författningssamling) 1981:1: *Kungörelse om avgiftstaxa för dispens från bestämmelser om högsta bly- och bensenhalt i motorbensin.*

SOU, 1989: 83: *Ekonomiska styrmedel i Miljöpolitiken.* Allmänna förlaget, Stockholm, Sweden.

Sveriges Riksdag, 1998: *Kvinnor i riksdagen* (online). Sveriges Riksdag, Stockholm, Sweden. Available from: http://www.riksdagen.se/faktabl/f08_kvin.htm (Accessed 10 Feb 1999).

Szargut, J., Morris, D. R. and Steward, F. R., 1988: *Exergy Analysis of Thermal, Chemical and Metallurgical Processes.* Hemisphere Publishing Corporation, New York.

Thunberg, B., 1992: Kemikaliesamhället. *In:* B. Hubendick, ed. *Miljö från A till Ö; Svenska folkets miljölexikon.* Det Naturliga Steget, Bokförlaget Bra Böcker och Nationalencyklopedin, Höganäs, Sweden.

Turner, R. K., Pearce, D. and Bateman, I., 1994: *Environmental Economics. An elementary introduction,* Harvester Wheatshef, Hempstead, Great Britain.

Udo de Haes, H. A., 1996: Discussion of general principles and guidelines for practical use. *In:* H. A., Udo de Haes, ed. *Towards a Methodology for Life Cycle Impact Assessment.* Society of Environmental Toxicology and Chemistry - Europe, Brussels, Belgium.

UNECE, 1991: Protocol to the 1979 convention on long-range transboundary fluxes. ECE7EB.air/30. United Nations Economic Commission for Europe, Geneva, Switzerland.

UNEP Industry and Environment, 1996: *Life cycle assessment: what it is and how to do it.* United nations publication, Paris, France.

Westerholm, R., 1988: *A cryogradient sampling system for chemical analysis of polycyclic aromatic compounds (PAC). Studies from the gas phase-emitted PAC from automobiles.* Thesis (PhD). Stockholm University, Sweden.

Appendix

The calculation of one-step weighting factors

The one-step weighting factors are calculated according to the principle that an equally large contribution to an effect category has the same value independently of what the cause is, and whether there is a tax or fee on it or not. Thus, e.g. 56 carbon-dioxide equivalents are worth the same amount, no matter if they are caused from emissions of methane or carbon-dioxide. If the carbon-dioxide tax of 0.37 SKr/kg is used the value, in this example, would be:

$$56 \text{ kg } CO_2 * 0.37 \text{ SKr/kg } CO_2 = 21 \text{ SKr.}$$

In cases where the tax or fee used is not on the reference substance of the characterisation method, the calculations are made according to the following function:

$$A_a/B_a = X_x/Y_x,$$

where (A_a) is the valuation weighting factor for substance a and (B_a) is the characterisation factor for substance a. (X_x) represents the value of substance x, which is the one-step weighting factor searched for, and (Y_x) is the characterisation factor for substance x, given by the characterisation method.

Table A1. One-step weighting factors for abiotic resources based on characterisation factors from Finnveden and Östlund (1997) and the taxes on natural gravel and energy.

	Characterisation factor	One-step weighting factors (SKr/kg)		
Material	Exergy content e_{ch} (MJ/kg ore)	based on 0.005 SKr/kg natural gravel	based on 0 SKr/MJ energy (min)	based on 0.14 SKr/MJ energy (max)
Aluminium ore	1.10E+00	1.72E-02	0	1.54E-01
Chromium ore	5.10E-01	7.97E-03	0	7.14E-02
Copper ore, type 1	6.30E-01	9.84E-03	0	8.82E-02
Copper ore, type 2	7.90E+00	1.23E-01	0	1.11E+00
Gold ore	8.30E+00	1.30E-01	0	1.16E+00
Iron ore	4.20E-01	6.56E-03	0	5.88E-02
Lead ore	5.60E-01	8.75E-03	0	7.84E-02
Nickel ore	8.80E+00	1.38E-01	0	1.23E+00
Phosphorous ore	2.80E-01	4.38E-03	0	3.92E-02
Platinum ore	5.80E-01	9.06E-03	0	8.12E-02
Zinc ore	1.90E+00	2.97E-02	0	2.66E-01
Lime	3.40E-02	5.31E-04	0	4.76E-03
Rock (= Granite)	3.20E-01	5.00E-03	0	4.48E-02
Sand	3.20E-02	5.00E-04	0	4.48E-03

Table A2. One-step weighting factors for abiotic resources based on characterisation factors from Guinée and Heijungs (1995) and the taxes on energy for fuels.

	Characterisation factor	One-step weighting factor (SKr/kg)					
Resource	Abiotic Depletion Potential (ADP)	based on 0.88 SKr/kg oil	based on 2.54 SKr/ kg oil	based on 0.316 SKr/kg hard coal	based on 0.316 SKr/kg soft coal	based on 0.241 SKr/m^3 natural gas	based on 1.678 SKr/m^3 natural gas
Actinium[1]	6.33E+13	1.28E+14	3.69E+14	3.33E+15	2.35E+15	4.77E+13	3.32E+14
Aluminium	1.00E-08	2.02E-08	5.83E-08	5.27E-07	3.71E-07	7.53E-09	5.24E-08
Antimony	1.00E+00	2.02E+00	5.83E+00	5.27E+01	3.71E+01	7.53E-01	5.24E+00
Argon[1]	4.71E-07	9.51E-07	2.74E-06	2.48E-05	1.75E-05	3.55E-07	2.47E-06
Arsenic	9.17E-03	1.85E-02	5.34E-02	4.83E-01	3.41E-01	6.91E-03	4.81E-02
Barium[1]	1.06E-10	2.14E-10	6.18E-10	5.58E-09	3.94E-09	7.98E-11	5.56E-10
Beryllium	3.19E-05	6.44E-05	1.86E-04	1.68E-03	1.18E-03	2.40E-05	1.67E-04
Bismuth	7.31E-02	1.48E-01	4.26E-01	3.85E+00	2.71E+00	5.51E-02	3.83E-01
Boron	4.67E-03	9.43E-03	2.72E-02	2.46E-01	1.73E-01	3.52E-03	2.45E-02
Bromine	6.67E-03	1.35E-02	3.89E-02	3.51E-01	2.48E-01	5.02E-03	3.50E-02
Cadmium	3.30E-01	6.66E-01	1.92E+00	1.74E+01	1.23E+01	2.49E-01	1.73E+00
Calcium	7.08E-10	1.43E-09	4.12E-09	3.73E-08	2.63E-08	5.33E-10	3.71E-09
Cerium[1]	5.32E-09	1.07E-08	3.10E-08	2.80E-07	1.98E-07	4.01E-09	2.79E-08
Cesium[1]	1.91E-05	3.86E-05	1.11E-04	1.01E-03	7.09E-04	1.44E-05	1.00E-04
Chlorine	4.86E-08	9.81E-08	2.83E-07	2.56E-06	1.80E-06	3.66E-08	2.55E-07
Cobalt	2.62E-05	5.29E-05	1.53E-04	1.38E-03	9.73E-04	1.97E-05	1.37E-04
Copper	1.94E-03	3.92E-03	1.13E-02	1.02E-01	7.20E-02	1.46E-03	1.02E-02
Chromium	8.58E-04	1.73E-03	5.00E-03	4.52E-02	3.19E-02	6.46E-04	4.50E-03
Dysposium[1]	2.13E-06	4.30E-06	1.24E-05	1.12E-04	7.91E-05	1.60E-06	1.12E-05
Erbium[1]	2.44E-06	4.92E-06	1.42E-05	1.29E-04	9.06E-05	1.84E-06	1.28E-05
Europium[1]	1.33E-05	2.68E-05	7.75E-05	7.00E-04	4.94E-04	1.00E-05	6.97E-05
Flourine	2.96E-06	5.97E-06	1.72E-05	1.56E-04	1.10E-04	2.23E-06	1.55E-05
Gadolinium[1]	6.57E-07	1.33E-06	3.83E-06	3.46E-05	2.44E-05	4.95E-07	3.45E-06

Resource	Characterisation factor Abiotic Depletion Potential (ADP)	One-step weighting factor (SKr/kg) based on 0.88 SKr/kg oil	based on 2.54 SKr/ kg oil	based on 0.316 SKr/kg hard coal	based on 0.316 SKr/kg soft coal	based on 0.241 SKr/m^3 natural gas	based on 1.678 SKr/m^3 natural gas
Gallium	1.03E-07	2.08E-07	6.00E-07	5.42E-06	3.82E-06	7.76E-08	5.40E-07
Germanium	1.47E-06	2.97E-06	8.56E-06	7.74E-05	5.46E-05	1.11E-06	7.71E-06
Gold	8.95E+01	1.81E+02	5.21E+02	4.71E+03	3.32E+03	6.74E+01	4.69E+02
Hafnium[1]	8.37E-04	1.69E-03	4.87E-03	4.41E-02	3.11E-02	6.30E-04	4.39E-03
Helium	1.48E+02	2.99E+02	8.62E+02	7.79E+03	5.50E+03	1.11E+02	7.76E+02
Holmium[1]	1.33E-05	2.68E-05	7.75E-05	7.00E-04	4.94E-04	1.00E-05	6.97E-05
Indium	9.03E-03	1.82E-02	5.26E-02	4.76E-01	3.35E-01	6.80E-03	4.74E-02
Iodine	4.27E-02	8.62E-02	2.49E-01	2.25E+00	1.59E+00	3.22E-02	2.24E-01
Iridium[2]	3.23E+01	6.52E+01	1.88E+02	1.70E+03	1.20E+03	2.43E+01	1.69E+02
Iron	8.43E-08	1.70E-07	4.91E-07	4.44E-06	3.13E-06	6.35E-08	4.42E-07
Kalium	3.13E-08	6.32E-08	1.82E-07	1.65E-06	1.16E-06	2.36E-08	1.64E-07
Krypton[1]	2.09E+01	4.22E+01	1.22E+02	1.10E+03	7.76E+02	1.57E+01	1.10E+02
Lanthanum[1]	2.13E-08	4.30E-08	1.24E-07	1.12E-06	7.91E-07	1.60E-08	1.12E-07
Lithium	9.23E-06	1.86E-05	5.38E-05	4.86E-04	3.43E-04	6.95E-06	4.84E-05
Lead	1.35E-02	2.72E-02	7.86E-02	7.11E-01	5.01E-01	1.02E-02	7.08E-02
Luteium[1]	7.66E-06	1.55E-05	4.46E-05	4.03E-04	2.84E-04	5.77E-06	4.02E-05
Magnesium	3.73E-09	7.53E-09	2.17E-08	1.96E-07	1.39E-07	2.81E-09	1.96E-08
Manganese	1.38E-05	2.79E-05	8.04E-05	7.27E-04	5.12E-04	1.04E-05	7.24E-05
Mercury	4.95E-01	9.99E-01	2.88E+00	2.61E+01	1.84E+01	3.73E-01	2.60E+00
Molybdeneum	3.17E-02	6.40E-02	1.85E-01	1.67E+00	1.18E+00	2.39E-02	1.66E-01
Neodymium	1.94E-17	3.92E-17	1.13E-16	1.02E-15	7.20E-16	1.46E-17	1.02E-16
Neon[1]	3.25E-01	6.56E-01	1.89E+00	1.71E+01	1.21E+01	2.45E-01	1.70E+00
Nickel	1.08E-04	2.18E-04	6.29E-04	5.69E-03	4.01E-03	8.13E-05	5.66E-04
Niobium	2.31E-05	4.66E-05	1.35E-04	1.22E-03	8.58E-04	1.74E-05	1.21E-04
Osmium[2]	1.44E+01	2.91E+01	8.39E+01	7.58E+02	5.35E+02	1.08E+01	7.55E+01

Resource	Characterisation factor: Abiotic Depletion Potential (ADP)	One-step weighting factor (SKr/kg): based on 0.88 SKr/kg oil	based on 2.54 SKr/ kg oil	based on 0.316 SKr/kg hard coal	based on 0.316 SKr/kg soft coal	based on 0.241 SKr/m³ natural gas	based on 1.678 SKr/m³ natural gas
Palladium[2]	3.23E-01	6.52E-01	1.88E+00	1.70E+01	1.20E+01	2.43E-01	1.69E+00
Phosphorus	8.44E-05	1.70E-04	4.92E-04	4.45E-03	3.13E-03	6.36E-05	4.43E-04
Platinum[2]	1.29E+00	2.60E+00	7.52E+00	6.79E+01	4.79E+01	9.72E-01	6.76E+00
Plonium[1]	4.79E+14	9.67E+14	2.79E+15	2.52E+16	1.78E+16	3.61E+14	2.51E+15
Praseodymium[1]	2.85E-07	5.75E-07	1.66E-06	1.50E-05	1.06E-05	2.15E-07	1.49E-06
Protactinium[1]	9.77E+06	1.97E+07	5.69E+07	5.15E+08	3.63E+08	7.36E+06	5.12E+07
Radium[1]	2.36E+07	4.76E+07	1.37E+08	1.24E+09	8.76E+08	1.78E+07	1.24E+08
Radon[1]	1.20E+20	2.42E+20	6.99E+20	6.32E+21	4.46E+21	9.04E+19	6.29E+20
Rhenium	7.66E-01	1.55E+00	4.46E+00	4.03E+01	2.84E+01	5.77E-01	4.02E+00
Rhodium[2]	3.23E+01	6.52E+01	1.88E+02	1.70E+03	1.20E+03	2.43E+01	1.69E+02
Rubidium	2.36E-09	4.76E-09	1.37E-08	1.24E-07	8.76E-08	1.78E-09	1.24E-08
Ruthenium[2]	3.23E+01	6.52E+01	1.88E+02	1.70E+03	1.20E+03	2.43E+01	1.69E+02
Samarium[1]	5.32E-07	1.07E-06	3.10E-06	2.80E-05	1.98E-05	4.01E-07	2.79E-06
Scandium[1]	3.96E-08	7.99E-08	2.31E-07	2.09E-06	1.47E-06	2.98E-08	2.08E-07
Selenium	4.75E-01	9.59E-01	2.77E+00	2.50E+01	1.76E+01	3.58E-01	2.49E+00
Silicum	2.99E-11	6.03E-11	1.74E-10	1.57E-09	1.11E-09	2.25E-11	1.57E-10
Silver	1.84E+00	3.71E+00	1.07E+01	9.69E+01	6.83E+01	1.39E+00	9.65E+00
Sodium	8.24E-11	1.66E-10	4.80E-10	4.34E-09	3.06E-09	6.21E-11	4.32E-10
Strontium	1.12E-06	2.26E-06	6.52E-06	5.90E-05	4.16E-05	8.44E-07	5.87E-06
Sulfur	3.58E-04	7.23E-04	2.09E-03	1.89E-02	1.33E-02	2.70E-04	1.88E-03
Tantalum	6.77E-05	1.37E-04	3.94E-04	3.57E-03	2.51E-03	5.10E-05	3.55E-04
Tellurium	5.28E+01	1.07E+02	3.08E+02	2.78E+03	1.96E+03	3.98E+01	2.77E+02
Terbium[1]	2.36E-05	4.76E-05	1.37E-04	1.24E-03	8.76E-04	1.78E-05	1.24E-04
Thallium	5.05E-05	1.02E-04	2.94E-04	2.66E-03	1.88E-03	3.80E-05	2.65E-04

Resource	Characterisation factor Abiotic Depletion Potential (ADP)	One-step weighting factor (SKr/kg) based on 0.88 SKr/kg oil	based on 2.54 SKr/ kg oil	based on 0.316 SKr/kg hard coal	based on 0.316 SKr/kg soft coal	based on 0.241 SKr/m^3 natural gas	based on 1.678 SKr/m^3 natural gas
Thorium[1]	2.08E-07	4.20E-07	1.21E-06	1.10E-05	7.72E-06	1.57E-07	1.09E-06
Thulium[1]	8.31E-05	1.68E-04	4.84E-04	4.38E-03	3.09E-03	6.26E-05	4.36E-04
Tin	3.30E-02	6.66E-02	1.92E-01	1.74E+00	1.23E+00	2.49E-02	1.73E-01
Titanium[1]	4.40E-08	8.88E-08	2.56E-07	2.32E-06	1.63E-06	3.31E-08	2.31E-07
Tungsten	1.17E-02	2.36E-02	6.82E-02	6.16E-01	4.34E-01	8.81E-03	6.14E-02
Uranium	2.87E-03	5.79E-03	1.67E-02	1.51E-01	1.07E-01	2.16E-03	1.50E-02
Vanadium	1.16E-06	2.34E-06	6.76E-06	6.11E-05	4.31E-05	8.74E-07	6.08E-06
Xenon[1]	1.75E+04	3.53E+04	1.02E+05	9.22E+05	6.50E+05	1.32E+04	9.18E+04
Ytterbium[1]	2.13E-06	4.30E-06	1.24E-05	1.12E-04	7.91E-05	1.60E-06	1.12E-05
Yttrium	3.34E-07	6.74E-07	1.95E-06	1.76E-05	1.24E-05	2.52E-07	1.75E-06
Zinc	9.92E-04	2.00E-03	5.78E-03	5.22E-02	3.68E-02	7.47E-04	5.20E-03
Zirconium	1.86E-05	3.75E-05	1.08E-04	9.80E-04	6.91E-04	1.40E-05	9.75E-05
Crude oil[3]	4.36E-01	8.80E-01	2.54E+00	2.30E+01	1.62E+01	3.28E-01	2.29E+00
Natural gas[3, 4]	3.20E-01	6.46E-01	1.86E+00	1.69E+01	1.19E+01	7.53E-01	5.24E+00
Soft coal[3]	8.51E-03	1.72E-02	4.96E-02	4.48E-01	3.16E-01	6.41E-03	4.46E-02
Hard coal[3]	6.00E-03	1.21E-02	3.50E-02	3.16E-01	2.23E-01	4.52E-03	3.15E-02

[1] Because specific production data were lacking, it is assumed that the production is equal to the production of rhenium. As there is no solid basis for this assumption, the reliability of the resulting ADP is low (Guinée and Heijungs 1995).

[2] The production of platinum, palladium, rhodium, ruthenium, iridium and osmium are calculated as the sum of the production of these elements divided by six, since separate production data were not avalilable (Guinée and Heijungs 1995).

[3] Reserve data are given in PJ and converted to kg for coal and oil and to m^3 for gas by multiplication with their energy contens which is for oil equal to 41.87 MJ/kg, for hard coal 27.91 MJ/kg, for soft coal 13.97 MJ/kg for gas 38.84 MJ/m^3 (Guinée and Heijungs 1995).

[4] The ADP is given in kg/m^3.

Table A4. One-step weighting factors for photo-oxidant formation based on photochemical ozone creation potentials (POCP) for different scenarios from Finnveden et al. (1992) and the exemption fee for high contents of benzene in petrol.

	Maximal difference in concentration			Average ozone contribution in ordinary Swedish background during 0-4 days			Average ozone contribution in high NO_x background during 0-4 days		
	Characterisation factor	One-step weighting factor (SKr/kg)		Characterisation factor	One-step weighting factor (SKr/kg)		Characterisation factor	One-step weighting factor (SKr/kg)	
Compound	Photochemical ozone creation potential (POCP)	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	Photochemical ozone creation potential (POCP)	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	Photochemical ozone creation potential (POCP)	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene
ethane	0.173	5.46	55	0.126	0.31	31.3	0.121	3.81	38.1
propane	0.604	19.1	191	0.503	1.25	125	0.518	16.3	163
n-butane	0.554	17.5	175	0.467	1.16	116	0.485	15.3	153
i-butane	0.331	10.4	104	0.411	1.02	102	0.389	12.2	122
n-pentane	0.612	19.3	193	0.298	0.74	74.1	0.387	12.2	122
i-pentane	0.360	11.4	114	0.314	0.78	78.1	0.345	10.8	108
hexane	0.784	24.7	247	0.452	1.12	112	0.495	15.6	156
2-methylpentane	0.712	22.5	225	0.529	1.32	132	0.565	17.8	178
3-methylpentane	0.647	20.4	204	0.409	1.02	102	0.457	14.4	144
n-heptane	0.791	25.0	250	0.518	1.29	129	0.592	18.6	186
n-oktane	0.698	22.0	220	0.461	1.15	115	0.544	17.1	171
2-methylheptane	0.691	21.8	218	0.457	1.14	114	0.524	16.5	165
n-nonane	0.633	20.0	200	0.351	0.87	87.3	0.463	14.6	146
2-methyloktane	0.669	21.1	211	0.454	1.13	113	0.523	16.4	164
n-decane	0.719	22.7	227	0.422	1.05	105	0.509	16.0	160
2-methylnonane	0.719	22.7	227	0.423	1.05	105	0.498	15.7	157
n-undecane	0.662	20.9	209	0.386	0.96	96.0	0.476	15.0	150
n-dodecane	0.576	18.2	182	0.311	0.77	77.4	0.452	14.2	142
methylcyclohexane	0.403	12.7	127	0.386	0.96	96.0	0.392	12.3	123
ethene	1.000	31.5	315	1.000	2.49	249	1.000	31.4	314
propene	0.734	23.2	232	0.599	1.49	149	1.060	33.3	333
1-butene	0.799	25.2	252	0.495	1.23	123	0.983	30.9	309

	Maximal difference in concentration			Average ozone contribution in ordinary Swedish background during 0-4 days			Average ozone contribution in high NO_x background during 0-4 days		
	Characterisation factor	One-step weighting factor (SKr/kg)		Characterisation factor	One-step weighting factor (SKr/kg)		Characterisation factor	One-step weighting factor (SKr/kg)	
Compound	Photochemical ozone creation potential (POCP)	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	Photochemical ozone creation potential (POCP)	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	Photochemical ozone creation potential (POCP)	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene
2-butene	0.784	24.7	247	0.436	1.08	108	1.021	32.1	321
1-pentene	0.727	22.93	229.34	0.424	1.05	105.47	0.833	26.2	262
2-pentene	0.770	24.29	242.90	0.381	0.95	94.78	0.965	30.3	303
2-m-1-butene	0.691	21.80	217.98	0.181	0.45	45.02	0.717	22.5	225
2-m-2-butene	0.935	29.50	294.95	0.453	1.13	112.69	0.784	24.7	247
butylene	0.791	24.95	249.53	0.580	1.44	144.28	0.648	20.4	204
isoprene	0.532	16.78	167.82	0.583	1.45	145.02	0.768	24.2	242
acetylene	0.273	8.61	86.12	0.368	0.92	91.54	0.291	9.15	92
benzene	0.317	10.00	100.00	0.402	1.00	100.00	0.318	10.0	100
toluene	0.446	14.07	140.69	0.470	1.17	116.92	0.565	17.8	178
o-xylene	0.424	13.38	133.75	0.167	0.42	41.54	0.598	18.8	188
m-xylene	0.583	18.39	183.91	0.474	1.18	117.91	0.884	27.8	278
p-xylene	0.612	19.31	193.06	0.472	1.17	117.41	0.796	25.0	250
etylbenzene	0.532	16.78	167.82	0.504	1.25	125.37	0.621	19.5	195
1,2,3-trimethylbenzene	0.698	22.02	220.19	0.292	0.73	72.64	0.868	27.3	273
1,2,4-trimethylbenzene	0.683	21.55	215.46	0.330	0.82	82.09	0.938	29.5	295
1,3,5-trimethylbenzene	0.691	21.80	217.98	0.330	0.82	82.09	0.989	31.1	311
o-ethyltoluene	0.597	18.83	188.33	0.408	1.01	101.49	0.637	20.0	200
m-ethyltoluene	0.626	19.75	197.48	0.401	1.00	99.75	0.729	22.9	229
p-ethyltoluene	0.626	19.75	197.48	0.443	1.10	110.20	0.682	21.4	214
n-propylbenzene	0.511	16.12	161.20	0.454	1.13	112.94	0.531	16.7	167
i-propylbenzene	0.511	16.12	161.20	0.523	1.30	130.10	0.594	18.7	187

Compound	Maximal difference in concentration			Average ozone contribution in ordinary Swedish background during 0-4 days			Average ozone contribution in high NO_x background during 0-4 days		
	Characterisation factor	One-step weighting factor (SKr/kg)		Characterisation factor	One-step weighting factor (SKr/kg)		Characterisation factor	One-step weighting factor (SKr/kg)	
	Photochemical ozone creation potential (POCP)	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	Photochemical ozone creation potential (POCP)	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	Photochemical ozone creation potential (POCP)	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene
methanol	0.165	5.21	52.05	0.213	0.53	52.99	0.178	5.6	56
ethanol	0.446	14.07	140.69	0.225	0.56	55.97	0.317	9.97	100
i-propanol	0.173	5.46	54.57	0.203	0.50	50.50	0.188	5.91	59
butanol	0.655	20.7	207	0.214	0.53	53.2	0.404	12.7	127
i-butanol	0.388	12.2	122	0.255	0.63	63.4	0.290	9.12	91.2
but-2-diol	0.288	9.09	90.9	0.066	0.16	16.4	0.216	6.79	67.9
acetone	0.173	5.46	54.6	0.124	0.31	30.8	0.160	5.03	50.3
methyl ethyl ketone	0.388	12.2	122	0.178	0.44	44.3	0.346	10.9	109
methyl i-butyl ketone	0.676	21.3	213	0.318	0.79	79.1	0.666	20.9	209
formaldehyde	0.424	13.4	134	0.261	0.65	64.9	0.379	11.9	119
acetaldehyde	0.532	16.8	168	0.186	0.46	46.3	0.615	19.3	193
propionaldehyde	0.655	20.7	207	0.170	0.42	42.3	0.652	20.5	205
butyraldehyde	0.640	20.2	202	0.171	0.43	42.5	0.597	18.8	188
i-butyraldehyde	0.583	18.4	184	0.300	0.75	74.6	0.677	21.3	213
valeraldehyde	0.612	19.3	193	0.321	0.80	79.9	0.686	21.6	216
acroleine	1.201	37.9	379	0.823	2.05	205	0.827	26.0	260
methylene chloride	0.000	0.00	0.00	0.000	0.00	0.00	0.000	0.00	0.00
chloroform (CHCl3)	0.007	0.22	2.21	0.004	0.01	1.00	0.003	0.09	0.94
methyl chloroform (CH3CCl3)	0.007	0.22	2.21	0.002	0.00	0.50	0.001	0.03	0.31
trichloroethylene	0.086	2.71	27.1	0.111	0.28	27.6	0.091	2.86	28.6
tetrachloroethylene	0.014	0.44	4.42	0.014	0.03	3.48	0.010	0.31	3.14
allyl chloride (CH2CHCH2Cl)	0.561	17.7	177	0.483	1.20	120	0.677	21.3	213
dimethylester	0.058	1.83	18.3	0.067	0.17	16.7	0.046	1.45	14.5

	Maximal difference in concentration			Average ozone contribution in ordinary Swedish background during 0-4 days			Average ozone contribution in high NO_x background during 0-4 days		
	Characterisation factor	One-step weighting factor (SKr/kg)		Characterisation factor	One-step weighting factor (SKr/kg)		Characterisation factor	One-step weighting factor (SKr/kg)	
Compound	Photochemical ozone creation potential (POCP)	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	Photochemical ozone creation potential (POCP)	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	Photochemical ozone creation potential (POCP)	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene
dimethylether	0.288	9.09	91	0.343	0.85	85.3	0.286	8.99	89.9
propylene glycole methyl ether	0.770	24.3	243	0.491	1.22	122	0.497	15.6	156
propylene glycole methyl ether	0.309	9.75	97	0.157	0.391	39.1	0.143	4.50	44.97
ethyl acetate	0.295	9.31	93.1	0.294	0.731	73.1	0.286	8.99	89.9
n-butyl acetate	0.439	13.8	138	0.320	0.796	79.6	0.367	11.5	115
i-butylacetate	0.288	9.09	90.9	0.353	0.878	87.8	0.345	10.8	108
C O	0.036	1.14	11.4	0.040	0.100	10.0	0.032	1.01	10.1

Table A5. One-step weighting factors for photo-oxidant formation based on photochemical ozone creation potentials (POCP) from Heijungs et al. (1992) and the exemption fee for high contents of benzene in petrol.

	Average from three different trajectories in Europe		
	Characterisation factor	One-step weighting factor (SKr/kg)	
Substance	Photochemical ozone cereation potential (POCP)	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene
alkanes			
methane	0.007	0.37	3.70
ethane	0.082	4.34	43.39
propane	0.420	22.22	222.22
n-butane	0.410	21.69	216.93
i-butane	0.315	16.67	166.67
n-pentane	0.408	21.59	215.87
i-pentane	0.296	15.66	156.61
n-hexane	0.421	22.28	222.75
2-methylpentane	0.524	27.72	277.25
3-methylpentane	0.431	22.80	228.04
2,2-dimethylbutane	0.251	13.28	132.80
2,3-dimethylbutane	0.384	20.32	203.17
n-heptane	0.529	27.99	279.89
2-methylhexane	0.492	26.03	260.32
3-methylhexane	0.492	26.03	260.32
n-octane	0.493	26.08	260.85
2-methylheptane	0.469	24.81	248.15
n-nonane	0.469	24.81	248.15
2-methyloctane	0.505	26.72	267.20
n-decane	0.464	24.55	245.50
2-methylnonane	0.448	23.70	237.04
n-undecane	0.436	23.07	230.69
n-duodecane	0.412	21.80	217.99
alkanes (average)	0.398	21.06	210.58
halogenated hydrocarbons			
methylenechloride	0.010	0.53	5.29
methylchloroform	0.001	0.05	0.53
trichloroethylene	0.066	3.49	34.92
tetrachloroethylene	0.005	0.26	2.65
halogenated hydrocarbons (averag	0.021	1.11	11.11
alcohols			
methanol	0.123	6.51	65.08
ethanol	0.268	14.18	141.80
alcohols (average)	0.196	10.37	103.70

Substance	Characterisation factor: Photochemical ozone cereation potential (POCP)	One-step weighting factor (SKr/kg): based on 10 SKr/kg benzene	One-step weighting factor (SKr/kg): based on 100 SKr/kg benzene
	Average from three different trajectories in Europe		
acetone	0.178	9.42	94.18
methyyl-ethylketone	0.473	25.03	250.26
ketones (average)	0.326	17.25	172.49
esters			
methylacetate	0.025	1.32	13.23
ethylacetate	0.218	11.53	115.34
i-propylacetate	0.215	11.38	113.76
n-butylacetate	0.323	17.09	170.90
i-butylacetate	0.332	17.57	175.66
esters (average)	0.223	11.80	117.99
olefins			
ethylene	1.000	52.91	529.10
propylene	1.030	54.50	544.97
1-butene	0.959	50.74	507.41
2-butene	0.992	52.49	524.87
1-pentene	1.059	56.03	560.32
2-pentene	0.930	49.21	492.06
2-methyl-1-butene	0.777	41.11	411.11
2-methyl-2-butene	0.779	41.22	412.17
3-metyl-1-butene	0.895	47.35	473.54
isobutene	0.634	33.54	335.45
olefins (average)	0.906	47.94	479.37
acetylenes			
acetylene	0.168	8.89	88.89
aromatics			
benzene	0.189	10.00	100.00
toluene	0.563	29.79	297.88
o-xylene	0.666	35.24	352.38
m-xylene	0.993	52.54	525.40
p-xylene	0.888	46.98	469.84
ethylbenzene	0.593	31.38	313.76
1,2,3-trimethylbenzene	1.170	61.90	619.05
1,2,4-trimethylbenzene	1.200	63.49	634.92
1,3,5-trimethylbenzene	1.150	60.85	608.47
o-ethyltoluene	0.668	35.34	353.44
m-ethyltoluene	0.794	42.01	420.11

	Average from three different trajectories in Europe		
	Characterisation factor	One-step weighting factor (SKr/kg)	
Substance	Photochemical cereation potential (POCP)	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene
n-propylbenzene	0.492	26.03	260.32
i-propylbenzene	0.565	29.89	298.94
aromatics (average)	0.761	40.26	402.65
aldehydes			
formaldehyde	0.421	22.28	222.75
acetaldehyde	0.527	27.88	278.84
propionaldehyde	0.603	31.90	319.05
butyraldehyde	0.568	30.05	300.53
i-butyraldehyde	0.631	33.39	333.86
valeraldehyde	0.686	36.30	362.96
benzaldehyde	-0.334	-17.67	-176.72
aldehydes (average)	0.443	23.44	234.39
hydrocarbons (average)	0.337	17.83	178.31
non-methane hydrocarbons (averag	0.416	22.01	220.11

Table A6. One-step weighting factors for acidification based on SO_2-equivalents from Finnveden et al. (1992) and the tax on the sulphur content in fossil fuels and the fee on emissions of NO_x from stationary combustion plants.

	min scenario			max scenario		
	Characterisation factor	One-step weighting factor (SKr/kg)		Characterisation factor	One-step weighting factor (SKr/kg)	
Substance	SO_2-equivalents	based on 30 SKr/kg sulphur	based on 40 SKr/kg NO_2	SO_2-equivalents	based on 30 SKr/kg sulphur	based on 40 kr/kg NO_2
SO_2	1	15	0	1	15	57
HCl	0.88	13	0	0.88	13	50
NO_x	0	0	0	0.7	10	40
NH_3	0	0	0	1.88	28	107

Table A7. One-step weighting factors for aquatic eutrophication based on a maximum scenario for oxygen consumption from Finnveden et al. (1992) and the tax on nitrogen in fertiliser and the fee on NO_x emitted from stationary combustion plants.

	Characterisation factors	One-step weighting factor (SKr/kg)	
Substance	Maximum g O_2/g	based on 12 SKr/kg N to water	based on 40 SKr/kg NO_2 to air
N to air	20	12	130
NO_x to air	6	4	40
NH_3	16	9.6	110
N to water	20	12	130
NO_3^- to water	4.4	2.6	29
NH_4^+ to water	15	9	100
P to water	140	84	930
PO_4^{3-}	46	28	310
C O D	1	0.6	7

Table A15. One-step weighting factors for human cancer risk from emissions to air, based on toxicity equivalence potentialas (TEP) from EDF (1999) and the exemption fees on high levels of benzene and lead in petrol and the tax on the active substance in pesticides.

		Characteristion factor	One-step weighting factor (SKr/kg)				
Substance	CAS or EDF Substance ID	Cancer TEP emission to air	based on 10 SKr/kg benzene	100 SKr/kg benzene	based on 180 SKr/kg lead	based on 350 SKr/kg lead	based on 20 SKr/kg cyanazin
1,1,1,2-TETRACHLOROETHANE	630-20-6	3.3E+00	7.3E+01	7.3E+02	8.7E+01	1.7E+02	1.3E+01
1,1,2,2-TETRACHLOROETHANE	79-34-5	1.0E+01	2.2E+02	2.2E+03	2.6E+02	5.1E+02	4.0E+01
1,1,2-TRICHLOROETHANE	79-00-5	2.5E+00	5.5E+01	5.5E+02	6.6E+01	1.3E+02	1.0E+01
1,1-DICHLOROETHANE	75-34-3	2.5E-01	5.5E+00	5.5E+01	6.6E+00	1.3E+01	1.0E+00
1,1-DICHLOROETHYLENE	75-35-4	9.1E-01	2.0E+01	2.0E+02	2.4E+01	4.7E+01	3.6E+00
1,1-DIMETHYL HYDRAZINE	57-14-7	1.6E-01	3.6E+00	3.6E+01	4.3E+00	8.4E+00	6.5E-01
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	67562-39-4	2.6E+07	5.8E+08	5.8E+09	6.9E+08	1.3E+09	1.0E+08
1,2,3-TRICHLOROPROPANE	96-18-4	7.7E+01	1.7E+03	1.7E+04	2.0E+03	4.0E+03	3.1E+02
1,2,5,6-DIBENZATHRACENE	53-70-3	6.8E+04	1.5E+06	1.5E+07	1.8E+06	3.5E+06	2.7E+05
1,2-BENZANTHRACENE	56-55-3	2.5E+01	5.5E+02	5.5E+03	6.6E+02	1.3E+03	1.0E+02
1,2-BENZPHENANTHRACENE	218-01-9	1.5E+01	3.4E+02	3.4E+03	4.1E+02	7.9E+02	6.2E+01
1,2-DIBROMOETHANE	106-93-4	3.8E+00	8.5E+01	8.5E+02	1.0E+02	2.0E+02	1.5E+01
1,2-DICHLOROETHANE	107-06-2	2.4E+00	5.3E+01	5.3E+02	6.4E+01	1.2E+02	9.6E+00
1,2-DICHLOROPROPANE	78-87-5	7.3E-01	1.6E+01	1.6E+02	1.9E+01	3.7E+01	2.9E+00
1,2-DIPHENYLHYDRAZINE	122-66-7	5.0E-01	1.1E+01	1.1E+02	1.3E+01	2.6E+01	2.0E+00
1,3-BUTADIENE	106-99-0	1.5E-01	3.3E+00	3.3E+01	4.0E+00	7.7E+00	6.0E-01
1,3-DICHLOROPROPENE (MIXED ISOMERS)	542-75-6	7.7E-02	1.7E+00	1.7E+01	2.0E+00	4.0E+00	3.1E-01
1,4-DICHLOROBENZENE	106-46-7	1.2E+00	2.6E+01	2.6E+02	3.1E+01	6.1E+01	4.7E+00
1,4-DIOXANE	123-91-1	1.5E-02	3.2E-01	3.2E+00	3.8E-01	7.5E-01	5.8E-02
2,3,4,7,8-PENTACHLORODIBENZOFURAN	57117-31-4	5.9E+07	1.3E+09	1.3E+10	1.6E+09	3.0E+09	2.4E+08
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN (TCDD)	1746-01-6	1.7E+08	3.7E+09	3.7E+10	4.4E+09	8.6E+09	6.7E+08
2,3,7,8-TETRACHLORODIBENZOFURAN	51207-31-9	2.5E+06	5.6E+07	5.6E+08	6.7E+07	1.3E+08	1.0E+07
2,4,6-TRICHLOROPHENOL	88-06-2	1.4E+00	3.0E+01	3.0E+02	3.6E+01	7.0E+01	5.4E+00
2,4,6-TRINITROTOLUENE	118-96-7	5.0E-03	1.1E-01	1.1E+00	1.3E-01	2.6E-01	2.0E-02

Substance	CAS or EDF Substance ID	Characteristion factor Cancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	100 SKr/kg benzene	based on 180 SKr/kg lead	based on 350 SKr/kg lead	based on 20 SKr/kg cyanazin
2,4-D	94-75-7	2.5E-03	5.6E-02	5.6E-01	6.7E-02	1.3E-01	1.0E-02
2,4-DIAMINOTOLUENE	95-80-7	6.4E-02	1.4E+00	1.4E+01	1.7E+00	3.3E+00	2.5E-01
2,4-DINITROTOLUENE	121-14-2	1.1E+00	2.4E+01	2.4E+02	2.9E+01	5.6E+01	4.4E+00
2,6-DINITROTOLUENE	606-20-2	1.8E+00	3.9E+01	3.9E+02	4.7E+01	9.1E+01	7.1E+00
2-AMINONAPHTHALENE	91-59-8	3.3E-01	7.4E+00	7.4E+01	8.8E+00	1.7E+01	1.3E+00
2-NITROPROPANE	79-46-9	2.7E+00	6.1E+01	6.1E+02	7.2E+01	1.4E+02	1.1E+01
2-PHENYLPHENOL	90-43-7	1.3E-05	2.9E-04	2.9E-03	3.5E-04	6.8E-04	5.3E-05
3,3'-DICHLOROBENZIDINE	91-94-1	1.1E+00	2.4E+01	2.4E+02	2.9E+01	5.6E+01	4.4E+00
3,4-BENZO-PYRENE	50-32-8	3.8E+03	8.4E+04	8.4E+05	1.0E+05	1.9E+05	1.5E+04
3,4-BENZOFLUORANTHENE	205-99-2	2.5E+02	5.6E+03	5.6E+04	6.7E+03	1.3E+04	1.0E+03
3,5,5-TRIMETHYL-2-CYCLOHEXENE-1-ONE	78-59-1	5.9E-05	1.3E-03	1.3E-02	1.6E-03	3.0E-03	2.4E-04
4,4'-METHYLENEDIANILINE	101-77-9	2.6E-02	5.8E-01	5.8E+00	6.9E-01	1.3E+00	1.0E-01
4-AMINOBIPHENYL	92-67-1	9.5E-01	2.1E+01	2.1E+02	2.5E+01	4.9E+01	3.8E+00
ACETALDEHYDE	75-07-0	1.6E-03	3.5E-02	3.5E-01	4.2E-02	8.2E-02	6.4E-03
ACETAMIDE	60-35-5	1.3E-02	2.9E-01	2.9E+00	3.5E-01	6.8E-01	5.3E-02
ACRYLAMIDE	79-06-1	1.0E+00	2.2E+01	2.2E+02	2.6E+01	5.1E+01	4.0E+00
ACRYLONITRILE	107-13-1	8.2E-01	1.8E+01	1.8E+02	2.2E+01	4.2E+01	3.3E+00
ALDRIN	309-00-2	1.5E+04	3.2E+05	3.2E+06	3.8E+05	7.5E+05	5.8E+04
ALLYL CHLORIDE	107-05-1	3.7E-03	8.2E-02	8.2E-01	9.7E-02	1.9E-01	1.5E-02
ALPHA-LINDANE	319-84-6	2.8E+01	6.2E+02	6.2E+03	7.3E+02	1.4E+03	1.1E+02
ANILINE	62-53-3	1.0E-03	2.3E-02	2.3E-01	2.8E-02	5.4E-02	4.2E-03
ARSENIC	7440-38-2	2.1E+02	4.7E+03	4.7E+04	5.6E+03	1.1E+04	8.5E+02
ARSENIC (ORGANIC OR INORGANIC COMPOUNDS)	ARF750	2.1E+02	4.7E+03	4.7E+04	5.6E+03	1.1E+04	8.5E+02
ATRAZINE	1912-24-9	2.1E-01	4.7E+00	4.7E+01	5.6E+00	1.1E+01	8.5E-01
BENZENE	71-43-2	4.5E-01	1.0E+01	1.0E+02	1.2E+01	2.3E+01	1.8E+00
BENZIDINE	92-87-5	8.2E+01	1.8E+03	1.8E+04	2.2E+03	4.2E+03	3.3E+02
BENZOIC TRICHLORIDE	98-07-7	1.3E+02	2.8E+03	2.8E+04	3.4E+03	6.5E+03	5.1E+02

		Characteristion factor	One-step weighting factor (SKr/kg)				
Substance	CAS or EDF Substance ID	Cancer TEP emission to air	based on 10 SKr/kg benzene	100 SKr/kg benzene	based on 180 SKr/kg lead	based on 350 SKr/kg lead	based on 20 SKr/kg cyanazin
BENZYL CHLORIDE	100-44-7	2.2E-01	4.8E+00	4.8E+01	5.8E+00	1.1E+01	8.7E-01
BERYLLIUM	7440-41-7	3.0E+00	6.8E+01	6.8E+02	8.1E+01	1.6E+02	1.2E+01
BERYLLIUM COMPOUNDS	BFQ500	3.0E+00	6.8E+01	6.8E+02	8.1E+01	1.6E+02	1.2E+01
BETA-LINDANE	319-85-7	8.2E+01	1.8E+03	1.8E+04	2.2E+03	4.2E+03	3.3E+02
BIS(2-CHLORO-1-METHYLETHYL) ETHER	108-60-1	1.0E-02	2.2E-01	2.2E+00	2.6E-01	5.1E-01	4.0E-02
BIS(2-CHLOROETHYL) ETHER	111-44-4	4.5E+00	1.0E+02	1.0E+03	1.2E+02	2.3E+02	1.8E+01
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	2.0E-01	4.4E+00	4.4E+01	5.3E+00	1.0E+01	8.0E-01
BROMOXYNIL	1689-84-5	1.6E+02	3.5E+03	3.5E+04	4.2E+03	8.2E+03	6.4E+02
CADMIUM	7440-43-9	5.0E+01	1.1E+03	1.1E+04	1.3E+03	2.6E+03	2.0E+02
CADMIUM COMPOUNDS	CAE750	5.0E+01	1.1E+03	1.1E+04	1.3E+03	2.6E+03	2.0E+02
CAMPHECHLOR	8001-35-2	3.8E+01	8.4E+02	8.4E+03	1.0E+03	1.9E+03	1.5E+02
CAPTAN	133-06-2	5.0E-04	1.1E-02	1.1E-01	1.3E-02	2.6E-02	2.0E-03
CARBARYL	63-25-2	1.2E-04	2.7E-03	2.7E-02	3.2E-03	6.3E-03	4.9E-04
CARBAZOLE	86-74-8	6.4E+01	1.4E+03	1.4E+04	1.7E+03	3.3E+03	2.5E+02
CARBON TETRACHLORIDE	56-23-5	4.1E+02	9.1E+03	9.1E+04	1.1E+04	2.1E+04	1.6E+03
CATECHOL	120-80-9	1.4E-03	3.1E-02	3.1E-01	3.7E-02	7.2E-02	5.6E-03
CHLORDANE	57-74-9	2.6E+02	5.8E+03	5.8E+04	6.9E+03	1.3E+04	1.0E+03
CHLORODIBROMOMETHANE	124-48-1	1.7E+01	3.8E+02	3.8E+03	4.6E+02	8.9E+02	6.9E+01
CHLOROFORM	67-66-3	2.1E+00	4.6E+01	4.6E+02	5.5E+01	1.1E+02	8.4E+00
CHLOROMETHANE	74-87-3	1.6E+00	3.6E+01	3.6E+02	4.3E+01	8.4E+01	6.5E+00
CHLOROMETHYL METHYL ETHER	107-30-2	3.2E+00	7.1E+01	7.1E+02	8.4E+01	1.6E+02	1.3E+01
CHROMIUM	7440-47-3	1.9E+01	4.1E+02	4.1E+03	4.9E+02	9.6E+02	7.4E+01
CHROMIUM COMPOUNDS	CMJ500	1.9E+01	4.1E+02	4.1E+03	4.9E+02	9.6E+02	7.4E+01
CROTONALDEHYDE, (E)-	123-73-9	3.0E-01	6.8E+00	6.8E+01	8.1E+00	1.6E+01	1.2E+00
CYANAZINE	21725-46-2	5.0E+00	1.1E+02	1.1E+03	1.3E+02	2.6E+02	2.0E+01
DDD	72-54-8	3.7E+02	8.2E+03	8.2E+04	9.7E+03	1.9E+04	1.5E+03

Substance	CAS or EDF Substance ID	Characteristion factor Cancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	100 SKr/kg benzene	based on 180 SKr/kg lead	based on 350 SKr/kg lead	based on 20 SKr/kg cyanazin
DDE	72-55-9	3.4E+02	7.5E+03	7.5E+04	8.9E+03	1.7E+04	1.3E+03
DDT	50-29-3	1.1E+02	2.5E+03	2.5E+04	3.0E+03	5.8E+03	4.5E+02
DICHLOROBROMOMETHANE	75-27-4	6.4E+01	1.4E+03	1.4E+04	1.7E+03	3.3E+03	2.5E+02
DICHLOROMETHANE	75-09-2	2.8E-01	6.3E+00	6.3E+01	7.5E+00	1.4E+01	1.1E+00
DICHLORVOS	62-73-7	1.7E-01	3.7E+00	3.7E+01	4.4E+00	8.6E+00	6.7E-01
DICOFOL	115-32-2	3.0E+01	6.7E+02	6.7E+03	7.9E+02	1.5E+03	1.2E+02
DIELDRIN	60-57-1	3.8E+04	8.5E+05	8.5E+06	1.0E+06	2.0E+06	1.5E+05
DIETHYL SULFATE	64-67-5	1.1E-01	2.5E+00	2.5E+01	3.0E+00	5.8E+00	4.5E-01
DIMETHYL SULFATE	77-78-1	6.4E+01	1.4E+03	1.4E+04	1.7E+03	3.3E+03	2.5E+02
EPICHLOROHYDRIN	106-89-8	6.4E-01	1.4E+01	1.4E+02	1.7E+01	3.3E+01	2.5E+00
ETHYL ACRYLATE	140-88-5	6.8E-03	1.5E-01	1.5E+00	1.8E-01	3.5E-01	2.7E-02
ETHYLENE OXIDE	75-21-8	1.5E+01	3.2E+02	3.2E+03	3.8E+02	7.5E+02	5.8E+01
ETHYLENE THIOUREA	96-45-7	1.5E-03	3.2E-02	3.2E-01	3.8E-02	7.5E-02	5.8E-03
ETHYLENEIMINE	151-56-4	8.2E+01	1.8E+03	1.8E+04	2.2E+03	4.2E+03	3.3E+02
FORMALDEHYDE	50-00-0	1.4E-03	3.0E-02	3.0E-01	3.6E-02	7.0E-02	5.4E-03
GAMMA-LINDANE	58-89-9	1.8E+01	3.9E+02	3.9E+03	4.7E+02	9.1E+02	7.1E+01
HEPTACHLOR	76-44-8	5.0E+00	1.1E+02	1.1E+03	1.3E+02	2.6E+02	2.0E+01
HEPTACHLOR EPOXIDE	1024-57-3	2.6E+01	5.8E+02	5.8E+03	6.9E+02	1.3E+03	1.0E+02
HEXACHLORINATED DIBENZOFURAN, 1,2,3,4,7,8-	70648-26-9	1.9E+08	4.1E+09	4.1E+10	4.9E+09	9.6E+09	7.4E+08
HEXACHLORO-1,3-BUTADIENE	87-68-3	3.8E+01	8.5E+02	8.5E+03	1.0E+03	2.0E+03	1.5E+02
HEXACHLOROBENZENE	118-74-1	1.0E+03	2.2E+04	2.2E+05	2.6E+04	5.1E+04	4.0E+03
HEXACHLOROETHANE	67-72-1	2.6E+02	5.9E+03	5.9E+04	7.0E+03	1.4E+04	1.1E+03
HYDRAZINE	302-01-2	2.2E+00	4.8E+01	4.8E+02	5.8E+01	1.1E+02	8.7E+00
HYDROQUINONE	123-31-9	8.6E-03	1.9E-01	1.9E+00	2.3E-01	4.4E-01	3.5E-02
INDENO(1,2,3-CD)PYRENE	193-39-5	1.5E+04	3.2E+05	3.2E+06	3.8E+05	7.5E+05	5.8E+04
LEAD	7439-92-1	6.8E+00	1.5E+02	1.5E+03	1.8E+02	3.5E+02	2.7E+01
LEAD COMPOUNDS	LCT000	6.8E+00	1.5E+02	1.5E+03	1.8E+02	3.5E+02	2.7E+01

Substance	CAS or EDF Substance ID	Characteristion factor	One-step weighting factor (SKr/kg)				
		Cancer TEP emission to air	based on 10 SKr/kg benzene	100 SKr/kg benzene	based on 180 SKr/kg lead	based on 350 SKr/kg lead	based on 20 SKr/kg cyanazin
METHYL IODIDE	74-88-4	9.1E+01	2.0E+03	2.0E+04	2.4E+03	4.7E+03	3.6E+02
N-NITROSODIPHENYLAMINE	86-30-6	8.6E-04	1.9E-02	1.9E-01	2.3E-02	4.4E-02	3.5E-03
NICKEL	7440-02-0	3.8E-01	8.4E+00	8.4E+01	1.0E+01	1.9E+01	1.5E+00
NICKEL COMPOUNDS	NDB000	3.8E-01	8.4E+00	8.4E+01	1.0E+01	1.9E+01	1.5E+00
NITROGLYCERIN	55-63-0	1.5E+00	3.3E+01	3.3E+02	4.0E+01	7.7E+01	6.0E+00
O-ANISIDINE	90-04-0	5.4E-03	1.2E-01	1.2E+00	1.4E-01	2.8E-01	2.2E-02
O-TOLUIDINE	95-53-4	4.1E-03	9.2E-02	9.2E-01	1.1E-01	2.1E-01	1.7E-02
P-CHLOROANILINE	106-47-8	2.4E-02	5.3E-01	5.3E+00	6.4E-01	1.2E+00	9.6E-02
P-TOLUIDINE	106-49-0	1.7E+02	3.7E+03	3.7E+04	4.4E+03	8.6E+03	6.7E+02
PENTACHLOROPHENOL	87-86-5	1.1E+01	2.5E+02	2.5E+03	3.0E+02	5.8E+02	4.5E+01
PRONAMIDE	23950-58-5	5.4E-01	1.2E+01	1.2E+02	1.4E+01	2.8E+01	2.2E+00
PROPOXUR	114-26-1	1.6E-04	3.5E-03	3.5E-02	4.2E-03	8.2E-03	6.4E-04
PROPYLENE OXIDE	75-56-9	2.2E-01	4.9E+00	4.9E+01	5.9E+00	1.1E+01	8.9E-01
QUINOLINE	91-22-5	8.6E+00	1.9E+02	1.9E+03	2.3E+02	4.4E+02	3.5E+01
QUINTOZENE	82-68-8	4.5E+01	1.0E+03	1.0E+04	1.2E+03	2.3E+03	1.8E+02
SAFROLE	94-59-7	1.3E-02	2.8E-01	2.8E+00	3.4E-01	6.5E-01	5.1E-02
STYRENE OXIDE	96-09-3	1.1E-01	2.5E+00	2.5E+01	3.0E+00	5.8E+00	4.5E-01
TETRACHLOROETHYLENE	127-18-4	8.2E-01	1.8E+01	1.8E+02	2.2E+01	4.2E+01	3.3E+00
THIOUREA	62-56-6	6.8E-03	1.5E-01	1.5E+00	1.8E-01	3.5E-01	2.7E-02
TRANS-1,3-DICHLOROPROPENE	10061-02-6	3.6E+04	8.1E+05	8.1E+06	9.6E+05	1.9E+06	1.5E+05
TRIBROMOMETHANE	75-25-2	9.1E-01	2.0E+01	2.0E+02	2.4E+01	4.7E+01	3.6E+00
TRICHLOROETHYLENE	79-01-6	2.7E-02	6.0E-01	6.0E+00	7.1E-01	1.4E+00	1.1E-01
TRIFLURALIN	1582-09-8	1.2E-01	2.6E+00	2.6E+01	3.1E+00	6.1E+00	4.7E-01
VINYL BROMIDE	593-60-2	5.9E-02	1.3E+00	1.3E+01	1.6E+00	3.0E+00	2.4E-01
VINYL CHLORIDE	75-01-4	6.8E-01	1.5E+01	1.5E+02	1.8E+01	3.5E+01	2.7E+00

Table A16. One-step weighting factors for human cancer risk from emission to water, based on toxicity eqiuvalency potentials (TEP) from EDF (1999) and the tax on the active substance in pesticides.

Substance	CAS or EDF Substance ID	Characterisation factor Cancer TEP emission to water	One-step weighting factor (SKr/kg) based on 20 SKr/kg cyanazin
1,1,1,2-TETRACHLOROETHANE	630-20-6	2.7E-01	1.3E+00
1,1,2,2-TETRACHLOROETHANE	79-34-5	5.9E+00	2.8E+01
1,1,2-TRICHLOROETHANE	79-00-5	2.6E+00	1.3E+01
1,1-DICHLOROETHANE	75-34-3	2.4E-01	1.1E+00
1,1-DICHLOROETHYLENE	75-35-4	4.5E+00	2.2E+01
1,1-DIMETHYL HYDRAZINE	57-14-7	5.9E-01	2.8E+00
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	67562-39-4	2.1E+06	1.0E+07
1,2,3-TRICHLOROPROPANE	96-18-4	1.0E+02	4.8E+02
1,2,5,6-DIBENZATHRACENE	53-70-3	1.0E+03	4.8E+03
1,2-BENZANTHRACENE	56-55-3	5.9E-01	2.8E+00
1,2-BENZPHENANTHRACENE	218-01-9	4.5E-01	2.2E+00
1,2-DIBROMOETHANE	106-93-4	7.7E+00	3.7E+01
1,2-DICHLOROETHANE	107-06-2	2.7E+00	1.3E+01
1,2-DICHLOROPROPANE	78-87-5	9.5E-01	4.6E+00
1,2-DIPHENYLHYDRAZINE	122-66-7	2.1E+00	1.0E+01
1,3-BUTADIENE	106-99-0	5.4E+00	2.6E+01
1,3-DICHLOROPROPENE (MIXED ISOMERS)	542-75-6	1.7E-01	8.3E-01
1,4-DICHLOROBENZENE	106-46-7	7.7E-01	3.7E+00
1,4-DIOXANE	123-91-1	1.1E-01	5.2E-01
2,3,4,7,8-PENTACHLORODIBENZOFURAN	57117-31-4	2.3E+07	1.1E+08
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN (TCDD)	1746-01-6	1.0E+09	5.0E+09
2,3,7,8-TETRACHLORODIBENZOFURAN	51207-31-9	4.2E+06	2.0E+07
2,4,6-TRICHLOROPHENOL	88-06-2	1.0E-02	4.8E-02
2,4,6-TRINITROTOLUENE	118-96-7	2.1E-03	1.0E-02
2,4-D	94-75-7	9.1E-03	4.3E-02
2,4-DIAMINOTOLUENE	95-80-7	2.4E+00	1.1E+01
2,4-DINITROTOLUENE	121-14-2	2.6E-02	1.2E-01
2,6-DINITROTOLUENE	606-20-2	3.0E-02	1.4E-01
2-AMINONAPHTHALENE	91-59-8	2.1E+00	1.0E+01
2-NITROPROPANE	79-46-9	3.9E+01	1.9E+02
2-PHENYLPHENOL	90-43-7	1.2E-03	5.7E-03
3,3'-DICHLOROBENZIDINE	91-94-1	1.7E-03	8.3E-03
3,4-BENZO-PYRENE	50-32-8	2.2E+01	1.0E+02
3,4-BENZOFLUORANTHENE	205-99-2	2.2E+02	1.1E+03
3,5,5-TRIMETHYL-2-CYCLOHEXENE-1-ONE	78-59-1	2.0E-03	9.6E-03
4,4'-METHYLENEDIANILINE	101-77-9	4.1E-01	2.0E+00
4-AMINOBIPHENYL	92-67-1	8.2E+00	3.9E+01
ACETALDEHYDE	75-07-0	3.0E-03	1.4E-02
ACETAMIDE	60-35-5	2.6E-02	1.3E-01
ACRYLAMIDE	79-06-1	7.7E+00	3.7E+01
ACRYLONITRILE	107-13-1	8.2E-01	3.9E+00
ALDRIN	309-00-2	4.3E+05	2.1E+06
ALLYL CHLORIDE	107-05-1	9.5E-03	4.6E-02
ALPHA-LINDANE	319-84-6	1.3E+02	6.3E+02
ANILINE	62-53-3	4.5E-03	2.2E-02
ARSENIC	7440-38-2	4.3E+02	2.1E+03
ARSENIC (ORGANIC OR INORGANIC COMPOUNDS	ARF750	4.3E+02	2.1E+03
ATRAZINE	1912-24-9	5.9E-03	2.8E-02
BENZENE	71-43-2	4.5E-01	2.2E+00
BENZIDINE	92-87-5	3.6E+02	1.7E+03
BENZOIC TRICHLORIDE	98-07-7	1.0E-02	5.0E-02
BENZYL CHLORIDE	100-44-7	3.5E-02	1.7E-01
BETA-LINDANE	319-85-7	8.2E+01	3.9E+02
BIS(2-CHLORO-1-METHYLETHYL) ETHER	108-60-1	2.1E-01	1.0E+00
BIS(2-CHLOROETHYL) ETHER	111-44-4	2.9E+01	1.4E+02
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	7.7E-01	3.7E+00
BROMOXYNIL	1689-84-5	1.7E+02	8.0E+02
CADMIUM	7440-43-9	7.7E-01	3.7E+00

Substance	CAS or EDF Substance ID	Characterisation factor Cancer TEP emission to water	One-step weighting factor (SKr/kg) based on 20 SKr/kg cyanazin
CADMIUM COMPOUNDS	CAE750	7.7E-01	3.7E+00
CAMPHECHLOR	8001-35-2	4.4E+01	2.1E+02
CAPTAN	133-06-2	5.0E-05	2.4E-04
CARBARYL	63-25-2	5.4E-02	2.6E-01
CARBAZOLE	86-74-8	6.4E+01	3.0E+02
CARBON TETRACHLORIDE	56-23-5	3.9E+02	1.9E+03
CATECHOL	120-80-9	4.2E-03	2.0E-02
CHLORDANE	57-74-9	5.0E+03	2.4E+04
CHLORODIBROMOMETHANE	124-48-1	1.5E+01	7.2E+01
CHLOROFORM	67-66-3	1.9E+00	9.1E+00
CHLOROMETHANE	74-87-3	9.1E-01	4.3E+00
CHLOROMETHYL METHYL ETHER	107-30-2	1.2E-03	5.7E-03
CROTONALDEHYDE, (E)-	123-73-9	8.2E-01	3.9E+00
CYANAZINE	21725-46-2	4.2E+00	2.0E+01
DDD	72-54-8	2.2E+03	1.0E+04
DDE	72-55-9	2.0E+02	9.6E+02
DDT	50-29-3	7.7E+02	3.7E+03
DICHLOROBROMOMETHANE	75-27-4	4.5E+01	2.2E+02
DICHLOROMETHANE	75-09-2	1.7E-01	8.0E-01
DICHLORVOS	62-73-7	2.8E-01	1.3E+00
DICOFOL	115-32-2	1.2E+02	5.7E+02
DIELDRIN	60-57-1	2.0E+05	9.8E+05
DIETHYL SULFATE	64-67-5	1.4E-02	6.5E-02
DIMETHYL SULFATE	77-78-1	4.5E-02	2.2E-01
EPICHLOROHYDRIN	106-89-8	1.9E-01	9.1E-01
ETHYL ACRYLATE	140-88-5	1.7E-02	8.0E-02
ETHYLENE OXIDE	75-21-8	5.9E+00	2.8E+01
ETHYLENE THIOUREA	96-45-7	3.3E-01	1.6E+00
ETHYLENEIMINE	151-56-4	1.1E+03	5.2E+03
FORMALDEHYDE	50-00-0	1.3E-04	6.3E-04
GAMMA-LINDANE	58-89-9	7.7E+01	3.7E+02
HEPTACHLOR	76-44-8	2.4E+02	1.2E+03
HEPTACHLOR EPOXIDE	1024-57-3	2.6E+03	1.3E+04
HEXACHLORINATED DIBENZOFURAN, 1,2,3,4,7,8-	70648-26-9	2.5E+08	1.2E+09
HEXACHLORO-1,3-BUTADIENE	87-68-3	3.8E+01	1.8E+02
HEXACHLOROBENZENE	118-74-1	2.0E+03	9.3E+03
HEXACHLOROETHANE	67-72-1	2.3E+02	1.1E+03
HYDRAZINE	302-01-2	5.4E+00	2.6E+01
HYDROQUINONE	123-31-9	1.8E-04	8.7E-04
INDENO(1,2,3-CD)PYRENE	193-39-5	3.4E+03	1.6E+04
LEAD	7439-92-1	5.9E+00	2.8E+01
LEAD COMPOUNDS	LCT000	5.9E+00	2.8E+01
METHYL IODIDE	74-88-4	4.5E+01	2.2E+02
N-NITROSODIPHENYLAMINE	86-30-6	9.5E-02	4.6E-01
NITROGLYCERIN	55-63-0	2.6E+00	1.2E+01
O-ANISIDINE	90-04-0	9.1E-02	4.3E-01
O-TOLUIDINE	95-53-4	7.7E-02	3.7E-01
P-CHLOROANILINE	106-47-8	5.0E-02	2.4E-01
P-TOLUIDINE	106-49-0	1.7E+02	8.3E+02
PENTACHLOROPHENOL	87-86-5	2.8E-03	1.3E-02
PRONAMIDE	23950-58-5	4.1E-01	2.0E+00
PROPOXUR	114-26-1	1.1E-02	5.2E-02
PROPYLENE OXIDE	75-56-9	5.4E-01	2.6E+00
QUINOLINE	91-22-5	6.4E+00	3.0E+01
QUINTOZENE	82-68-8	4.5E+01	2.2E+02
SAFROLE	94-59-7	1.3E+00	6.3E+00
STYRENE OXIDE	96-09-3	5.0E-02	2.4E-01
TETRACHLOROETHYLENE	127-18-4	6.4E-01	3.0E+00
THIOUREA	62-56-6	2.9E-02	1.4E-01
TRANS-1,3-DICHLOROPROPENE	10061-02-6	3.6E+04	1.7E+05

Substance	CAS or EDF Substance ID	Characterisation factor Cancer TEP emission to water	One-step weighting factor (SKr/kg) based on 20 SKr/kg cyanazin
TRICHLOROETHYLENE	79-01-6	9.1E-02	4.3E-01
TRIFLURALIN	1582-09-8	5.0E-02	2.4E-01
VINYL BROMIDE	593-60-2	4.5E-01	2.2E+00
VINYL CHLORIDE	75-01-4	2.3E+00	1.1E+01

Table A17. One-step weighting factors for non-cancer toxicological human helth risk from substances emitted to air. Toxicity equivalency potentials (TEP) from EDF (1999) are combined with the exemption fees for high levels of benzene and lead in petrol and with the tax on the active substance in pesticides. The least and the most toxic pesticide admitted for use in Sweden are used to produce minimum and maximum values.

		Characterisation factor	One-step weighting factor (SKr/kg)					
Substance	CAS or EDF Substance ID	Noncancer TEP emission to air	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
1,1,1,2-TETRACHLOROETHANE	630-20-6	1.2E+02	1.5E+02	1.5E+03	3.6E-02	7.0E-02	7.8E-03	9.6E+03
1,1,1-TRICHLOROETHANE	71-55-6	9.5E+01	1.2E+02	1.2E+03	2.9E-02	5.7E-02	6.3E-03	7.8E+03
1,1,2,2-TETRACHLOROETHANE	79-34-5	4.5E+00	5.8E+00	5.8E+01	1.4E-03	2.7E-03	3.0E-04	3.7E+02
1,1,2-TRICHLOROETHANE	79-00-5	8.6E+00	1.1E+01	1.1E+02	2.6E-03	5.1E-03	5.7E-04	7.0E+02
1,1-DICHLOROETHANE	75-34-3	8.6E+00	1.1E+01	1.1E+02	2.6E-03	5.1E-03	5.7E-04	7.0E+02
1,1-DICHLOROETHYLENE	75-35-4	3.9E+00	5.0E+00	5.0E+01	1.2E-03	2.3E-03	2.5E-04	3.1E+02
1,1-DIMETHYL HYDRAZINE	57-14-7	9.1E+00	1.2E+01	1.2E+02	2.8E-03	5.4E-03	6.0E-04	7.4E+02
1,2,3-TRICHLOROPROPANE	96-18-4	5.0E+01	6.5E+01	6.5E+02	1.5E-02	3.0E-02	3.3E-03	4.1E+03
1,2,4-TRICHLOROBENZENE	120-82-1	1.2E+01	1.5E+01	1.5E+02	3.6E-03	7.0E-03	7.8E-04	9.6E+02
1,2,4-TRIMETHYLBENZENE	95-63-6	1.6E+00	2.1E+00	2.1E+01	5.0E-04	9.7E-04	1.1E-04	1.3E+02
1,2-DIBROMOETHANE	106-93-4	1.8E+03	2.4E+03	2.4E+04	5.5E-01	1.1E+00	1.2E-01	1.5E+05
1,2-DICHLOROBENZENE	95-50-1	1.4E+01	1.8E+01	1.8E+02	4.2E-03	8.1E-03	9.0E-04	1.1E+03
1,2-DICHLOROETHANE	107-06-2	8.6E+00	1.1E+01	1.1E+02	2.6E-03	5.1E-03	5.7E-04	7.0E+02
1,2-DICHLOROETHYLENE	540-59-0	4.5E+00	5.9E+00	5.9E+01	1.4E-03	2.7E-03	3.0E-04	3.7E+02
1,2-DICHLOROPROPANE	78-87-5	2.9E+02	3.8E+02	3.8E+03	8.9E-02	1.7E-01	1.9E-02	2.4E+04
1,2-TRANS-DICHLOROETHYLENE	156-60-5	6.4E-01	8.2E-01	8.2E+00	1.9E-04	3.8E-04	4.2E-05	5.2E+01
1,3-BUTADIENE	106-99-0	5.4E-01	7.1E-01	7.1E+00	1.7E-04	3.2E-04	3.6E-05	4.4E+01
1,3-DICHLOROPROPENE (MIXED ISOMERS)	542-75-6	6.8E+00	8.8E+00	8.8E+01	2.1E-03	4.0E-03	4.5E-04	5.6E+02
1,4-DICHLOROBENZENE	106-46-7	3.8E+00	4.9E+00	4.9E+01	1.1E-03	2.2E-03	2.5E-04	3.1E+02
1,4-DIOXANE	123-91-1	1.5E-02	2.0E-02	2.0E-01	4.7E-06	9.2E-06	1.0E-06	1.3E+00
1-BUTYL CHLORIDE	109-69-3	6.8E+04	8.8E+04	8.8E+05	2.1E+01	4.0E+01	4.5E+00	5.6E+06
1-CHLORO-1,1-DIFLUOROETHANE	75-68-3	3.8E+00	4.9E+00	4.9E+01	1.1E-03	2.2E-03	2.5E-04	3.1E+02
1-METHYL-2-NITROBENZENE	88-72-2	1.5E+00	2.0E+00	2.0E+01	4.7E-04	9.2E-04	1.0E-04	1.3E+02
1-METHYL-3-NITROBENZENE	99-08-1	1.8E+04	2.4E+04	2.4E+05	5.5E+00	1.1E+01	1.2E+00	1.5E+06

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
1-METHYL-4-NITROBENZENE	99-99-0	1.2E+04	1.6E+04	1.6E+05	3.7E+00	7.3E+00	8.1E-01	1.0E+06
2,3,4,7,8-PENTACHLORODIBENZOFURAN	57117-31-4	5.9E+09	7.6E+09	7.6E+10	1.8E+06	3.5E+06	3.9E+05	4.8E+11
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN (TCI	1746-01-6	3.8E+11	4.9E+11	4.9E+12	1.2E+08	2.3E+08	2.5E+07	3.1E+13
2,4,5-T	93-76-5	5.0E+00	6.5E+00	6.5E+01	1.5E-03	3.0E-03	3.3E-04	4.1E+02
2,4,5-TRICHLOROPHENOL	95-95-4	5.0E+00	6.5E+00	6.5E+01	1.5E-03	3.0E-03	3.3E-04	4.1E+02
2,4,6-TRICHLOROPHENOL	88-06-2	1.0E+01	1.3E+01	1.3E+02	3.0E-03	5.9E-03	6.6E-04	8.1E+02
2,4,6-TRINITROPHENOL	88-89-1	2.8E+03	3.6E+03	3.6E+04	8.6E-01	1.7E+00	1.9E-01	2.3E+05
2,4,6-TRINITROTOLUENE	118-96-7	9.1E+00	1.2E+01	1.2E+02	2.8E-03	5.4E-03	6.0E-04	7.4E+02
2,4-D	94-75-7	3.0E-01	3.8E-01	3.8E+00	9.0E-05	1.8E-04	1.9E-05	2.4E+01
2,4-DB	94-82-6	1.0E+02	1.4E+02	1.4E+03	3.2E-02	6.2E-02	6.9E-03	8.5E+03
2,4-DICHLOROPHENOL	120-83-2	1.6E+01	2.1E+01	2.1E+02	5.0E-03	9.7E-03	1.1E-03	1.3E+03
2,4-DIMETHYLPHENOL	105-67-9	9.5E-02	1.2E-01	1.2E+00	2.9E-05	5.7E-05	6.3E-06	7.8E+00
2,4-DINITROPHENOL	51-28-5	3.2E+01	4.2E+01	4.2E+02	9.8E-03	1.9E-02	2.1E-03	2.6E+03
2,4-DINITROTOLUENE	121-14-2	3.9E+01	5.1E+01	5.1E+02	1.2E-02	2.3E-02	2.6E-03	3.2E+03
2,6-DIMETHYLPHENOL	576-26-1	2.7E+04	3.5E+04	3.5E+05	8.3E+00	1.6E+01	1.8E+00	2.2E+06
2,6-DINITROTOLUENE	606-20-2	6.4E+01	8.2E+01	8.2E+02	1.9E-02	3.8E-02	4.2E-03	5.2E+03
2-CHLOR-1,3-BUTADIENE	126-99-8	2.5E+00	3.3E+00	3.3E+01	7.8E-04	1.5E-03	1.7E-04	2.1E+02
2-CHLOROPHENOL	95-57-8	3.6E+03	4.7E+03	4.7E+04	1.1E+00	2.2E+00	2.4E-01	3.0E+05
2-CHLOROPROPANE	75-29-6	1.5E+06	1.9E+06	1.9E+07	4.6E+02	8.9E+02	9.9E+01	1.2E+08
2-METHYL-1-PROPANOL	78-83-1	1.6E-01	2.1E-01	2.1E+00	4.8E-05	9.4E-05	1.0E-05	1.3E+01
2-METHYL-2-PROPENOIC ACID, ETHYL ESTER	97-63-2	7.7E+05	1.0E+06	1.0E+07	2.4E+02	4.6E+02	5.1E+01	6.3E+07
2-NITROPROPANE	79-46-9	1.4E+00	1.8E+00	1.8E+01	4.3E-04	8.3E-04	9.3E-05	1.1E+02
2-PHENYLPHENOL	90-43-7	9.1E-03	1.2E-02	1.2E-01	2.8E-06	5.4E-06	6.0E-07	7.4E-01
3,5,5-TRIMETHYL-2-CYCLOHEXENE-1-ONE	78-59-1	2.8E-03	3.6E-03	3.6E-02	8.6E-07	1.7E-06	1.9E-07	2.3E-01
4,4'-ISOPROPYLIDENEDIPHENOL	80-05-7	2.6E-02	3.4E-02	3.4E-01	7.9E-06	1.5E-05	1.7E-06	2.1E+00
4,4'-METHYLENEDIANILINE	101-77-9	7.7E-02	1.0E-01	1.0E+00	2.4E-05	4.6E-05	5.1E-06	6.3E+00
4,6-DINITRO-O-CRESOL	534-52-1	7.3E+02	9.4E+02	9.4E+03	2.2E-01	4.3E-01	4.8E-02	5.9E+04

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
4-NITROPHENOL	100-02-7	3.0E+00	3.9E+00	3.9E+01	9.1E-04	1.8E-03	2.0E-04	2.4E+02
ACENAPHTHENE	83-32-9	9.1E-02	1.2E-01	1.2E+00	2.8E-05	5.4E-05	6.0E-06	7.4E+00
ACETALDEHYDE	75-07-0	1.7E+00	2.2E+00	2.2E+01	5.3E-04	1.0E-03	1.1E-04	1.4E+02
ACETONE	67-64-1	1.1E-01	1.5E-01	1.5E+00	3.5E-05	6.7E-05	7.5E-06	9.3E+00
ACETONITRILE	75-05-8	9.5E+01	1.2E+02	1.2E+03	2.9E-02	5.7E-02	6.3E-03	7.8E+03
ACETOPHENONE	98-86-2	3.8E+00	4.9E+00	4.9E+01	1.2E-03	2.3E-03	2.5E-04	3.1E+02
ACROLEIN	107-02-8	9.5E+02	1.2E+03	1.2E+04	2.9E-01	5.7E-01	6.3E-02	7.8E+04
ACRYLAMIDE	79-06-1	3.0E+01	3.8E+01	3.8E+02	9.0E-03	1.8E-02	1.9E-03	2.4E+03
ACRYLIC ACID	79-10-7	1.2E+01	1.6E+01	1.6E+02	3.7E-03	7.3E-03	8.1E-04	1.0E+03
ACRYLONITRILE	107-13-1	3.9E+01	5.1E+01	5.1E+02	1.2E-02	2.3E-02	2.6E-03	3.2E+03
ALDICARB	116-06-3	4.5E+00	5.9E+00	5.9E+01	1.4E-03	2.7E-03	3.0E-04	3.7E+02
ALDRIN	309-00-2	1.4E+07	1.8E+07	1.8E+08	4.2E+03	8.1E+03	9.0E+02	1.1E+09
ALLYL ALCOHOL	107-18-6	7.3E-01	9.4E-01	9.4E+00	2.2E-04	4.3E-04	4.8E-05	5.9E+01
ALLYL CHLORIDE	107-05-1	1.7E+01	2.2E+01	2.2E+02	5.3E-03	1.0E-02	1.1E-03	1.4E+03
ALPHA-LINDANE	319-84-6	2.7E+01	3.5E+01	3.5E+02	8.3E-03	1.6E-02	1.8E-03	2.2E+03
ALUMINUM	7429-90-5	3.1E+03	4.1E+03	4.1E+04	9.6E-01	1.9E+00	2.1E-01	2.6E+05
AMMONIA	7664-41-7	1.5E+00	1.9E+00	1.9E+01	4.4E-04	8.6E-04	9.6E-05	1.2E+02
ANILINE	62-53-3	1.5E+01	2.0E+01	2.0E+02	4.7E-03	9.2E-03	1.0E-03	1.3E+03
ANTHRACENE	120-12-7	2.0E-02	2.5E-02	2.5E-01	6.0E-06	1.2E-05	1.3E-06	1.6E+00
ANTIMONY	7440-36-0	9.1E+05	1.2E+06	1.2E+07	2.8E+02	5.4E+02	6.0E+01	7.4E+07
ANTIMONY COMPOUNDS	ADQ500	9.1E+05	1.2E+06	1.2E+07	2.8E+02	5.4E+02	6.0E+01	7.4E+07
AROCLOR 1016	12674-11-2	6.8E+05	8.8E+05	8.8E+06	2.1E+02	4.0E+02	4.5E+01	5.6E+07
AROCLOR 1254	11097-69-1	4.0E+06	5.2E+06	5.2E+07	1.2E+03	2.4E+03	2.7E+02	3.3E+08
ARSENIC	7440-38-2	2.5E+04	3.2E+04	3.2E+05	7.5E+00	1.5E+01	1.6E+00	2.0E+06
ARSENIC (ORGANIC OR INORGANIC COMPOUNDS)	ARF750	2.5E+04	3.2E+04	3.2E+05	7.5E+00	1.5E+01	1.6E+00	2.0E+06
ATRAZINE	1912-24-9	6.4E-01	8.2E-01	8.2E+00	1.9E-04	3.8E-04	4.2E-05	5.2E+01

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
BARIUM	7440-39-3	1.8E+03	2.4E+03	2.4E+04	5.5E-01	1.1E+00	1.2E-01	1.5E+05
BARIUM COMPOUNDS	BAK500	1.8E+03	2.4E+03	2.4E+04	5.5E-01	1.1E+00	1.2E-01	1.5E+05
BENZENE	71-43-2	7.7E+00	1.0E+01	1.0E+02	2.4E-03	4.6E-03	5.1E-04	6.3E+02
BENZENETHIOL	108-98-5	8.6E+07	1.1E+08	1.1E+09	2.6E+04	5.1E+04	5.7E+03	7.0E+09
BENZIDINE	92-87-5	1.5E+00	2.0E+00	2.0E+01	4.7E-04	9.2E-04	1.0E-04	1.3E+02
BENZOIC ACID	65-85-0	1.2E-02	1.5E-02	1.5E-01	3.6E-06	7.0E-06	7.8E-07	9.6E-01
BENZYL BUTYL PHTHALATE	85-68-7	5.9E+00	7.6E+00	7.6E+01	1.8E-03	3.5E-03	3.9E-04	4.8E+02
BENZYL CHLORIDE	100-44-7	1.0E+01	1.4E+01	1.4E+02	3.2E-03	6.2E-03	6.9E-04	8.5E+02
BERYLLIUM	7440-41-7	7.7E+04	1.0E+05	1.0E+06	2.4E+01	4.6E+01	5.1E+00	6.3E+06
BERYLLIUM COMPOUNDS	BFQ500	7.7E+04	1.0E+05	1.0E+06	2.4E+01	4.6E+01	5.1E+00	6.3E+06
BETA-LINDANE	319-85-7	3.0E+03	3.8E+03	3.8E+04	9.0E-01	1.8E+00	1.9E-01	2.4E+05
BIPHENYL	92-52-4	2.7E-01	3.5E-01	3.5E+00	8.2E-05	1.6E-04	1.8E-05	2.2E+01
BIS(2-CHLOROETHYL) ETHER	111-44-4	1.5E+00	1.9E+00	1.9E+01	4.4E-04	8.6E-04	9.6E-05	1.2E+02
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	5.9E+01	7.6E+01	7.6E+02	1.8E-02	3.5E-02	3.9E-03	4.8E+03
BROMOXYNIL	1689-84-5	1.2E+03	1.6E+03	1.6E+04	3.7E-01	7.3E-01	8.1E-02	1.0E+05
CADMIUM	7440-43-9	1.4E+06	1.8E+06	1.8E+07	4.2E+02	8.1E+02	9.0E+01	1.1E+08
CADMIUM COMPOUNDS	CAE750	1.4E+06	1.8E+06	1.8E+07	4.2E+02	8.1E+02	9.0E+01	1.1E+08
CAMPHECHLOR	8001-35-2	2.1E+03	2.8E+03	2.8E+04	6.5E-01	1.3E+00	1.4E-01	1.7E+05
CAPTAN	133-06-2	4.0E-02	5.2E-02	5.2E-01	1.2E-05	2.4E-05	2.7E-06	3.3E+00
CARBARYL	63-25-2	1.4E-03	1.8E-03	1.8E-02	4.2E-07	8.1E-07	9.0E-08	1.1E-01
CARBOFURAN	1563-66-2	2.8E+02	3.6E+02	3.6E+03	8.4E-02	1.6E-01	1.8E-02	2.3E+04
CARBON DISULFIDE	75-15-0	2.2E+00	2.9E+00	2.9E+01	6.8E-04	1.3E-03	1.5E-04	1.8E+02
CARBON TETRACHLORIDE	56-23-5	7.3E+03	9.4E+03	9.4E+04	2.2E+00	4.3E+00	4.8E-01	5.9E+05
CHLORDANE	57-74-9	3.3E+05	4.2E+05	4.2E+06	1.0E+02	1.9E+02	2.1E+01	2.7E+07
CHLOROACETIC ACID	79-11-8	1.5E+02	1.9E+02	1.9E+03	4.6E-02	8.9E-02	9.9E-03	1.2E+04
CHLOROBENZENE	108-90-7	1.3E+00	1.6E+00	1.6E+01	3.9E-04	7.5E-04	8.4E-05	1.0E+02
CHLORODIBROMOMETHANE	124-48-1	2.5E+02	3.3E+02	3.3E+03	7.8E-02	1.5E-01	1.7E-02	2.1E+04

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
CHLORODIFLUOROMETHANE	75-45-6	9.1E+00	1.2E+01	1.2E+02	2.8E-03	5.4E-03	6.0E-04	7.4E+02
CHLOROETHANE	75-00-3	9.1E-02	1.2E-01	1.2E+00	2.8E-05	5.4E-05	6.0E-06	7.4E+00
CHLOROFORM	67-66-3	3.6E+01	4.7E+01	4.7E+02	1.1E-02	2.2E-02	2.4E-03	3.0E+03
CHLOROMETHANE	74-87-3	2.5E+02	3.2E+02	3.2E+03	7.5E-02	1.5E-01	1.6E-02	2.0E+04
CHROMIUM	7440-47-3	1.0E+05	1.4E+05	1.4E+06	3.2E+01	6.2E+01	6.9E+00	8.5E+06
CHROMIUM COMPOUNDS	CMJ500	1.0E+05	1.4E+05	1.4E+06	3.2E+01	6.2E+01	6.9E+00	8.5E+06
CIS-1,2-DICHLOROETHYLENE	156-59-2	1.5E+01	1.9E+01	1.9E+02	4.4E-03	8.6E-03	9.6E-04	1.2E+03
COBALT	7440-48-4	1.2E+04	1.6E+04	1.6E+05	3.7E+00	7.3E+00	8.1E-01	1.0E+06
COBALT COMPOUNDS	CNB850	1.2E+04	1.6E+04	1.6E+05	3.7E+00	7.3E+00	8.1E-01	1.0E+06
COPPER	7440-50-8	3.0E+05	3.9E+05	3.9E+06	9.3E+01	1.8E+02	2.0E+01	2.5E+07
COPPER COMPOUNDS	CNK750	3.0E+05	3.9E+05	3.9E+06	9.3E+01	1.8E+02	2.0E+01	2.5E+07
CUMENE	98-82-8	1.4E-01	1.8E-01	1.8E+00	4.3E-05	8.3E-05	9.3E-06	1.1E+01
CYANAZINE*	21725-46-2	7.3E+01	9.4E+01	9.4E+02	2.2E-02	4.3E-02	4.8E-03	5.9E+03
CYCLOHEXANE	110-82-7	1.3E-02	1.7E-02	1.7E-01	4.0E-06	7.8E-06	8.7E-07	1.1E+00
CYCLOHEXANONE	108-94-1	9.5E-03	1.2E-02	1.2E-01	2.9E-06	5.7E-06	6.3E-07	7.8E-01
DDT	50-29-3	7.3E+04	9.4E+04	9.4E+05	2.2E+01	4.3E+01	4.8E+00	5.9E+06
DI-N-OCTYL PHTHALATE	117-84-0	4.2E+09	5.5E+09	5.5E+10	1.3E+06	2.5E+06	2.8E+05	3.4E+11
DIAZINON*	333-41-5	1.4E+03	1.8E+03	1.8E+04	4.2E-01	8.1E-01	9.0E-02	1.1E+05
DIBUTYL PHTHALATE	84-74-2	1.6E+01	2.1E+01	2.1E+02	5.0E-03	9.7E-03	1.1E-03	1.3E+03
DICAMBA	1918-00-9	5.4E+01	7.1E+01	7.1E+02	1.7E-02	3.2E-02	3.6E-03	4.4E+03
DICHLOROBROMOMETHANE	75-27-4	6.8E+02	8.8E+02	8.8E+03	2.1E-01	4.0E-01	4.5E-02	5.6E+04
DICHLORODIFLUOROMETHANE	75-71-8	1.3E+01	1.7E+01	1.7E+02	4.0E-03	7.8E-03	8.7E-04	1.1E+03
DICHLOROMETHANE	75-09-2	2.6E+01	3.4E+01	3.4E+02	8.0E-03	1.6E-02	1.7E-03	2.1E+03
DICHLORVOS	62-73-7	1.1E+02	1.5E+02	1.5E+03	3.5E-02	6.7E-02	7.5E-03	9.3E+03
DICOFOL	115-32-2	2.4E+03	3.1E+03	3.1E+04	7.2E-01	1.4E+00	1.6E-01	1.9E+05
DIELDRIN	60-57-1	2.3E+06	3.0E+06	3.0E+07	7.1E+02	1.4E+03	1.5E+02	1.9E+08

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
DIETHANOLAMINE	111-42-2	2.0E-01	2.6E-01	2.6E+00	6.2E-05	1.2E-04	1.3E-05	1.7E+01
DIETHYL ETHER	60-29-7	7.7E-02	1.0E-01	1.0E+00	2.4E-05	4.6E-05	5.1E-06	6.3E+00
DIETHYL PHTHALATE	84-66-2	1.6E-01	2.1E-01	2.1E+00	5.0E-05	9.7E-05	1.1E-05	1.3E+01
DIMETHOATE	60-51-5	1.1E+01	1.5E+01	1.5E+02	3.5E-03	6.7E-03	7.5E-04	9.3E+02
DIMETHYL PHTHALATE	131-11-3	1.9E-02	2.4E-02	2.4E-01	5.7E-06	1.1E-05	1.2E-06	1.5E+00
DIMETHYLAMINE	124-40-3	7.7E+00	1.0E+01	1.0E+02	2.4E-03	4.6E-03	5.1E-04	6.3E+02
DINITROBUTYL PHENOL	88-85-7	6.8E+02	8.8E+02	8.8E+03	2.1E-01	4.0E-01	4.5E-02	5.6E+04
DIPHENYLAMINE	122-39-4	4.3E+00	5.6E+00	5.6E+01	1.3E-03	2.6E-03	2.8E-04	3.5E+02
DIURON	330-54-1	8.2E+02	1.1E+03	1.1E+04	2.5E-01	4.8E-01	5.4E-02	6.7E+04
ENDOSULFAN	115-29-7	2.5E+00	3.3E+00	3.3E+01	7.8E-04	1.5E-03	1.7E-04	2.1E+02
ENDRIN	72-20-8	1.1E+05	1.5E+05	1.5E+06	3.5E+01	6.7E+01	7.5E+00	9.3E+06
EPICHLOROHYDRIN	106-89-8	7.7E+02	1.0E+03	1.0E+04	2.4E-01	4.6E-01	5.1E-02	6.3E+04
ETHYL ACETATE	141-78-6	5.4E-02	7.1E-02	7.1E-01	1.7E-05	3.2E-05	3.6E-06	4.4E+00
ETHYL ACRYLATE	140-88-5	2.8E-01	3.6E-01	3.6E+00	8.6E-05	1.7E-04	1.9E-05	2.3E+01
ETHYL DIPROPYLTHIOCARBAMATE	759-94-4	1.1E+03	1.4E+03	1.4E+04	3.3E-01	6.5E-01	7.2E-02	8.9E+04
ETHYLBENZENE	100-41-4	1.5E-01	1.9E-01	1.9E+00	4.6E-05	8.9E-05	9.9E-06	1.2E+01
ETHYLENE GLYCOL	107-21-1	1.2E-01	1.5E-01	1.5E+00	3.6E-05	7.0E-05	7.8E-06	9.6E+00
ETHYLENE GLYCOL MONOETHYL ETHER	110-80-5	1.1E-01	1.5E-01	1.5E+00	3.5E-05	6.7E-05	7.5E-06	9.3E+00
ETHYLENE GLYCOL MONOMETHYL ETHER	109-86-4	1.6E+00	2.1E+00	2.1E+01	5.0E-04	9.7E-04	1.1E-04	1.3E+02
ETHYLENE OXIDE	75-21-8	9.1E+02	1.2E+03	1.2E+04	2.8E-01	5.4E-01	6.0E-02	7.4E+04
ETHYLENE THIOUREA	96-45-7	1.1E+00	1.5E+00	1.5E+01	3.5E-04	6.7E-04	7.5E-05	9.3E+01
FLUORANTHENE	206-44-0	2.3E+01	2.9E+01	2.9E+02	6.9E-03	1.3E-02	1.5E-03	1.9E+03
FLUORENE	86-73-7	1.2E+00	1.5E+00	1.5E+01	3.6E-04	7.0E-04	7.8E-05	9.6E+01
FORMALDEHYDE	50-00-0	3.2E+00	4.1E+00	4.1E+01	9.7E-04	1.9E-03	2.1E-04	2.6E+02
FORMIC ACID	64-18-6	1.5E-02	1.9E-02	1.9E-01	4.6E-06	8.9E-06	9.9E-07	1.2E+00

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
FREON 113	76-13-1	3.1E+01	4.1E+01	4.1E+02	9.6E-03	1.9E-02	2.1E-03	2.6E+03
FURAN	110-00-9	1.5E+01	2.0E+01	2.0E+02	4.7E-03	9.2E-03	1.0E-03	1.3E+03
GAMMA-LINDANE	58-89-9	1.5E+03	1.9E+03	1.9E+04	4.6E-01	8.9E-01	9.9E-02	1.2E+05
HEPTACHLOR	76-44-8	5.9E+01	7.6E+01	7.6E+02	1.8E-02	3.5E-02	3.9E-03	4.8E+03
HEPTACHLOR EPOXIDE	1024-57-3	4.1E+03	5.3E+03	5.3E+04	1.2E+00	2.4E+00	2.7E-01	3.3E+05
HEXACHLORO-1,3-BUTADIENE	87-68-3	8.6E+03	1.1E+04	1.1E+05	2.6E+00	5.1E+00	5.7E-01	7.0E+05
HEXACHLOROBENZENE	118-74-1	2.5E+04	3.3E+04	3.3E+05	7.8E+00	1.5E+01	1.7E+00	2.1E+06
HEXACHLOROCYCLOPENTADIENE	77-47-4	3.5E+01	4.5E+01	4.5E+02	1.1E-02	2.0E-02	2.3E-03	2.8E+03
HEXACHLOROETHANE	67-72-1	1.1E+04	1.4E+04	1.4E+05	3.3E+00	6.5E+00	7.2E-01	8.9E+05
HYDRAZINE	302-01-2	5.0E+01	6.5E+01	6.5E+02	1.5E-02	3.0E-02	3.3E-03	4.1E+03
HYDROGEN CYANIDE	74-90-8	9.5E+03	1.2E+04	1.2E+05	2.9E+00	5.7E+00	6.3E-01	7.8E+05
HYDROQUINONE	123-31-9	1.0E-01	1.4E-01	1.4E+00	3.2E-05	6.2E-05	6.9E-06	8.5E+00
ISOPROPYL ALCOHOL (MANUFACTURING - STRONG ACID PROCESS ONLY, NO SUPPLIER NOTIFICATION)	67-63-0	1.8E-02	2.3E-02	2.3E-01	5.4E-06	1.1E-05	1.2E-06	1.4E+00
LEAD	7439-92-1	5.9E+05	7.6E+05	7.6E+06	1.8E+02	3.5E+02	3.9E+01	4.8E+07
LEAD COMPOUNDS	LCT000	5.9E+05	7.6E+05	7.6E+06	1.8E+02	3.5E+02	3.9E+01	4.8E+07
M-CRESOL	108-39-4	1.5E+00	2.0E+00	2.0E+01	4.7E-04	9.2E-04	1.0E-04	1.3E+02
M-DINITROBENZENE	99-65-0	1.2E+05	1.5E+05	1.5E+06	3.6E+01	7.0E+01	7.8E+00	9.6E+06
M-PHENYLENEDIAMINE	108-45-2	2.3E-01	2.9E-01	2.9E+00	6.9E-05	1.3E-04	1.5E-05	1.9E+01
M-XYLENE	108-38-3	7.3E-02	9.4E-02	9.4E-01	2.2E-05	4.3E-05	4.8E-06	5.9E+00
MALATHION*	121-75-5	2.5E-01	3.2E-01	3.2E+00	7.5E-05	1.5E-04	1.6E-05	2.0E+01
MALEIC ANHYDRIDE	108-31-6	5.0E+04	6.5E+04	6.5E+05	1.5E+01	3.0E+01	3.3E+00	4.1E+06
MANGANESE	7439-96-5	4.4E+03	5.8E+03	5.8E+04	1.4E+00	2.6E+00	2.9E-01	3.6E+05
MANGANESE COMPOUNDS	MAR500	4.4E+03	5.8E+03	5.8E+04	1.4E+00	2.6E+00	2.9E-01	3.6E+05
MERCURY	7439-97-6	1.0E+05	1.3E+05	1.3E+06	3.0E+01	5.9E+01	6.6E+00	8.1E+06
MERCURY COMPOUNDS	EDF-033	1.0E+05	1.3E+05	1.3E+06	3.0E+01	5.9E+01	6.6E+00	8.1E+06

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
METHACRYLONITRILE	126-98-7	1.7E+05	2.2E+05	2.2E+06	5.3E+01	1.0E+02	1.1E+01	1.4E+07
METHANOL	67-56-1	4.4E-02	5.7E-02	5.7E-01	1.3E-05	2.6E-05	2.9E-06	3.6E+00
METHOXYCHLOR	72-43-5	6.8E+01	8.8E+01	8.8E+02	2.1E-02	4.0E-02	4.5E-03	5.6E+03
METHYL ACETATE	79-20-9	5.0E-02	6.5E-02	6.5E-01	1.5E-05	3.0E-05	3.3E-06	4.1E+00
METHYL ACRYLATE	96-33-3	1.5E-01	1.9E-01	1.9E+00	4.4E-05	8.6E-05	9.6E-06	1.2E+01
METHYL BROMIDE	74-83-9	5.4E+03	7.1E+03	7.1E+04	1.7E+00	3.2E+00	3.6E-01	4.4E+05
METHYL ETHYL KETONE	78-93-3	5.0E-01	6.5E-01	6.5E+00	1.5E-04	3.0E-04	3.3E-05	4.1E+01
METHYL ISOBUTYL KETONE	108-10-1	3.3E-01	4.2E-01	4.2E+00	1.0E-04	1.9E-04	2.1E-05	2.7E+01
METHYL METHACRYLATE	80-62-6	6.4E-02	8.2E-02	8.2E-01	1.9E-05	3.8E-05	4.2E-06	5.2E+00
METHYL PARATHION	298-00-0	9.1E+02	1.2E+03	1.2E+04	2.8E-01	5.4E-01	6.0E-02	7.4E+04
METHYL TERT-BUTYL ETHER	1634-04-4	4.0E-02	5.2E-02	5.2E-01	1.2E-05	2.4E-05	2.7E-06	3.3E+00
METHYLENE BROMIDE	74-95-3	1.4E+02	1.8E+02	1.8E+03	4.2E-02	8.1E-02	9.0E-03	1.1E+04
METRIBUZIN*	21087-64-9	7.3E+00	9.4E+00	9.4E+01	2.2E-03	4.3E-03	4.8E-04	5.9E+02
N,N-DIMETHYLANILINE	121-69-7	2.2E+00	2.8E+00	2.8E+01	6.6E-04	1.3E-03	1.4E-04	1.8E+02
N-BUTYL ALCOHOL	71-36-3	4.2E-01	5.4E-01	5.4E+00	1.3E-04	2.5E-04	2.7E-05	3.4E+01
N-HEXANE	110-54-3	4.2E-01	5.5E-01	5.5E+00	1.3E-04	2.5E-04	2.8E-05	3.4E+01
NAPHTHALENE	91-20-3	5.9E+00	7.6E+00	7.6E+01	1.8E-03	3.5E-03	3.9E-04	4.8E+02
NICKEL	7440-02-0	4.3E+03	5.5E+03	5.5E+04	1.3E+00	2.5E+00	2.8E-01	3.5E+05
NICKEL COMPOUNDS	NDB000	4.3E+03	5.5E+03	5.5E+04	1.3E+00	2.5E+00	2.8E-01	3.5E+05
NITROBENZENE	98-95-3	1.1E+01	1.4E+01	1.4E+02	3.3E-03	6.5E-03	7.2E-04	8.9E+02
O-ANISIDINE	90-04-0	1.5E+01	1.9E+01	1.9E+02	4.4E-03	8.6E-03	9.6E-04	1.2E+03
O-CRESOL	95-48-7	2.3E+00	2.9E+00	2.9E+01	6.9E-04	1.3E-03	1.5E-04	1.9E+02
O-DINITROBENZENE	528-29-0	2.2E+06	2.8E+06	2.8E+07	6.6E+02	1.3E+03	1.4E+02	1.8E+08
O-NITROANILINE	88-74-4	1.0E+06	1.4E+06	1.4E+07	3.2E+02	6.2E+02	6.9E+01	8.5E+07
O-XYLENE	95-47-6	1.3E-01	1.6E-01	1.6E+00	3.9E-05	7.5E-05	8.4E-06	1.0E+01
P-CHLOROANILINE	106-47-8	1.6E+00	2.1E+00	2.1E+01	4.8E-04	9.4E-04	1.0E-04	1.3E+02

		Characterisation factor	One-step weighting factor (SKr/kg)					
Substance	CAS or EDF Substance ID	Noncancer TEP emission to air	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
P-CRESOL	106-44-5	2.1E+00	2.7E+00	2.7E+01	6.4E-04	1.2E-03	1.4E-04	1.7E+02
P-PHENYLENEDIAMINE	106-50-3	2.4E-03	3.1E-03	3.1E-02	7.3E-07	1.4E-06	1.6E-07	2.0E-01
P-XYLENE	106-42-3	1.2E-01	1.6E-01	1.6E+00	3.7E-05	7.3E-05	8.1E-06	1.0E+01
PENTACHLOROPHENOL	87-86-5	5.9E+02	7.6E+02	7.6E+03	1.8E-01	3.5E-01	3.9E-02	4.8E+04
PHENOL	108-95-2	2.0E-02	2.6E-02	2.6E-01	6.2E-06	1.2E-05	1.3E-06	1.7E+00
PHOSGENE	75-44-5	4.3E+05	5.6E+05	5.6E+06	1.3E+02	2.6E+02	2.8E+01	3.5E+07
PHTHALIC ANHYDRIDE	85-44-9	9.5E-01	1.2E+00	1.2E+01	2.9E-04	5.7E-04	6.3E-05	7.8E+01
PRONAMIDE	23950-58-5	1.0E+01	1.4E+01	1.4E+02	3.2E-03	6.2E-03	6.9E-04	8.5E+02
PROPOXUR	114-26-1	2.9E-01	3.8E-01	3.8E+00	8.9E-05	1.7E-04	1.9E-05	2.4E+01
PROPYLENE	115-07-1	3.3E-03	4.2E-03	4.2E-02	1.0E-06	1.9E-06	2.1E-07	2.7E-01
PROPYLENE OXIDE	75-56-9	4.5E-01	5.9E-01	5.9E+00	1.4E-04	2.7E-04	3.0E-05	3.7E+01
PYRENE	129-00-0	2.8E+00	3.6E+00	3.6E+01	8.6E-04	1.7E-03	1.9E-04	2.3E+02
PYRIDINE	110-86-1	9.1E+01	1.2E+02	1.2E+03	2.8E-02	5.4E-02	6.0E-03	7.4E+03
QUINTOZENE	82-68-8	1.5E+03	2.0E+03	2.0E+04	4.7E-01	9.2E-01	1.0E-01	1.3E+05
S,S,S-TRIBUTYLTRITHIOPHOSPHATE	78-48-8	2.1E+04	2.7E+04	2.7E+05	6.4E+00	1.2E+01	1.4E+00	1.7E+06
SELENIUM	7782-49-2	3.8E+03	4.9E+03	4.9E+04	1.2E+00	2.3E+00	2.5E-01	3.1E+05
SELENIUM COMPOUNDS	SBP500	3.8E+03	4.9E+03	4.9E+04	1.2E+00	2.3E+00	2.5E-01	3.1E+05
SILVER	7440-22-4	3.3E+03	4.2E+03	4.2E+04	1.0E+00	1.9E+00	2.1E-01	2.7E+05
SILVER COMPOUNDS	SDO000	3.3E+03	4.2E+03	4.2E+04	1.0E+00	1.9E+00	2.1E-01	2.7E+05
STYRENE	100-42-5	1.4E-02	1.8E-02	1.8E-01	4.2E-06	8.1E-06	9.0E-07	1.1E+00
STYRENE OXIDE	96-09-3	1.1E+01	1.5E+01	1.5E+02	3.5E-03	6.7E-03	7.5E-04	9.3E+02
TETRACHLOROETHYLENE	127-18-4	1.0E+02	1.4E+02	1.4E+03	3.2E-02	6.2E-02	6.9E-03	8.5E+03
THALLIUM	7440-28-0	1.9E+05	2.4E+05	2.4E+06	5.7E+01	1.1E+02	1.2E+01	1.5E+07
THIRAM	137-26-8	2.6E+01	3.4E+01	3.4E+02	8.0E-03	1.6E-02	1.7E-03	2.1E+03
TOLUENE	108-88-3	4.5E-01	5.9E-01	5.9E+00	1.4E-04	2.7E-04	3.0E-05	3.7E+01
TRANS-1,3-DICHLOROPROPENE	10061-02-6	1.5E+06	2.0E+06	2.0E+07	4.7E+02	9.2E+02	1.0E+02	1.3E+08
TRIBROMOMETHANE	75-25-2	3.2E+02	4.2E+02	4.2E+03	9.8E-02	1.9E-01	2.1E-02	2.6E+04

		Characterisation factor	One-step weighting factor (SKr/kg)					
Substance	CAS or EDF Substance ID	Noncancer TEP emission to air	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
TRICHLOROETHYLENE	79-01-6	4.5E-01	5.9E-01	5.9E+00	1.4E-04	2.7E-04	3.0E-05	3.7E+01
TRICHLOROFLUOROMETHANE	75-69-4	3.9E+01	5.1E+01	5.1E+02	1.2E-02	2.3E-02	2.6E-03	3.2E+03
TRIETHYLAMINE	121-44-8	2.0E+00	2.6E+00	2.6E+01	6.1E-04	1.2E-03	1.3E-04	1.6E+02
TRIFLURALIN	1582-09-8	7.7E+01	1.0E+02	1.0E+03	2.4E-02	4.6E-02	5.1E-03	6.3E+03
VANADIUM	7440-62-2	9.5E+03	1.2E+04	1.2E+05	2.9E+00	5.7E+00	6.3E-01	7.8E+05
VINYL ACETATE	108-05-4	8.6E-01	1.1E+00	1.1E+01	2.6E-04	5.1E-04	5.7E-05	7.0E+01
VINYL BROMIDE	593-60-2	8.2E+00	1.1E+01	1.1E+02	2.5E-03	4.8E-03	5.4E-04	6.7E+02
VINYL CHLORIDE	75-01-4	5.0E+01	6.5E+01	6.5E+02	1.5E-02	3.0E-02	3.3E-03	4.1E+03
XYLENE (MIXED ISOMERS)	1330-20-7	3.7E-01	4.8E-01	4.8E+00	1.1E-04	2.2E-04	2.4E-05	3.0E+01
ZINC	7440-66-6	1.2E+03	1.5E+03	1.5E+04	3.6E-01	7.0E-01	7.8E-02	9.6E+04
ZINC COMPOUNDS	ZFS000	1.2E+03	1.5E+03	1.5E+04	3.6E-01	7.0E-01	7.8E-02	9.6E+04

*Pesicides admitted for use in Sweden, taxed with 20 SKr/kg.

Table A17. One-step weighting factors for non-cancer toxicological human helth risk from substances emitted to air. Toxicity equivalency potentials (TEP) from EDF (1999) are combined with the exemption fees for high levels of benzene and lead in petrol and with the tax on the active substance in pesticides. The least and the most toxic pesticide admitted for use in Sweden are used to produce minimum and maximum values.

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
1,1,1,2-TETRACHLOROETHANE	630-20-6	1.2E+02	1.5E+02	1.5E+03	3.6E-02	7.0E-02	7.8E-03	9.6E+03
1,1,1-TRICHLOROETHANE	71-55-6	9.5E+01	1.2E+02	1.2E+03	2.9E-02	5.7E-02	6.3E-03	7.8E+03
1,1,2,2-TETRACHLOROETHANE	79-34-5	4.5E+00	5.8E+00	5.8E+01	1.4E-03	2.7E-03	3.0E-04	3.7E+02
1,1,2-TRICHLOROETHANE	79-00-5	8.6E+00	1.1E+01	1.1E+02	2.6E-03	5.1E-03	5.7E-04	7.0E+02
1,1-DICHLOROETHANE	75-34-3	8.6E+00	1.1E+01	1.1E+02	2.6E-03	5.1E-03	5.7E-04	7.0E+02
1,1-DICHLOROETHYLENE	75-35-4	3.9E+00	5.0E+00	5.0E+01	1.2E-03	2.3E-03	2.5E-04	3.1E+02
1,1-DIMETHYL HYDRAZINE	57-14-7	9.1E+00	1.2E+01	1.2E+02	2.8E-03	5.4E-03	6.0E-04	7.4E+02
1,2,3-TRICHLOROPROPANE	96-18-4	5.0E+01	6.5E+01	6.5E+02	1.5E-02	3.0E-02	3.3E-03	4.1E+03
1,2,4-TRICHLOROBENZENE	120-82-1	1.2E+01	1.5E+01	1.5E+02	3.6E-03	7.0E-03	7.8E-04	9.6E+02
1,2,4-TRIMETHYLBENZENE	95-63-6	1.6E+00	2.1E+00	2.1E+01	5.0E-04	9.7E-04	1.1E-04	1.3E+02
1,2-DIBROMOETHANE	106-93-4	1.8E+03	2.4E+03	2.4E+04	5.5E-01	1.1E+00	1.2E-01	1.5E+05
1,2-DICHLOROBENZENE	95-50-1	1.4E+01	1.8E+01	1.8E+02	4.2E-03	8.1E-03	9.0E-04	1.1E+03
1,2-DICHLOROETHANE	107-06-2	8.6E+00	1.1E+01	1.1E+02	2.6E-03	5.1E-03	5.7E-04	7.0E+02
1,2-DICHLOROETHYLENE	540-59-0	4.5E+00	5.9E+00	5.9E+01	1.4E-03	2.7E-03	3.0E-04	3.7E+02
1,2-DICHLOROPROPANE	78-87-5	2.9E+02	3.8E+02	3.8E+03	8.9E-02	1.7E-01	1.9E-02	2.4E+04
1,2-TRANS-DICHLOROETHYLENE	156-60-5	6.4E-01	8.2E-01	8.2E+00	1.9E-04	3.8E-04	4.2E-05	5.2E+01
1,3-BUTADIENE	106-99-0	5.4E-01	7.1E-01	7.1E+00	1.7E-04	3.2E-04	3.6E-05	4.4E+01
1,3-DICHLOROPROPENE (MIXED ISOMERS)	542-75-6	6.8E+00	8.8E+00	8.8E+01	2.1E-03	4.0E-03	4.5E-04	5.6E+02
1,4-DICHLOROBENZENE	106-46-7	3.8E+00	4.9E+00	4.9E+01	1.1E-03	2.2E-03	2.5E-04	3.1E+02
1,4-DIOXANE	123-91-1	1.5E-02	2.0E-02	2.0E-01	4.7E-06	9.2E-06	1.0E-06	1.3E+00
1-BUTYL CHLORIDE	109-69-3	6.8E+04	8.8E+04	8.8E+05	2.1E+01	4.0E+01	4.5E+00	5.6E+06
1-CHLORO-1,1-DIFLUOROETHANE	75-68-3	3.8E+00	4.9E+00	4.9E+01	1.1E-03	2.2E-03	2.5E-04	3.1E+02
1-METHYL-2-NITROBENZENE	88-72-2	1.5E+00	2.0E+00	2.0E+01	4.7E-04	9.2E-04	1.0E-04	1.3E+02
1-METHYL-3-NITROBENZENE	99-08-1	1.8E+04	2.4E+04	2.4E+05	5.5E+00	1.1E+01	1.2E+00	1.5E+06

Substance	CAS or EDF Substance ID	Characterisation factor	One-step weighting factor (SKr/kg)					
		Noncancer TEP emission to air	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
1-METHYL-4-NITROBENZENE	99-99-0	1.2E+04	1.6E+04	1.6E+05	3.7E+00	7.3E+00	8.1E-01	1.0E+06
2,3,4,7,8-PENTACHLORODIBENZOFURAN	57117-31-4	5.9E+09	7.6E+09	7.6E+10	1.8E+06	3.5E+06	3.9E+05	4.8E+11
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN (TCI	1746-01-6	3.8E+11	4.9E+11	4.9E+12	1.2E+08	2.3E+08	2.5E+07	3.1E+13
2,4,5-T	93-76-5	5.0E+00	6.5E+00	6.5E+01	1.5E-03	3.0E-03	3.3E-04	4.1E+02
2,4,5-TRICHLOROPHENOL	95-95-4	5.0E+00	6.5E+00	6.5E+01	1.5E-03	3.0E-03	3.3E-04	4.1E+02
2,4,6-TRICHLOROPHENOL	88-06-2	1.0E+01	1.3E+01	1.3E+02	3.0E-03	5.9E-03	6.6E-04	8.1E+02
2,4,6-TRINITROPHENOL	88-89-1	2.8E+03	3.6E+03	3.6E+04	8.6E-01	1.7E+00	1.9E-01	2.3E+05
2,4,6-TRINITROTOLUENE	118-96-7	9.1E+00	1.2E+01	1.2E+02	2.8E-03	5.4E-03	6.0E-04	7.4E+02
2,4-D	94-75-7	3.0E-01	3.8E-01	3.8E+00	9.0E-05	1.8E-04	1.9E-05	2.4E+01
2,4-DB	94-82-6	1.0E+02	1.4E+02	1.4E+03	3.2E-02	6.2E-02	6.9E-03	8.5E+03
2,4-DICHLOROPHENOL	120-83-2	1.6E+01	2.1E+01	2.1E+02	5.0E-03	9.7E-03	1.1E-03	1.3E+03
2,4-DIMETHYLPHENOL	105-67-9	9.5E-02	1.2E-01	1.2E+00	2.9E-05	5.7E-05	6.3E-06	7.8E+00
2,4-DINITROPHENOL	51-28-5	3.2E+01	4.2E+01	4.2E+02	9.8E-03	1.9E-02	2.1E-03	2.6E+03
2,4-DINITROTOLUENE	121-14-2	3.9E+01	5.1E+01	5.1E+02	1.2E-02	2.3E-02	2.6E-03	3.2E+03
2,6-DIMETHYLPHENOL	576-26-1	2.7E+04	3.5E+04	3.5E+05	8.3E+00	1.6E+01	1.8E+00	2.2E+06
2,6-DINITROTOLUENE	606-20-2	6.4E+01	8.2E+01	8.2E+02	1.9E-02	3.8E-02	4.2E-03	5.2E+03
2-CHLOR-1,3-BUTADIENE	126-99-8	2.5E+00	3.3E+00	3.3E+01	7.8E-04	1.5E-03	1.7E-04	2.1E+02
2-CHLOROPHENOL	95-57-8	3.6E+03	4.7E+03	4.7E+04	1.1E+00	2.2E+00	2.4E-01	3.0E+05
2-CHLOROPROPANE	75-29-6	1.5E+06	1.9E+06	1.9E+07	4.6E+02	8.9E+02	9.9E+01	1.2E+08
2-METHYL-1-PROPANOL	78-83-1	1.6E-01	2.1E-01	2.1E+00	4.8E-05	9.4E-05	1.0E-05	1.3E+01
2-METHYL-2-PROPENOIC ACID, ETHYL ESTER	97-63-2	7.7E+05	1.0E+06	1.0E+07	2.4E+02	4.6E+02	5.1E+01	6.3E+07
2-NITROPROPANE	79-46-9	1.4E+00	1.8E+00	1.8E+01	4.3E-04	8.3E-04	9.3E-05	1.1E+02
2-PHENYLPHENOL	90-43-7	9.1E-03	1.2E-02	1.2E-01	2.8E-06	5.4E-06	6.0E-07	7.4E-01
3,5,5-TRIMETHYL-2-CYCLOHEXENE-1-ONE	78-59-1	2.8E-03	3.6E-03	3.6E-02	8.6E-07	1.7E-06	1.9E-07	2.3E-01
4,4'-ISOPROPYLIDENEDIPHENOL	80-05-7	2.6E-02	3.4E-02	3.4E-01	7.9E-06	1.5E-05	1.7E-06	2.1E+00
4,4'-METHYLENEDIANILINE	101-77-9	7.7E-02	1.0E-01	1.0E+00	2.4E-05	4.6E-05	5.1E-06	6.3E+00
4,6-DINITRO-O-CRESOL	534-52-1	7.3E+02	9.4E+02	9.4E+03	2.2E-01	4.3E-01	4.8E-02	5.9E+04

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
4-NITROPHENOL	100-02-7	3.0E+00	3.9E+00	3.9E+01	9.1E-04	1.8E-03	2.0E-04	2.4E+02
ACENAPHTHENE	83-32-9	9.1E-02	1.2E-01	1.2E+00	2.8E-05	5.4E-05	6.0E-06	7.4E+00
ACETALDEHYDE	75-07-0	1.7E+00	2.2E+00	2.2E+01	5.3E-04	1.0E-03	1.1E-04	1.4E+02
ACETONE	67-64-1	1.1E-01	1.5E-01	1.5E+00	3.5E-05	6.7E-05	7.5E-06	9.3E+00
ACETONITRILE	75-05-8	9.5E+01	1.2E+02	1.2E+03	2.9E-02	5.7E-02	6.3E-03	7.8E+03
ACETOPHENONE	98-86-2	3.8E+00	4.9E+00	4.9E+01	1.2E-03	2.3E-03	2.5E-04	3.1E+02
ACROLEIN	107-02-8	9.5E+02	1.2E+03	1.2E+04	2.9E-01	5.7E-01	6.3E-02	7.8E+04
ACRYLAMIDE	79-06-1	3.0E+01	3.8E+01	3.8E+02	9.0E-03	1.8E-02	1.9E-03	2.4E+03
ACRYLIC ACID	79-10-7	1.2E+01	1.6E+01	1.6E+02	3.7E-03	7.3E-03	8.1E-04	1.0E+03
ACRYLONITRILE	107-13-1	3.9E+01	5.1E+01	5.1E+02	1.2E-02	2.3E-02	2.6E-03	3.2E+03
ALDICARB	116-06-3	4.5E+00	5.9E+00	5.9E+01	1.4E-03	2.7E-03	3.0E-04	3.7E+02
ALDRIN	309-00-2	1.4E+07	1.8E+07	1.8E+08	4.2E+03	8.1E+03	9.0E+02	1.1E+09
ALLYL ALCOHOL	107-18-6	7.3E-01	9.4E-01	9.4E+00	2.2E-04	4.3E-04	4.8E-05	5.9E+01
ALLYL CHLORIDE	107-05-1	1.7E+01	2.2E+01	2.2E+02	5.3E-03	1.0E-02	1.1E-03	1.4E+03
ALPHA-LINDANE	319-84-6	2.7E+01	3.5E+01	3.5E+02	8.3E-03	1.6E-02	1.8E-03	2.2E+03
ALUMINUM	7429-90-5	3.1E+03	4.1E+03	4.1E+04	9.6E-01	1.9E+00	2.1E-01	2.6E+05
AMMONIA	7664-41-7	1.5E+00	1.9E+00	1.9E+01	4.4E-04	8.6E-04	9.6E-05	1.2E+02
ANILINE	62-53-3	1.5E+01	2.0E+01	2.0E+02	4.7E-03	9.2E-03	1.0E-03	1.3E+03
ANTHRACENE	120-12-7	2.0E-02	2.5E-02	2.5E-01	6.0E-06	1.2E-05	1.3E-06	1.6E+00
ANTIMONY	7440-36-0	9.1E+05	1.2E+06	1.2E+07	2.8E+02	5.4E+02	6.0E+01	7.4E+07
ANTIMONY COMPOUNDS	ADQ500	9.1E+05	1.2E+06	1.2E+07	2.8E+02	5.4E+02	6.0E+01	7.4E+07
AROCLOR 1016	12674-11-2	6.8E+05	8.8E+05	8.8E+06	2.1E+02	4.0E+02	4.5E+01	5.6E+07
AROCLOR 1254	11097-69-1	4.0E+06	5.2E+06	5.2E+07	1.2E+03	2.4E+03	2.7E+02	3.3E+08
ARSENIC	7440-38-2	2.5E+04	3.2E+04	3.2E+05	7.5E+00	1.5E+01	1.6E+00	2.0E+06
ARSENIC (ORGANIC OR INORGANIC COMPOUNDS)	ARF750	2.5E+04	3.2E+04	3.2E+05	7.5E+00	1.5E+01	1.6E+00	2.0E+06
ATRAZINE	1912-24-9	6.4E-01	8.2E-01	8.2E+00	1.9E-04	3.8E-04	4.2E-05	5.2E+01

Substance	CAS or EDF Substance ID	Characterisation factor: Noncancer TEP emission to air	One-step weighting factor (SKr/kg): based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
BARIUM	7440-39-3	1.8E+03	2.4E+03	2.4E+04	5.5E-01	1.1E+00	1.2E-01	1.5E+05
BARIUM COMPOUNDS	BAK500	1.8E+03	2.4E+03	2.4E+04	5.5E-01	1.1E+00	1.2E-01	1.5E+05
BENZENE	71-43-2	7.7E+00	1.0E+01	1.0E+02	2.4E-03	4.6E-03	5.1E-04	6.3E+02
BENZENETHIOL	108-98-5	8.6E+07	1.1E+08	1.1E+09	2.6E+04	5.1E+04	5.7E+03	7.0E+09
BENZIDINE	92-87-5	1.5E+00	2.0E+00	2.0E+01	4.7E-04	9.2E-04	1.0E-04	1.3E+02
BENZOIC ACID	65-85-0	1.2E-02	1.5E-02	1.5E-01	3.6E-06	7.0E-06	7.8E-07	9.6E-01
BENZYL BUTYL PHTHALATE	85-68-7	5.9E+00	7.6E+00	7.6E+01	1.8E-03	3.5E-03	3.9E-04	4.8E+02
BENZYL CHLORIDE	100-44-7	1.0E+01	1.4E+01	1.4E+02	3.2E-03	6.2E-03	6.9E-04	8.5E+02
BERYLLIUM	7440-41-7	7.7E+04	1.0E+05	1.0E+06	2.4E+01	4.6E+01	5.1E+00	6.3E+06
BERYLLIUM COMPOUNDS	BFQ500	7.7E+04	1.0E+05	1.0E+06	2.4E+01	4.6E+01	5.1E+00	6.3E+06
BETA-LINDANE	319-85-7	3.0E+03	3.8E+03	3.8E+04	9.0E-01	1.8E+00	1.9E-01	2.4E+05
BIPHENYL	92-52-4	2.7E-01	3.5E-01	3.5E+00	8.2E-05	1.6E-04	1.8E-05	2.2E+01
BIS(2-CHLOROETHYL) ETHER	111-44-4	1.5E+00	1.9E+00	1.9E+01	4.4E-04	8.6E-04	9.6E-05	1.2E+02
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	5.9E+01	7.6E+01	7.6E+02	1.8E-02	3.5E-02	3.9E-03	4.8E+03
BROMOXYNIL	1689-84-5	1.2E+03	1.6E+03	1.6E+04	3.7E-01	7.3E-01	8.1E-02	1.0E+05
CADMIUM	7440-43-9	1.4E+06	1.8E+06	1.8E+07	4.2E+02	8.1E+02	9.0E+01	1.1E+08
CADMIUM COMPOUNDS	CAE750	1.4E+06	1.8E+06	1.8E+07	4.2E+02	8.1E+02	9.0E+01	1.1E+08
CAMPHECHLOR	8001-35-2	2.1E+03	2.8E+03	2.8E+04	6.5E-01	1.3E+00	1.4E-01	1.7E+05
CAPTAN	133-06-2	4.0E-02	5.2E-02	5.2E-01	1.2E-05	2.4E-05	2.7E-06	3.3E+00
CARBARYL	63-25-2	1.4E-03	1.8E-03	1.8E-02	4.2E-07	8.1E-07	9.0E-08	1.1E-01
CARBOFURAN	1563-66-2	2.8E+02	3.6E+02	3.6E+03	8.4E-02	1.6E-01	1.8E-02	2.3E+04
CARBON DISULFIDE	75-15-0	2.2E+00	2.9E+00	2.9E+01	6.8E-04	1.3E-03	1.5E-04	1.8E+02
CARBON TETRACHLORIDE	56-23-5	7.3E+03	9.4E+03	9.4E+04	2.2E+00	4.3E+00	4.8E-01	5.9E+05
CHLORDANE	57-74-9	3.3E+05	4.2E+05	4.2E+06	1.0E+02	1.9E+02	2.1E+01	2.7E+07
CHLOROACETIC ACID	79-11-8	1.5E+02	1.9E+02	1.9E+03	4.6E-02	8.9E-02	9.9E-03	1.2E+04
CHLOROBENZENE	108-90-7	1.3E+00	1.6E+00	1.6E+01	3.9E-04	7.5E-04	8.4E-05	1.0E+02
CHLORODIBROMOMETHANE	124-48-1	2.5E+02	3.3E+02	3.3E+03	7.8E-02	1.5E-01	1.7E-02	2.1E+04

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
CHLORODIFLUOROMETHANE	75-45-6	9.1E+00	1.2E+01	1.2E+02	2.8E-03	5.4E-03	6.0E-04	7.4E+02
CHLOROETHANE	75-00-3	9.1E-02	1.2E-01	1.2E+00	2.8E-05	5.4E-05	6.0E-06	7.4E+00
CHLOROFORM	67-66-3	3.6E+01	4.7E+01	4.7E+02	1.1E-02	2.2E-02	2.4E-03	3.0E+03
CHLOROMETHANE	74-87-3	2.5E+02	3.2E+02	3.2E+03	7.5E-02	1.5E-01	1.6E-02	2.0E+04
CHROMIUM	7440-47-3	1.0E+05	1.4E+05	1.4E+06	3.2E+01	6.2E+01	6.9E+00	8.5E+06
CHROMIUM COMPOUNDS	CMJ500	1.0E+05	1.4E+05	1.4E+06	3.2E+01	6.2E+01	6.9E+00	8.5E+06
CIS-1,2-DICHLOROETHYLENE	156-59-2	1.5E+01	1.9E+01	1.9E+02	4.4E-03	8.6E-03	9.6E-04	1.2E+03
COBALT	7440-48-4	1.2E+04	1.6E+04	1.6E+05	3.7E+00	7.3E+00	8.1E-01	1.0E+06
COBALT COMPOUNDS	CNB850	1.2E+04	1.6E+04	1.6E+05	3.7E+00	7.3E+00	8.1E-01	1.0E+06
COPPER	7440-50-8	3.0E+05	3.9E+05	3.9E+06	9.3E+01	1.8E+02	2.0E+01	2.5E+07
COPPER COMPOUNDS	CNK750	3.0E+05	3.9E+05	3.9E+06	9.3E+01	1.8E+02	2.0E+01	2.5E+07
CUMENE	98-82-8	1.4E-01	1.8E-01	1.8E+00	4.3E-05	8.3E-05	9.3E-06	1.1E+01
CYANAZINE*	21725-46-2	7.3E+01	9.4E+01	9.4E+02	2.2E-02	4.3E-02	4.8E-03	5.9E+03
CYCLOHEXANE	110-82-7	1.3E-02	1.7E-02	1.7E-01	4.0E-06	7.8E-06	8.7E-07	1.1E+00
CYCLOHEXANONE	108-94-1	9.5E-03	1.2E-02	1.2E-01	2.9E-06	5.7E-06	6.3E-07	7.8E-01
DDT	50-29-3	7.3E+04	9.4E+04	9.4E+05	2.2E+01	4.3E+01	4.8E+00	5.9E+06
DI-N-OCTYL PHTHALATE	117-84-0	4.2E+09	5.5E+09	5.5E+10	1.3E+06	2.5E+06	2.8E+05	3.4E+11
DIAZINON*	333-41-5	1.4E+03	1.8E+03	1.8E+04	4.2E-01	8.1E-01	9.0E-02	1.1E+05
DIBUTYL PHTHALATE	84-74-2	1.6E+01	2.1E+01	2.1E+02	5.0E-03	9.7E-03	1.1E-03	1.3E+03
DICAMBA	1918-00-9	5.4E+01	7.1E+01	7.1E+02	1.7E-02	3.2E-02	3.6E-03	4.4E+03
DICHLOROBROMOMETHANE	75-27-4	6.8E+02	8.8E+02	8.8E+03	2.1E-01	4.0E-01	4.5E-02	5.6E+04
DICHLORODIFLUOROMETHANE	75-71-8	1.3E+01	1.7E+01	1.7E+02	4.0E-03	7.8E-03	8.7E-04	1.1E+03
DICHLOROMETHANE	75-09-2	2.6E+01	3.4E+01	3.4E+02	8.0E-03	1.6E-02	1.7E-03	2.1E+03
DICHLORVOS	62-73-7	1.1E+02	1.5E+02	1.5E+03	3.5E-02	6.7E-02	7.5E-03	9.3E+03
DICOFOL	115-32-2	2.4E+03	3.1E+03	3.1E+04	7.2E-01	1.4E+00	1.6E-01	1.9E+05
DIELDRIN	60-57-1	2.3E+06	3.0E+06	3.0E+07	7.1E+02	1.4E+03	1.5E+02	1.9E+08

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
DIETHANOLAMINE	111-42-2	2.0E-01	2.6E-01	2.6E+00	6.2E-05	1.2E-04	1.3E-05	1.7E+01
DIETHYL ETHER	60-29-7	7.7E-02	1.0E-01	1.0E+00	2.4E-05	4.6E-05	5.1E-06	6.3E+00
DIETHYL PHTHALATE	84-66-2	1.6E-01	2.1E-01	2.1E+00	5.0E-05	9.7E-05	1.1E-05	1.3E+01
DIMETHOATE	60-51-5	1.1E+01	1.5E+01	1.5E+02	3.5E-03	6.7E-03	7.5E-04	9.3E+02
DIMETHYL PHTHALATE	131-11-3	1.9E-02	2.4E-02	2.4E-01	5.7E-06	1.1E-05	1.2E-06	1.5E+00
DIMETHYLAMINE	124-40-3	7.7E+00	1.0E+01	1.0E+02	2.4E-03	4.6E-03	5.1E-04	6.3E+02
DINITROBUTYL PHENOL	88-85-7	6.8E+02	8.8E+02	8.8E+03	2.1E-01	4.0E-01	4.5E-02	5.6E+04
DIPHENYLAMINE	122-39-4	4.3E+00	5.6E+00	5.6E+01	1.3E-03	2.6E-03	2.8E-04	3.5E+02
DIURON	330-54-1	8.2E+02	1.1E+03	1.1E+04	2.5E-01	4.8E-01	5.4E-02	6.7E+04
ENDOSULFAN	115-29-7	2.5E+00	3.3E+00	3.3E+01	7.8E-04	1.5E-03	1.7E-04	2.1E+02
ENDRIN	72-20-8	1.1E+05	1.5E+05	1.5E+06	3.5E+01	6.7E+01	7.5E+00	9.3E+06
EPICHLOROHYDRIN	106-89-8	7.7E+02	1.0E+03	1.0E+04	2.4E-01	4.6E-01	5.1E-02	6.3E+04
ETHYL ACETATE	141-78-6	5.4E-02	7.1E-02	7.1E-01	1.7E-05	3.2E-05	3.6E-06	4.4E+00
ETHYL ACRYLATE	140-88-5	2.8E-01	3.6E-01	3.6E+00	8.6E-05	1.7E-04	1.9E-05	2.3E+01
ETHYL DIPROPYLTHIOCARBAMATE	759-94-4	1.1E+03	1.4E+03	1.4E+04	3.3E-01	6.5E-01	7.2E-02	8.9E+04
ETHYLBENZENE	100-41-4	1.5E-01	1.9E-01	1.9E+00	4.6E-05	8.9E-05	9.9E-06	1.2E+01
ETHYLENE GLYCOL	107-21-1	1.2E-01	1.5E-01	1.5E+00	3.6E-05	7.0E-05	7.8E-06	9.6E+00
ETHYLENE GLYCOL MONOETHYL ETHER	110-80-5	1.1E-01	1.5E-01	1.5E+00	3.5E-05	6.7E-05	7.5E-06	9.3E+00
ETHYLENE GLYCOL MONOMETHYL ETHER	109-86-4	1.6E+00	2.1E+00	2.1E+01	5.0E-04	9.7E-04	1.1E-04	1.3E+02
ETHYLENE OXIDE	75-21-8	9.1E+02	1.2E+03	1.2E+04	2.8E-01	5.4E-01	6.0E-02	7.4E+04
ETHYLENE THIOUREA	96-45-7	1.1E+00	1.5E+00	1.5E+01	3.5E-04	6.7E-04	7.5E-05	9.3E+01
FLUORANTHENE	206-44-0	2.3E+01	2.9E+01	2.9E+02	6.9E-03	1.3E-02	1.5E-03	1.9E+03
FLUORENE	86-73-7	1.2E+00	1.5E+00	1.5E+01	3.6E-04	7.0E-04	7.8E-05	9.6E+01
FORMALDEHYDE	50-00-0	3.2E+00	4.1E+00	4.1E+01	9.7E-04	1.9E-03	2.1E-04	2.6E+02
FORMIC ACID	64-18-6	1.5E-02	1.9E-02	1.9E-01	4.6E-06	8.9E-06	9.9E-07	1.2E+00

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
FREON 113	76-13-1	3.1E+01	4.1E+01	4.1E+02	9.6E-03	1.9E-02	2.1E-03	2.6E+03
FURAN	110-00-9	1.5E+01	2.0E+01	2.0E+02	4.7E-03	9.2E-03	1.0E-03	1.3E+03
GAMMA-LINDANE	58-89-9	1.5E+03	1.9E+03	1.9E+04	4.6E-01	8.9E-01	9.9E-02	1.2E+05
HEPTACHLOR	76-44-8	5.9E+01	7.6E+01	7.6E+02	1.8E-02	3.5E-02	3.9E-03	4.8E+03
HEPTACHLOR EPOXIDE	1024-57-3	4.1E+03	5.3E+03	5.3E+04	1.2E+00	2.4E+00	2.7E-01	3.3E+05
HEXACHLORO-1,3-BUTADIENE	87-68-3	8.6E+03	1.1E+04	1.1E+05	2.6E+00	5.1E+00	5.7E-01	7.0E+05
HEXACHLOROBENZENE	118-74-1	2.5E+04	3.3E+04	3.3E+05	7.8E+00	1.5E+01	1.7E+00	2.1E+06
HEXACHLOROCYCLOPENTADIENE	77-47-4	3.5E+01	4.5E+01	4.5E+02	1.1E-02	2.0E-02	2.3E-03	2.8E+03
HEXACHLOROETHANE	67-72-1	1.1E+04	1.4E+04	1.4E+05	3.3E+00	6.5E+00	7.2E-01	8.9E+05
HYDRAZINE	302-01-2	5.0E+01	6.5E+01	6.5E+02	1.5E-02	3.0E-02	3.3E-03	4.1E+03
HYDROGEN CYANIDE	74-90-8	9.5E+03	1.2E+04	1.2E+05	2.9E+00	5.7E+00	6.3E-01	7.8E+05
HYDROQUINONE	123-31-9	1.0E-01	1.4E-01	1.4E+00	3.2E-05	6.2E-05	6.9E-06	8.5E+00
ISOPROPYL ALCOHOL (MANUFACTURING - STRONG ACID PROCESS ONLY, NO SUPPLIER NOTIFICATION)	67-63-0	1.8E-02	2.3E-02	2.3E-01	5.4E-06	1.1E-05	1.2E-06	1.4E+00
LEAD	7439-92-1	5.9E+05	7.6E+05	7.6E+06	1.8E+02	3.5E+02	3.9E+01	4.8E+07
LEAD COMPOUNDS	LCT000	5.9E+05	7.6E+05	7.6E+06	1.8E+02	3.5E+02	3.9E+01	4.8E+07
M-CRESOL	108-39-4	1.5E+00	2.0E+00	2.0E+01	4.7E-04	9.2E-04	1.0E-04	1.3E+02
M-DINITROBENZENE	99-65-0	1.2E+05	1.5E+05	1.5E+06	3.6E+01	7.0E+01	7.8E+00	9.6E+06
M-PHENYLENEDIAMINE	108-45-2	2.3E-01	2.9E-01	2.9E+00	6.9E-05	1.3E-04	1.5E-05	1.9E+01
M-XYLENE	108-38-3	7.3E-02	9.4E-02	9.4E-01	2.2E-05	4.3E-05	4.8E-06	5.9E+00
MALATHION*	121-75-5	2.5E-01	3.2E-01	3.2E+00	7.5E-05	1.5E-04	1.6E-05	2.0E+01
MALEIC ANHYDRIDE	108-31-6	5.0E+04	6.5E+04	6.5E+05	1.5E+01	3.0E+01	3.3E+00	4.1E+06
MANGANESE	7439-96-5	4.4E+03	5.8E+03	5.8E+04	1.4E+00	2.6E+00	2.9E-01	3.6E+05
MANGANESE COMPOUNDS	MAR500	4.4E+03	5.8E+03	5.8E+04	1.4E+00	2.6E+00	2.9E-01	3.6E+05
MERCURY	7439-97-6	1.0E+05	1.3E+05	1.3E+06	3.0E+01	5.9E+01	6.6E+00	8.1E+06
MERCURY COMPOUNDS	EDF-033	1.0E+05	1.3E+05	1.3E+06	3.0E+01	5.9E+01	6.6E+00	8.1E+06

Substance	CAS or EDF Substance ID	Characterisation factor	One-step weighting factor (SKr/kg)					
		Noncancer TEP emission to air	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
METHACRYLONITRILE	126-98-7	1.7E+05	2.2E+05	2.2E+06	5.3E+01	1.0E+02	1.1E+01	1.4E+07
METHANOL	67-56-1	4.4E-02	5.7E-02	5.7E-01	1.3E-05	2.6E-05	2.9E-06	3.6E+00
METHOXYCHLOR	72-43-5	6.8E+01	8.8E+01	8.8E+02	2.1E-02	4.0E-02	4.5E-03	5.6E+03
METHYL ACETATE	79-20-9	5.0E-02	6.5E-02	6.5E-01	1.5E-05	3.0E-05	3.3E-06	4.1E+00
METHYL ACRYLATE	96-33-3	1.5E-01	1.9E-01	1.9E+00	4.4E-05	8.6E-05	9.6E-06	1.2E+01
METHYL BROMIDE	74-83-9	5.4E+03	7.1E+03	7.1E+04	1.7E+00	3.2E+00	3.6E-01	4.4E+05
METHYL ETHYL KETONE	78-93-3	5.0E-01	6.5E-01	6.5E+00	1.5E-04	3.0E-04	3.3E-05	4.1E+01
METHYL ISOBUTYL KETONE	108-10-1	3.3E-01	4.2E-01	4.2E+00	1.0E-04	1.9E-04	2.1E-05	2.7E+01
METHYL METHACRYLATE	80-62-6	6.4E-02	8.2E-02	8.2E-01	1.9E-05	3.8E-05	4.2E-06	5.2E+00
METHYL PARATHION	298-00-0	9.1E+02	1.2E+03	1.2E+04	2.8E-01	5.4E-01	6.0E-02	7.4E+04
METHYL TERT-BUTYL ETHER	1634-04-4	4.0E-02	5.2E-02	5.2E-01	1.2E-05	2.4E-05	2.7E-06	3.3E+00
METHYLENE BROMIDE	74-95-3	1.4E+02	1.8E+02	1.8E+03	4.2E-02	8.1E-02	9.0E-03	1.1E+04
METRIBUZIN*	21087-64-9	7.3E+00	9.4E+00	9.4E+01	2.2E-03	4.3E-03	4.8E-04	5.9E+02
N,N-DIMETHYLANILINE	121-69-7	2.2E+00	2.8E+00	2.8E+01	6.6E-04	1.3E-03	1.4E-04	1.8E+02
N-BUTYL ALCOHOL	71-36-3	4.2E-01	5.4E-01	5.4E+00	1.3E-04	2.5E-04	2.7E-05	3.4E+01
N-HEXANE	110-54-3	4.2E-01	5.5E-01	5.5E+00	1.3E-04	2.5E-04	2.8E-05	3.4E+01
NAPHTHALENE	91-20-3	5.9E+00	7.6E+00	7.6E+01	1.8E-03	3.5E-03	3.9E-04	4.8E+02
NICKEL	7440-02-0	4.3E+03	5.5E+03	5.5E+04	1.3E+00	2.5E+00	2.8E-01	3.5E+05
NICKEL COMPOUNDS	NDB000	4.3E+03	5.5E+03	5.5E+04	1.3E+00	2.5E+00	2.8E-01	3.5E+05
NITROBENZENE	98-95-3	1.1E+01	1.4E+01	1.4E+02	3.3E-03	6.5E-03	7.2E-04	8.9E+02
O-ANISIDINE	90-04-0	1.5E+01	1.9E+01	1.9E+02	4.4E-03	8.6E-03	9.6E-04	1.2E+03
O-CRESOL	95-48-7	2.3E+00	2.9E+00	2.9E+01	6.9E-04	1.3E-03	1.5E-04	1.9E+02
O-DINITROBENZENE	528-29-0	2.2E+06	2.8E+06	2.8E+07	6.6E+02	1.3E+03	1.4E+02	1.8E+08
O-NITROANILINE	88-74-4	1.0E+06	1.4E+06	1.4E+07	3.2E+02	6.2E+02	6.9E+01	8.5E+07
O-XYLENE	95-47-6	1.3E-01	1.6E-01	1.6E+00	3.9E-05	7.5E-05	8.4E-06	1.0E+01
P-CHLOROANILINE	106-47-8	1.6E+00	2.1E+00	2.1E+01	4.8E-04	9.4E-04	1.0E-04	1.3E+02

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
P-CRESOL	106-44-5	2.1E+00	2.7E+00	2.7E+01	6.4E-04	1.2E-03	1.4E-04	1.7E+02
P-PHENYLENEDIAMINE	106-50-3	2.4E-03	3.1E-03	3.1E-02	7.3E-07	1.4E-06	1.6E-07	2.0E-01
P-XYLENE	106-42-3	1.2E-01	1.6E-01	1.6E+00	3.7E-05	7.3E-05	8.1E-06	1.0E+01
PENTACHLOROPHENOL	87-86-5	5.9E+02	7.6E+02	7.6E+03	1.8E-01	3.5E-01	3.9E-02	4.8E+04
PHENOL	108-95-2	2.0E-02	2.6E-02	2.6E-01	6.2E-06	1.2E-05	1.3E-06	1.7E+00
PHOSGENE	75-44-5	4.3E+05	5.6E+05	5.6E+06	1.3E+02	2.6E+02	2.8E+01	3.5E+07
PHTHALIC ANHYDRIDE	85-44-9	9.5E-01	1.2E+00	1.2E+01	2.9E-04	5.7E-04	6.3E-05	7.8E+01
PRONAMIDE	23950-58-5	1.0E+01	1.4E+01	1.4E+02	3.2E-03	6.2E-03	6.9E-04	8.5E+02
PROPOXUR	114-26-1	2.9E-01	3.8E-01	3.8E+00	8.9E-05	1.7E-04	1.9E-05	2.4E+01
PROPYLENE	115-07-1	3.3E-03	4.2E-03	4.2E-02	1.0E-06	1.9E-06	2.1E-07	2.7E-01
PROPYLENE OXIDE	75-56-9	4.5E-01	5.9E-01	5.9E+00	1.4E-04	2.7E-04	3.0E-05	3.7E+01
PYRENE	129-00-0	2.8E+00	3.6E+00	3.6E+01	8.6E-04	1.7E-03	1.9E-04	2.3E+02
PYRIDINE	110-86-1	9.1E+01	1.2E+02	1.2E+03	2.8E-02	5.4E-02	6.0E-03	7.4E+03
QUINTOZENE	82-68-8	1.5E+03	2.0E+03	2.0E+04	4.7E-01	9.2E-01	1.0E-01	1.3E+05
S,S,S-TRIBUTYLTRITHIOPHOSPHATE	78-48-8	2.1E+04	2.7E+04	2.7E+05	6.4E+00	1.2E+01	1.4E+00	1.7E+06
SELENIUM	7782-49-2	3.8E+03	4.9E+03	4.9E+04	1.2E+00	2.3E+00	2.5E-01	3.1E+05
SELENIUM COMPOUNDS	SBP500	3.8E+03	4.9E+03	4.9E+04	1.2E+00	2.3E+00	2.5E-01	3.1E+05
SILVER	7440-22-4	3.3E+03	4.2E+03	4.2E+04	1.0E+00	1.9E+00	2.1E-01	2.7E+05
SILVER COMPOUNDS	SDO000	3.3E+03	4.2E+03	4.2E+04	1.0E+00	1.9E+00	2.1E-01	2.7E+05
STYRENE	100-42-5	1.4E-02	1.8E-02	1.8E-01	4.2E-06	8.1E-06	9.0E-07	1.1E+00
STYRENE OXIDE	96-09-3	1.1E+01	1.5E+01	1.5E+02	3.5E-03	6.7E-03	7.5E-04	9.3E+02
TETRACHLOROETHYLENE	127-18-4	1.0E+02	1.4E+02	1.4E+03	3.2E-02	6.2E-02	6.9E-03	8.5E+03
THALLIUM	7440-28-0	1.9E+05	2.4E+05	2.4E+06	5.7E+01	1.1E+02	1.2E+01	1.5E+07
THIRAM	137-26-8	2.6E+01	3.4E+01	3.4E+02	8.0E-03	1.6E-02	1.7E-03	2.1E+03
TOLUENE	108-88-3	4.5E-01	5.9E-01	5.9E+00	1.4E-04	2.7E-04	3.0E-05	3.7E+01
TRANS-1,3-DICHLOROPROPENE	10061-02-6	1.5E+06	2.0E+06	2.0E+07	4.7E+02	9.2E+02	1.0E+02	1.3E+08
TRIBROMOMETHANE	75-25-2	3.2E+02	4.2E+02	4.2E+03	9.8E-02	1.9E-01	2.1E-02	2.6E+04

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to air	One-step weighting factor (SKr/kg) based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	180 SKr/kg lead	350 SKr/kg lead	based on 20 SKr/kg copper	based on 20 SKr/kg malathion
TRICHLOROETHYLENE	79-01-6	4.5E-01	5.9E-01	5.9E+00	1.4E-04	2.7E-04	3.0E-05	3.7E+01
TRICHLOROFLUOROMETHANE	75-69-4	3.9E+01	5.1E+01	5.1E+02	1.2E-02	2.3E-02	2.6E-03	3.2E+03
TRIETHYLAMINE	121-44-8	2.0E+00	2.6E+00	2.6E+01	6.1E-04	1.2E-03	1.3E-04	1.6E+02
TRIFLURALIN	1582-09-8	7.7E+01	1.0E+02	1.0E+03	2.4E-02	4.6E-02	5.1E-03	6.3E+03
VANADIUM	7440-62-2	9.5E+03	1.2E+04	1.2E+05	2.9E+00	5.7E+00	6.3E-01	7.8E+05
VINYL ACETATE	108-05-4	8.6E-01	1.1E+00	1.1E+01	2.6E-04	5.1E-04	5.7E-05	7.0E+01
VINYL BROMIDE	593-60-2	8.2E+00	1.1E+01	1.1E+02	2.5E-03	4.8E-03	5.4E-04	6.7E+02
VINYL CHLORIDE	75-01-4	5.0E+01	6.5E+01	6.5E+02	1.5E-02	3.0E-02	3.3E-03	4.1E+03
XYLENE (MIXED ISOMERS)	1330-20-7	3.7E-01	4.8E-01	4.8E+00	1.1E-04	2.2E-04	2.4E-05	3.0E+01
ZINC	7440-66-6	1.2E+03	1.5E+03	1.5E+04	3.6E-01	7.0E-01	7.8E-02	9.6E+04
ZINC COMPOUNDS	ZFS000	1.2E+03	1.5E+03	1.5E+04	3.6E-01	7.0E-01	7.8E-02	9.6E+04

*Pesicides admitted for use in Sweden, taxed with 20 SKr/kg.

Table A18. One-step weghting factors for non-cancer human health risk from substances emitted to water. Toxicity equivalency potentials (TEP) from EDF (1999) are combined with the tax on the active substance in pesticides and the tax on the cadmium content in phosphor fertilisers.

		Characterisation factor	One-step weighting factor (SKr/kg)		
Substance	CAS or EDF Substance ID	Noncancer TEP emission to water	based on 20 kr/kg copper	based on 20 SKr/kg malathion	based on 30000 SKr/kg cadmium
1,1,1,2-TETRACHLOROETHANE	630-20-6	9.5E+00	6.1E-04	3.2E+01	1.8E-01
1,1,1-TRICHLOROETHANE	71-55-6	9.1E+01	5.8E-03	3.1E+02	1.7E+00
1,1,2,2-TETRACHLOROETHANE	79-34-5	2.5E+00	1.6E-04	8.3E+00	4.5E-02
1,1,2-TRICHLOROETHANE	79-00-5	1.3E+01	8.1E-04	4.3E+01	2.3E-01
1,1-DICHLOROETHANE	75-34-3	7.7E+00	4.9E-04	2.6E+01	1.4E-01
1,1-DICHLOROETHYLENE	75-35-4	1.6E+01	1.0E-03	5.4E+01	2.9E-01
1,1-DIMETHYL HYDRAZINE	57-14-7	3.8E+02	2.4E-02	1.3E+03	7.0E+00
1,2,3-TRICHLOROPROPANE	96-18-4	5.9E+01	3.8E-03	2.0E+02	1.1E+00
1,2,4-TRICHLOROBENZENE	120-82-1	4.5E+01	2.9E-03	1.5E+02	8.3E-01
1,2,4-TRIMETHYLBENZENE	95-63-6	3.1E+02	2.0E-02	1.0E+03	5.7E+00
1,2-DIBROMOETHANE	106-93-4	1.5E+03	9.9E-02	5.2E+03	2.8E+01
1,2-DICHLOROBENZENE	95-50-1	1.3E+01	8.1E-04	4.3E+01	2.3E-01
1,2-DICHLOROETHANE	107-06-2	9.1E+00	5.8E-04	3.1E+01	1.7E-01
1,2-DICHLOROETHYLENE	540-59-0	8.6E+00	5.5E-04	2.9E+01	1.6E-01
1,2-DICHLOROPROPANE	78-87-5	3.4E+02	2.2E-02	1.2E+03	6.3E+00
1,2-TRANS-DICHLOROETHYLENE	156-60-5	2.0E+00	1.2E-04	6.6E+00	3.6E-02
1,3-BUTADIENE	106-99-0	1.2E+01	7.5E-04	4.0E+01	2.2E-01
1,3-DICHLOROPROPENE (MIXED ISOMERS)	542-75-6	5.0E+01	3.2E-03	1.7E+02	9.2E-01
1,4-DICHLOROBENZENE	106-46-7	1.8E+00	1.1E-04	6.0E+00	3.3E-02
1,4-DIOXANE	123-91-1	1.1E-01	7.2E-06	3.8E-01	2.1E-03
1-BUTYL CHLORIDE	109-69-3	6.8E+04	4.3E+00	2.3E+05	1.3E+03
1-CHLORO-1,1-DIFLUOROETHANE	75-68-3	3.2E-02	2.1E-06	1.1E-01	5.9E-04
1-METHYL-2-NITROBENZENE	88-72-2	7.3E-01	4.6E-05	2.5E+00	1.3E-02
1-METHYL-3-NITROBENZENE	99-08-1	1.8E+04	1.2E+00	6.2E+04	3.3E+02

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to water	One-step weighting factor (SKr/kg) based on 20 kr/kg copper	 based on 20 SKr/kg malathion	 based on 30000 SKr/kg cadmium
1-METHYL-4-NITROBENZENE	99-99-0	1.3E+04	8.1E-01	4.3E+04	2.3E+02
2,3,4,7,8-PENTACHLORODIBENZOFURAN	57117-31-4	2.3E+09	1.5E+05	7.8E+09	4.3E+07
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN (TCDD	1746-01-6	2.4E+12	1.5E+08	8.2E+12	4.4E+10
2,4,5-T	93-76-5	6.8E+00	4.3E-04	2.3E+01	1.3E-01
2,4,5-TRICHLOROPHENOL	95-95-4	1.5E+00	9.9E-05	5.2E+00	2.8E-02
2,4,6-TRICHLOROPHENOL	88-06-2	6.8E-02	4.3E-06	2.3E-01	1.3E-03
2,4,6-TRINITROPHENOL	88-89-1	9.5E+02	6.1E-02	3.2E+03	1.8E+01
2,4,6-TRINITROTOLUENE	118-96-7	3.7E+00	2.3E-04	1.2E+01	6.8E-02
2,4-D	94-75-7	9.5E-01	6.1E-05	3.2E+00	1.8E-02
2,4-DB	94-82-6	6.8E+00	4.3E-04	2.3E+01	1.3E-01
2,4-DICHLOROPHENOL	120-83-2	9.5E-02	6.1E-06	3.2E-01	1.8E-03
2,4-DIMETHYLPHENOL	105-67-9	9.5E-01	6.1E-05	3.2E+00	1.8E-02
2,4-DINITROPHENOL	51-28-5	7.3E+00	4.6E-04	2.5E+01	1.3E-01
2,4-DINITROTOLUENE	121-14-2	1.0E+00	6.7E-05	3.5E+00	1.9E-02
2,6-DIMETHYLPHENOL	576-26-1	3.0E+04	1.9E+00	1.0E+05	5.5E+02
2,6-DINITROTOLUENE	606-20-2	1.1E+00	7.2E-05	3.8E+00	2.1E-02
2-CHLOR-1,3-BUTADIENE	126-99-8	2.4E+01	1.5E-03	8.2E+01	4.4E-01
2-CHLOROPHENOL	95-57-8	3.7E+03	2.3E-01	1.2E+04	6.8E+01
2-CHLOROPROPANE	75-29-6	1.5E+06	9.6E+01	5.1E+06	2.8E+04
2-METHYL-1-PROPANOL	78-83-1	1.7E-02	1.1E-06	5.8E-02	3.2E-04
2-METHYL-2-PROPENOIC ACID, ETHYL ESTER	97-63-2	7.7E+05	4.9E+01	2.6E+06	1.4E+04
2-NITROPROPANE	79-46-9	1.1E+01	7.2E-04	3.8E+01	2.1E-01
2-PHENYLPHENOL	90-43-7	5.0E-01	3.2E-05	1.7E+00	9.2E-03
3,5,5-TRIMETHYL-2-CYCLOHEXENE-1-ONE	78-59-1	2.2E-01	1.4E-05	7.4E-01	4.0E-03
4,4'-ISOPROPYLIDENEDIPHENOL	80-05-7	4.2E-01	2.7E-05	1.4E+00	7.8E-03
4,4'-METHYLENEDIANILINE	101-77-9	8.6E-02	5.5E-06	2.9E-01	1.6E-03

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to water	One-step weighting factor (SKr/kg) based on 20 kr/kg copper	based on 20 SKr/kg malathion	based on 30000 SKr/kg cadmium
4,6-DINITRO-O-CRESOL	534-52-1	7.3E+01	4.6E-03	2.5E+02	1.3E+00
4-NITROPHENOL	100-02-7	1.4E-01	8.7E-06	4.6E-01	2.5E-03
ACENAPHTHENE	83-32-9	2.9E+00	1.8E-04	9.7E+00	5.3E-02
ACETALDEHYDE	75-07-0	3.2E+00	2.1E-04	1.1E+01	5.9E-02
ACETONE	67-64-1	8.6E-02	5.5E-06	2.9E-01	1.6E-03
ACETONITRILE	75-05-8	2.3E+01	1.4E-03	7.7E+01	4.2E-01
ACETOPHENONE	98-86-2	2.4E-01	1.5E-05	8.2E-01	4.4E-03
ACROLEIN	107-02-8	5.4E+03	3.5E-01	1.8E+04	1.0E+02
ACRYLAMIDE	79-06-1	2.4E+02	1.5E-02	8.0E+02	4.3E+00
ACRYLIC ACID	79-10-7	1.4E-01	9.0E-06	4.8E-01	2.6E-03
ACRYLONITRILE	107-13-1	1.8E+01	1.2E-03	6.2E+01	3.3E-01
ALDICARB	116-06-3	2.4E+02	1.5E-02	8.2E+02	4.4E+00
ALDRIN	309-00-2	4.1E+08	2.6E+04	1.4E+09	7.5E+06
ALLYL ALCOHOL	107-18-6	7.7E-01	4.9E-05	2.6E+00	1.4E-02
ALLYL CHLORIDE	107-05-1	2.7E+01	1.7E-03	9.1E+01	4.9E-01
ALPHA-LINDANE	319-84-6	1.5E+02	9.6E-03	5.1E+02	2.8E+00
ALUMINUM	7429-90-5	0.0E+00	0.0E+00	0.0E+00	0.0E+00
AMMONIA	7664-41-7	1.9E-02	1.2E-06	6.3E-02	3.4E-04
ANILINE	62-53-3	6.8E+01	4.3E-03	2.3E+02	1.3E+00
ANTHRACENE	120-12-7	1.9E-02	1.2E-06	6.5E-02	3.5E-04
ANTIMONY	7440-36-0	1.5E+06	9.6E+01	5.1E+06	2.8E+04
ANTIMONY COMPOUNDS	ADQ500	1.5E+06	9.6E+01	5.1E+06	2.8E+04
AROCLOR 1016	12674-11-2	1.5E+06	9.6E+01	5.1E+06	2.8E+04
AROCLOR 1254	11097-69-1	1.9E+07	1.2E+03	6.5E+07	3.5E+05
ARSENIC	7440-38-2	2.7E+04	1.7E+00	9.1E+04	4.9E+02
ARSENIC (ORGANIC OR INORGANIC COMPOUND	ARF750	2.7E+04	1.7E+00	9.1E+04	4.9E+02
ATRAZINE	1912-24-9	1.9E-02	1.2E-06	6.5E-02	3.5E-04

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to water	One-step weighting factor (SKr/kg) based on 20 kr/kg copper	based on 20 SKr/kg malathion	based on 30000 SKr/kg cadmium
BARIUM	7440-39-3	2.5E+03	1.6E-01	8.3E+03	4.5E+01
BARIUM COMPOUNDS	BAK500	2.5E+03	1.6E-01	8.3E+03	4.5E+01
BENZENE	71-43-2	5.0E+00	3.2E-04	1.7E+01	9.2E-02
BENZENETHIOL	108-98-5	8.6E+07	5.5E+03	2.9E+08	1.6E+06
BENZIDINE	92-87-5	6.4E+00	4.1E-04	2.2E+01	1.2E-01
BENZOIC ACID	65-85-0	1.6E-03	1.0E-07	5.4E-03	2.9E-05
BENZYL BUTYL PHTHALATE	85-68-7	2.2E+00	1.4E-04	7.5E+00	4.1E-02
BENZYL CHLORIDE	100-44-7	9.5E-01	6.1E-05	3.2E+00	1.8E-02
BERYLLIUM	7440-41-7	2.0E+04	1.2E+00	6.6E+04	3.6E+02
BERYLLIUM COMPOUNDS	BFQ500	2.0E+04	1.2E+00	6.6E+04	3.6E+02
BETA-LINDANE	319-85-7	3.0E+03	1.9E-01	1.0E+04	5.5E+01
BIPHENYL	92-52-4	3.5E+00	2.2E-04	1.2E+01	6.3E-02
BIS(2-CHLOROETHYL) ETHER	111-44-4	6.4E+00	4.1E-04	2.2E+01	1.2E-01
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	2.4E+02	1.5E-02	8.2E+02	4.4E+00
BROMOXYNIL	1689-84-5	1.2E+03	7.8E-02	4.2E+03	2.3E+01
CADMIUM	7440-43-9	1.6E+06	1.0E+02	5.5E+06	3.0E+04
CADMIUM COMPOUNDS	CAE750	1.6E+06	1.0E+02	5.5E+06	3.0E+04
CAMPHECHLOR	8001-35-2	2.4E+03	1.5E-01	8.2E+03	4.4E+01
CAPTAN	133-06-2	3.9E-03	2.5E-07	1.3E-02	7.2E-05
CARBARYL	63-25-2	6.4E-01	4.1E-05	2.2E+00	1.2E-02
CARBOFURAN	1563-66-2	3.9E+01	2.5E-03	1.3E+02	7.3E-01
CARBON DISULFIDE	75-15-0	2.5E+00	1.6E-04	8.6E+00	4.7E-02
CARBON TETRACHLORIDE	56-23-5	6.8E+03	4.3E-01	2.3E+04	1.3E+02
CHLORDANE	57-74-9	6.4E+06	4.1E+02	2.2E+07	1.2E+05
CHLOROACETIC ACID	79-11-8	2.0E+00	1.2E-04	6.6E+00	3.6E-02
CHLOROBENZENE	108-90-7	3.2E+00	2.1E-04	1.1E+01	5.9E-02

		Characterisation factor	One-step weighting factor (SKr/kg)		
Substance	CAS or EDF Substance ID	Noncancer TEP emission to water	based on 20 kr/kg copper	based on 20 SKr/kg malathion	based on 30000 SKr/kg cadmium
CHLORODIBROMOMETHANE	124-48-1	2.2E+02	1.4E-02	7.5E+02	4.1E+00
CHLORODIFLUOROMETHANE	75-45-6	6.8E-02	4.3E-06	2.3E-01	1.3E-03
CHLOROETHANE	75-00-3	8.2E-02	5.2E-06	2.8E-01	1.5E-03
CHLOROFORM	67-66-3	3.3E+01	2.1E-03	1.1E+02	6.0E-01
CHLOROMETHANE	74-87-3	1.4E+02	8.7E-03	4.6E+02	2.5E+00
CHROMIUM	7440-47-3	3.0E+03	1.9E-01	1.0E+04	5.4E+01
CHROMIUM COMPOUNDS	CMJ500	3.0E+03	1.9E-01	1.0E+04	5.4E+01
CIS-1,2-DICHLOROETHYLENE	156-59-2	1.9E+01	1.2E-03	6.5E+01	3.5E-01
COPPER*	7440-50-8	3.1E+05	2.0E+01	1.1E+06	5.8E+03
COPPER COMPOUNDS*	CNK750	3.1E+05	2.0E+01	1.1E+06	5.8E+03
CUMENE	98-82-8	1.7E-01	1.1E-05	5.7E-01	3.1E-03
CYANAZINE*	21725-46-2	5.0E+01	3.2E-03	1.7E+02	9.2E-01
CYCLOHEXANE	110-82-7	1.0E-01	6.7E-06	3.5E-01	1.9E-03
CYCLOHEXANONE	108-94-1	3.6E-03	2.3E-07	1.2E-02	6.7E-05
DDT	50-29-3	5.0E+05	3.2E+01	1.7E+06	9.2E+03
DI-N-OCTYL PHTHALATE	117-84-0	2.2E+05	1.4E+01	7.5E+05	4.1E+03
DIAZINON*	333-41-5	1.1E+03	7.2E-02	3.8E+03	2.1E+01
DIBUTYL PHTHALATE	84-74-2	8.6E+00	5.5E-04	2.9E+01	1.6E-01
DICAMBA	1918-00-9	9.1E+00	5.8E-04	3.1E+01	1.7E-01
DICHLOROBROMOMETHANE	75-27-4	5.0E+02	3.2E-02	1.7E+03	9.2E+00
DICHLORODIFLUOROMETHANE	75-71-8	1.0E+01	6.7E-04	3.5E+01	1.9E-01
DICHLOROMETHANE	75-09-2	1.5E+01	9.3E-04	4.9E+01	2.7E-01
DICHLORVOS	62-73-7	1.0E+02	6.7E-03	3.5E+02	1.9E+00
DICOFOL	115-32-2	9.1E+03	5.8E-01	3.1E+04	1.7E+02
DIELDRIN	60-57-1	1.3E+07	8.1E+02	4.3E+07	2.3E+05
DIETHANOLAMINE	111-42-2	3.4E-01	2.1E-05	1.1E+00	6.2E-03

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to water	One-step weighting factor (SKr/kg) based on 20 kr/kg copper	based on 20 SKr/kg malathion	based on 30000 SKr/kg cadmium
DIETHYL ETHER	60-29-7	2.2E-01	1.4E-05	7.5E-01	4.1E-03
DIETHYL PHTHALATE	84-66-2	1.2E-01	7.8E-06	4.2E-01	2.3E-03
DIMETHOATE	60-51-5	5.0E+02	3.2E-02	1.7E+03	9.2E+00
DIMETHYL PHTHALATE	131-11-3	1.4E-03	9.0E-08	4.8E-03	2.6E-05
DIMETHYLAMINE	124-40-3	8.2E+00	5.2E-04	2.8E+01	1.5E-01
DINITROBUTYL PHENOL	88-85-7	7.3E+02	4.6E-02	2.5E+03	1.3E+01
DIPHENYLAMINE	122-39-4	1.4E+01	9.0E-04	4.8E+01	2.6E-01
DIURON	330-54-1	1.4E+02	8.7E-03	4.6E+02	2.5E+00
ENDOSULFAN	115-29-7	1.2E+01	7.8E-04	4.2E+01	2.3E-01
ENDRIN	72-20-8	8.2E+05	5.2E+01	2.8E+06	1.5E+04
EPICHLOROHYDRIN	106-89-8	1.6E+02	1.0E-02	5.4E+02	2.9E+00
ETHYL ACETATE	141-78-6	1.4E-02	9.0E-07	4.8E-02	2.6E-04
ETHYL ACRYLATE	140-88-5	3.9E-01	2.5E-05	1.3E+00	7.1E-03
ETHYL DIPROPYLTHIOCARBAMATE	759-94-4	1.1E+03	7.0E-02	3.7E+03	2.0E+01
ETHYLBENZENE	100-41-4	2.8E-01	1.8E-05	9.5E-01	5.2E-03
ETHYLENE GLYCOL	107-21-1	9.5E-03	6.1E-07	3.2E-02	1.8E-04
ETHYLENE GLYCOL MONOETHYL ETHER	110-80-5	1.9E-01	1.2E-05	6.5E-01	3.5E-03
ETHYLENE GLYCOL MONOMETHYL ETHER	109-86-4	3.7E+01	2.4E-03	1.3E+02	6.8E-01
ETHYLENE OXIDE	75-21-8	3.4E+02	2.1E-02	1.1E+03	6.2E+00
ETHYLENE THIOUREA	96-45-7	2.6E+03	1.7E-01	8.8E+03	4.8E+01
FLUORANTHENE	206-44-0	1.6E+01	1.0E-03	5.5E+01	3.0E-01
FLUORENE	86-73-7	3.1E+01	2.0E-03	1.1E+02	5.8E-01
FORMALDEHYDE	50-00-0	3.0E-01	1.9E-05	1.0E+00	5.6E-03
FORMIC ACID	64-18-6	1.9E-03	1.2E-07	6.5E-03	3.5E-05
FREON 113	76-13-1	3.0E+01	1.9E-03	1.0E+02	5.4E-01
FURAN	110-00-9	2.4E+01	1.5E-03	8.2E+01	4.4E-01

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to water	One-step weighting factor (SKr/kg) based on 20 kr/kg copper	 based on 20 SKr/kg malathion	 based on 30000 SKr/kg cadmium
GAMMA-LINDANE	58-89-9	7.3E+03	4.6E-01	2.5E+04	1.3E+02
HEPTACHLOR	76-44-8	3.5E+03	2.2E-01	1.2E+04	6.3E+01
HEPTACHLOR EPOXIDE	1024-57-3	7.7E+05	4.9E+01	2.6E+06	1.4E+04
HEXACHLORO-1,3-BUTADIENE	87-68-3	1.7E+04	1.1E+00	5.7E+04	3.1E+02
HEXACHLOROBENZENE	118-74-1	5.9E+04	3.8E+00	2.0E+05	1.1E+03
HEXACHLOROCYCLOPENTADIENE	77-47-4	1.3E+02	8.1E-03	4.3E+02	2.3E+00
HEXACHLOROETHANE	67-72-1	9.5E+03	6.1E-01	3.2E+04	1.8E+02
HYDRAZINE	302-01-2	1.5E+02	9.6E-03	5.1E+02	2.8E+00
HYDROGEN CYANIDE	74-90-8	8.2E+03	5.2E-01	2.8E+04	1.5E+02
HYDROQUINONE	123-31-9	2.2E-03	1.4E-07	7.5E-03	4.1E-05
STRONG ACID PROCESS ONLY, NO SUPPLIER NOTIFICATION)	67-63-0	6.8E-03	4.3E-07	2.3E-02	1.3E-04
LEAD	7439-92-1	2.5E+05	1.6E+01	8.6E+05	4.7E+03
LEAD COMPOUNDS	LCT000	2.5E+05	1.6E+01	8.6E+05	4.7E+03
M-CRESOL	108-39-4	4.5E-01	2.9E-05	1.5E+00	8.3E-03
M-DINITROBENZENE	99-65-0	2.3E+06	1.4E+02	7.7E+06	4.2E+04
M-PHENYLENEDIAMINE	108-45-2	8.6E+00	5.5E-04	2.9E+01	1.6E-01
M-XYLENE	108-38-3	3.9E-01	2.5E-05	1.3E+00	7.2E-03
MALATHION*	121-75-5	5.9E+00	3.8E-04	2.0E+01	1.1E-01
MALEIC ANHYDRIDE	108-31-6	5.4E-02	3.5E-06	1.8E-01	1.0E-03
MANGANESE	7439-96-5	7.7E+03	4.9E-01	2.6E+04	1.4E+02
MANGANESE COMPOUNDS	MAR500	7.7E+03	4.9E-01	2.6E+04	1.4E+02
MERCURY	7439-97-6	5.4E+05	3.5E+01	1.8E+06	1.0E+04
MERCURY COMPOUNDS	EDF-033	5.4E+05	3.5E+01	1.8E+06	1.0E+04
METHACRYLONITRILE	126-98-7	1.1E+05	7.2E+00	3.8E+05	2.1E+03
METHANOL	67-56-1	1.2E-02	7.5E-07	4.0E-02	2.2E-04
METHOXYCHLOR	72-43-5	3.9E+00	2.5E-04	1.3E+01	7.3E-02

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to water	One-step weighting factor (SKr/kg) based on 20 kr/kg copper	based on 20 SKr/kg malathion	based on 30000 SKr/kg cadmium
METHYL ACETATE	79-20-9	1.1E-02	7.0E-07	3.7E-02	2.0E-04
METHYL ACRYLATE	96-33-3	1.9E-01	1.2E-05	6.3E-01	3.4E-03
METHYL BROMIDE	74-83-9	3.0E+03	1.9E-01	1.0E+04	5.6E+01
METHYL ETHYL KETONE	78-93-3	4.2E-02	2.7E-06	1.4E-01	7.7E-04
METHYL ISOBUTYL KETONE	108-10-1	2.3E-01	1.4E-05	7.7E-01	4.2E-03
METHYL METHACRYLATE	80-62-6	9.1E-01	5.8E-05	3.1E+00	1.7E-02
METHYL PARATHION	298-00-0	2.0E+03	1.3E-01	6.9E+03	3.8E+01
METHYL TERT-BUTYL ETHER	1634-04-4	1.1E-01	7.0E-06	3.7E-01	2.0E-03
METHYLENE BROMIDE	74-95-3	1.4E+02	9.0E-03	4.8E+02	2.6E+00
METRIBUZIN*	21087-64-9	7.7E+00	4.9E-04	2.6E+01	1.4E-01
N,N-DIMETHYLANILINE	121-69-7	2.5E+00	1.6E-04	8.3E+00	4.5E-02
N-BUTYL ALCOHOL	71-36-3	9.1E-02	5.8E-06	3.1E-01	1.7E-03
N-HEXANE	110-54-3	9.1E+00	5.8E-04	3.1E+01	1.7E-01
NAPHTHALENE	91-20-3	1.2E+01	7.8E-04	4.2E+01	2.3E-01
NICKEL	7440-02-0	5.9E+03	3.8E-01	2.0E+04	1.1E+02
NICKEL COMPOUNDS	NDB000	5.9E+03	3.8E-01	2.0E+04	1.1E+02
NITROBENZENE	98-95-3	4.3E+02	2.7E-02	1.4E+03	7.8E+00
O-ANISIDINE	90-04-0	1.7E+01	1.1E-03	5.7E+01	3.1E-01
O-CRESOL	95-48-7	2.9E-01	1.9E-05	9.8E-01	5.3E-03
O-DINITROBENZENE	528-29-0	2.4E+06	1.5E+02	8.2E+06	4.4E+04
O-NITROANILINE	88-74-4	1.1E+06	7.2E+01	3.8E+06	2.1E+04
O-XYLENE	95-47-6	4.5E-01	2.9E-05	1.5E+00	8.3E-03
P-CHLOROANILINE	106-47-8	5.0E+00	3.2E-04	1.7E+01	9.2E-02
P-CRESOL	106-44-5	4.5E-02	2.9E-06	1.5E-01	8.3E-04
P-PHENYLENEDIAMINE	106-50-3	6.4E-02	4.1E-06	2.2E-01	1.2E-03
P-XYLENE	106-42-3	4.5E-01	2.9E-05	1.5E+00	8.3E-03

		Characterisation factor	One-step weighting factor (SKr/kg)		
Substance	CAS or EDF Substance ID	Noncancer TEP emission to water	based on 20 kr/kg copper	based on 20 SKr/kg malathion	based on 30000 SKr/kg cadmium
PENTACHLOROPHENOL	87-86-5	1.0E-01	6.7E-06	3.5E-01	1.9E-03
PHENOL	108-95-2	1.7E-03	1.1E-07	5.8E-03	3.2E-05
PHOSGENE	75-44-5	1.2E+02	7.5E-03	4.0E+02	2.2E+00
PHTHALIC ANHYDRIDE	85-44-9	2.7E-05	1.7E-09	9.2E-05	5.0E-07
PRONAMIDE	23950-58-5	7.7E+00	4.9E-04	2.6E+01	1.4E-01
PROPOXUR	114-26-1	2.0E+01	1.3E-03	6.8E+01	3.7E-01
PROPYLENE	115-07-1	3.4E-02	2.2E-06	1.2E-01	6.3E-04
PROPYLENE OXIDE	75-56-9	2.0E-01	1.3E-05	6.8E-01	3.7E-03
PYRENE	129-00-0	5.0E-01	3.2E-05	1.7E+00	9.2E-03
PYRIDINE	110-86-1	4.3E+00	2.8E-04	1.5E+01	7.9E-02
QUINTOZENE	82-68-8	1.5E+03	9.3E-02	4.9E+03	2.7E+01
S,S,S-TRIBUTYLTRITHIOPHOSPHATE	78-48-8	1.4E+05	8.7E+00	4.6E+05	2.5E+03
SELENIUM	7782-49-2	3.4E+03	2.1E-01	1.1E+04	6.2E+01
SELENIUM COMPOUNDS	SBP500	3.4E+03	2.1E-01	1.1E+04	6.2E+01
SILVER	7440-22-4	2.6E+03	1.7E-01	8.8E+03	4.8E+01
SILVER COMPOUNDS	SDO000	2.6E+03	1.7E-01	8.8E+03	4.8E+01
STYRENE	100-42-5	3.3E-01	2.1E-05	1.1E+00	6.0E-03
STYRENE OXIDE	96-09-3	3.3E+00	2.1E-04	1.1E+01	6.1E-02
TETRACHLOROETHYLENE	127-18-4	7.3E+01	4.6E-03	2.5E+02	1.3E+00
THALLIUM	7440-28-0	1.2E+05	7.8E+00	4.2E+05	2.3E+03
THIRAM	137-26-8	7.3E+00	4.6E-04	2.5E+01	1.3E-01
TOLUENE	108-88-3	4.5E-01	2.9E-05	1.5E+00	8.3E-03
TRANS-1,3-DICHLOROPROPENE	10061-02-6	1.5E+06	9.9E+01	5.2E+06	2.8E+04
TRIBROMOMETHANE	75-25-2	3.3E+02	2.1E-02	1.1E+03	6.0E+00
TRICHLOROETHYLENE	79-01-6	3.9E+01	2.5E-03	1.3E+02	7.1E-01
TRICHLOROFLUOROMETHANE	75-69-4	3.7E+01	2.4E-03	1.3E+02	6.8E-01

Substance	CAS or EDF Substance ID	Characterisation factor Noncancer TEP emission to water	One-step weighting factor (SKr/kg) based on 20 kr/kg copper	based on 20 SKr/kg malathion	based on 30000 SKr/kg cadmium
TRIETHYLAMINE	121-44-8	6.8E-01	4.3E-05	2.3E+00	1.3E-02
TRIFLURALIN	1582-09-8	3.4E+01	2.1E-03	1.1E+02	6.2E-01
VANADIUM	7440-62-2	1.1E+04	7.0E-01	3.7E+04	2.0E+02
VINYL ACETATE	108-05-4	5.9E-01	3.8E-05	2.0E+00	1.1E-02
VINYL BROMIDE	593-60-2	3.1E+01	2.0E-03	1.1E+02	5.8E-01
VINYL CHLORIDE	75-01-4	2.6E+03	1.7E-01	8.9E+03	4.8E+01
XYLENE (MIXED ISOMERS)	1330-20-7	7.7E-01	4.9E-05	2.6E+00	1.4E-02
ZINC	7440-66-6	1.6E+03	1.0E-01	5.4E+03	2.9E+01
ZINC COMPOUNDS	ZFS000	1.6E+03	1.0E-01	5.4E+03	2.9E+01

*Pesticides admitted for use in Sweden, taxed with 20 SKr/kg.

Table A12. One-step weighting factors for human toxicity for emissions to out-door air, based on human toxicity potentials (HTP) from Jolliet and Crettaz (1997) and the exemption fees on high levels of benzne and lead in petrol.

	Characterisation factor	One-step weighting factor (SKr/kg)			
Substance	HTP emission to air	based on 10 SKr/kg benzene	based on 100 SKr/kg benzene	based on 180 SKr/kg lead	based on 350 SKr/kg lead
Carbon monoxide	1.4E-04	1.2E-01	1.2E+00	1.1E-05	2.1E-05
Nitrogen oxide	2.0E-03	1.7E+00	1.7E+01	1.6E-04	3.0E-04
Sulfur dioxide	7.5E-03	6.3E+00	6.3E+01	5.9E-04	1.1E-03
Particles	7.5E-03	6.3E+00	6.3E+01	5.9E-04	1.1E-03
Formaldhyde	9.9E-03	8.3E+00	8.3E+01	7.7E-04	1.5E-03
Aldehyde	8.7E-03	7.3E+00	7.3E+01	6.8E-04	1.3E-03
Benzene	1.2E-02	1.0E+01	1.0E+02	9.4E-04	1.8E-03
Arsenic	9.0E+03	7.5E+06	7.5E+07	7.0E+02	1.4E+03
Cadmium	1.9E+04	1.6E+07	1.6E+08	1.5E+03	2.9E+03
Chromium	3.7E+03	3.1E+06	3.1E+07	2.9E+02	5.6E+02
Cobalt	1.3E+04	1.1E+07	1.1E+08	1.0E+03	2.0E+03
Copper	1.5E+02	1.2E+05	1.2E+06	1.1E+01	2.2E+01
Lead*	2.3E+03	1.9E+06	1.9E+07	1.8E+02	3.5E+02
Mercury	4.6E+04	3.8E+07	3.8E+08	3.6E+03	7.0E+03
Nickel	3.7E+02	3.1E+05	3.1E+06	2.9E+01	5.6E+01
Selenium	6.4E+04	5.3E+07	5.3E+08	5.0E+03	9.7E+03
Tin	9.0E+00	7.5E+03	7.5E+04	7.0E-01	1.4E+00
Zinc	2.7E+01	2.3E+04	2.3E+05	2.1E+00	4.1E+00

* If only the inhalation route of exposure is taken into account, the HTP is equal to 1.

Table A14. One-step weighting factors for human toxicity for emissions to agricultural soil, taken up by non-edible crops and edible crops. The one-step weighting factors are based on humen toxicity potentials (HTP) from Jolliet and Crettaz (1997) and the tax on the active substance in pesticides. Note that all pesticides admitted for use in Sweden are in reality taxed with 20 SKr/kg.

	Emission to agricultural soil					
	Characterisation factor	One-step weighting factor (SKr/kg)		Characterisation factor	One-step weighting factor (SKr/kg)	
Substance	HTP non edible crop	based on 20 SKr/kg diquat	based on 20 SKr/kg fluroxypyr	HTP edible crop	based on 20 SKr/kg ioxynil	based on 20 SKr/kg glyphosate
Amitrole	3.4E-01	4.0E+03	1.2E+07	3.4E-01	1.3E+00	9.2E+03
Atrazin	2.9E-03	3.4E+01	1.0E+05	3.2E+00	1.3E+01	8.6E+04
Carbendazim	1.1E-03	1.3E+01	3.9E+04	1.1E+01	4.2E+01	2.9E+05
Chloromequat	2.0E-04	2.4E+00	7.0E+03	7.7E+00	3.0E+01	2.1E+05
Cholrothalonil	3.4E-03	4.0E+01	1.2E+05	5.9E+00	2.3E+01	1.6E+05
Chlorpyrifos	1.0E-03	1.2E+01	3.5E+04	1.0E-03	3.9E-03	2.7E+01
Cypermethrin*	2.0E-04	2.4E+00	7.0E+03	5.9E-02	2.3E-01	1.6E+03
Diflufenican*	1.7E-05	2.0E-01	6.0E+02	1.3E+00	5.1E+00	3.5E+04
Diquat*	1.7E-03	2.0E+01	6.0E+04	7.4E-02	2.9E-01	2.0E+03
D N O C	6.7E-03	7.9E+01	2.4E+05	4.7E-01	1.8E+00	1.3E+04
Dinoseb	6.8E-03	8.0E+01	2.4E+05	1.5E+00	5.9E+00	4.1E+04
Ethephon	9.8E-07	1.2E-02	3.4E+01	2.3E+00	9.0E+00	6.2E+04
Fenpiclonil*	7.9E-04	9.3E+00	2.8E+04	7.9E-04	3.1E-03	2.1E+01
Fluroxypyr*	5.7E-07	6.7E-03	2.0E+01	3.0E-01	1.2E+00	8.1E+03
Flusilazole	1.3E-02	1.5E+02	4.6E+05	4.5E+01	1.8E+02	1.2E+06
Glufosinate*	9.0E-06	1.1E-01	3.2E+02	1.7E+01	6.5E+01	4.5E+05
Glyphosate*	4.2E-05	4.9E-01	1.5E+03	7.4E-04	2.9E-03	2.0E+01
Hexacanazole	2.5E-04	2.9E+00	8.8E+03	4.7E+01	1.8E+02	1.3E+06
Ioxynil*	5.4E-06	6.4E-02	1.9E+02	5.1E+00	2.0E+01	1.4E+05
Isoproturon*	2.2E-05	2.6E-01	7.7E+02	1.4E+00	5.5E+00	3.8E+04
Lindane	1.4E-01	1.6E+03	4.9E+06	1.4E-01	5.5E-01	3.8E+03
Mecoprop-P*	4.9E-05	5.8E-01	1.7E+03	3.5E-01	1.4E+00	9.5E+03
Methiocarb	1.0E-02	1.2E+02	3.5E+05	1.0E-02	3.9E-02	2.7E+02
Paraquat	2.5E-03	2.9E+01	8.8E+04	2.5E-03	9.8E-03	6.8E+01
Pentachlorophenol	3.9E-03	4.6E+01	1.4E+05	3.9E-03	1.5E-02	1.1E+02
Pirmicarb*	5.4E-04	6.4E+00	1.9E+04	6.0E-01	2.4E+00	1.6E+04
Simazine	5.2E-03	6.1E+01	1.8E+05	1.2E+00	4.6E+00	3.2E+04
Tebucanozole	1.7E-06	2.0E-02	6.0E+01	1.8E-02	7.1E-02	4.9E+02

* Pesticides admitted for use in Sweden, taxes with 20 SKr/kg.

Table A13. One-step weighting factors for human toxicity for emissions to water and soil. Human toxicity potentials (HTP) from Jolliet and Crettaz (1997) for water emissions are combined with the tax on the active subastance in pesticides. For emissions to soil, taken up by edible crops and non-edible crops, the tax on the cadmium content in phpsphor fertiliser is used in combination with HTPs.

	Emission to water		Emission to soil			
	Characterisation factor	One-step weighting factor (SKr/kg)	Characterisation factor	One-step weighting factor (SKr/kg)	Characterisation factor	One-step weighting factor (SKr/kg)
Substance	HTP	based on 20 SKr/kg copper	HTP non edible crop	based on 30000 SKr/kg cadmium	HTP edible crop	based on 30000 SKr/kg cadmium
Flouride	4.5E-02	4.1E+01				
Sulfide	2.1E+00	1.9E+03				
Nitrate	8.5E-04	7.7E-01				
Phosphate	3.2E-06	2.9E-03				
Phenol	5.2E-02	4.7E+01				
B O D	2.2E-02	2.0E+01				
Arsenic	1.5E+00	1.4E+03	7.0E-01	1.4E+04	7.9E+04	1.5E+04
Cadmium	3.2E+00	2.9E+03	1.5E+00	3.0E+04	1.6E+05	3.0E+04
Chromium	6.2E-01	5.6E+02	2.9E-01	6.0E+03	3.2E+04	5.9E+03
Cobalt	2.2E+00	2.0E+03	1.0E+00	2.1E+04	1.1E+05	2.1E+04
Copper	2.2E-02	2.0E+01	9.0E-03	1.8E+02	1.3E+03	2.3E+02
Lead*	8.6E-01	7.8E+02	6.0E-01	1.2E+04	2.0E+04	3.7E+03
Mercury	7.8E+00	7.1E+03	3.6E+00	7.4E+04	4.0E+05	7.4E+04
Nickel	6.2E-02	5.6E+01	2.9E-02	6.0E+02	3.2E+03	5.9E+02
Selenium	1.1E+01	9.9E+03	5.0E+00	1.0E+05	5.6E+05	1.0E+05
Tin	1.5E-03	1.4E+00	7.0E-04	1.4E+01	7.8E+01	1.4E+01
Zinc	3.2E-03	2.9E+00	7.0E-04	1.4E+01	2.3E+02	4.3E+01

*If only the inhalation route of exposure is taken into account, the HTP is equal to 1.

Table A11. One-step weighting factors for terrestrial ecotoxicity from pesticides applied to the field. The one-step weighting factors are based on terrestrial ecotoxicity potentials (TEPs) applied to the from Jolliet and Crettaz (1997) and on the tax on the active substance in pesticides. The tax is applied to the least and the most toxic pesticides admitted for use in Sweden, thus producing min and max values for each pesticide. Note that all pesticides allowed for use in Sweden are in reality taxed with 20 SKr/kg.

	Caracterisation factor	One-step weighting factor (SKr/kg)	
Substance	TEP per kg pesticide applied to the field	based on 20 SKr/kg glyphosate	based on 20 SKr/kg primicarb
Atrazin	3.1E-02	3.3E+04	2.4E+02
Carbendazim	2.0E-03	2.1E+03	1.5E+01
Chloromequat	1.1E-05	1.2E+01	8.5E-02
Chlorothalonil	3.5E-03	3.7E+03	2.7E+01
Cypermethrin*	5.2E-04	5.5E+02	4.0E+00
Cyprocanazol	9.2E-04	9.7E+02	7.1E+00
Diflufenican*	4.0E-04	4.2E+02	3.1E+00
D N O C (potatoes)	2.7E-03	2.8E+03	2.1E+01
Dinoseb (potatoes)	7.7E-04	8.1E+02	5.9E+00
Fenpiclonil*	1.0E-02	1.1E+04	7.7E+01
Fenpropidin	3.8E-04	4.0E+02	2.9E+00
Flusilazole	2.7E-03	2.8E+03	2.1E+01
Glufosinate* (potatoes)	3.9E-04	4.1E+02	3.0E+00
Glyphosate*	1.9E-05	2.0E+01	1.5E-01
Ioxynil*	1.9E-04	2.0E+02	1.5E+00
Isoproturon*	2.0E-05	2.1E+01	1.5E-01
Lindane	1.8E+00	1.9E+06	1.4E+04
Mecoprop-P*	1.8E-03	1.9E+03	1.4E+01
Pirimcarb*	2.6E-03	2.7E+03	2.0E+01
Tebucanazole	1.9E-04	2.0E+02	1.5E+00

* Pesticides admitted for use in Sweden, taxed with 20 SKr/kg.

Table A9. One-step weighting factors for terrestrial ecotoxicity for metals released to soil and air. Terrestrial ecotoxicity potentials (TEP) from Jolliet and Crettaz (1997) are, for emissions to soil, combined with the tax on the cadmium content in phosphor fertiliser. For emissions to air they are combined with the exemption fee for high contents of lead in petrol.

	Emission to soil		Emission to air		
	Caracterisation factor	One-step weighting factor (SKr/kg)	Caracterisation factor	One-step weighting factor (SKr/kg)	
Substance	TEP	based on 30000 SKr/kg cadmium	TEP	based on 180 SKr/kg lead	based on 350 SKr/kg lead
Arsenic	2.3E+00	7.2E+03	7.5E-01	1.0E+03	2.0E+03
Cadmium	9.6E+00	3.0E+04	3.1E+00	4.3E+03	8.5E+03
Chromium	2.6E-01	8.1E+02	8.0E-02	1.1E+02	2.2E+02
Cobalt	2.6E-01	8.1E+02	8.0E-02	1.1E+02	2.2E+02
Copper	4.2E-01	1.3E+03	1.4E-01	1.9E+02	3.8E+02
Lead	4.1E-01	1.3E+03	1.3E-01	1.8E+02	3.5E+02
Mercury	1.8E+01	5.7E+04	5.9E+00	8.2E+03	1.6E+04
Nickel	1.1E+00	3.4E+03	3.5E-01	4.8E+02	9.4E+02
Zinc	1.0E+00	3.1E+03	3.3E-01	4.6E+02	8.9E+02