REPORT

Model for future waste generation

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TOWARDS SUSTAINABLE WASTE MANAGEMENT

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Report Summary

Project title
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Title and subtitle of the report

Model for future waste generation.

Abstract

The research presented in this report is part of the effort to estimate future Swedish waste quantities in the research programme Towards Sustainable Waste Management. More specifically, we estimate future waste coefficients that are designed to be fed into EMEC, which describes the Swedish economy in terms of 26 industrial sectors, a public sector, and households. Production in the model of industry and public sector requires input of labour, capital, energy, and other commidities. With waste-intensity coefficients added to each production parameter in each sector, EMEC can calculate the future waste quantities generated in different economic scenarios.

To produce the waste-intensity coefficients, we make a survey of the current Swedish waste statistics. For each waste category from each sector we estimate whether the quantity depends primarily on the production in the sector, on the inputs of commodities, on the depreciation of capital goods, or on the size of the workforce in the sector. We calculate current waste-intensity coefficients by dividing the waste quantities by the parameter(s) to which they are assigned. We also present five different scenarios to describe how the waste intensity can develop until the year 2030.

As far as possible and when deemed to be relevant, we have set the industrial waste generation to depend on the use of a commodity or an energy carrier. The quantity of spent vehicles and most equipment is set to depend on the depreciation of capital goods. Some wastes have been allocated to the staff, for example household waste from business. The quantities of wastes from households have a similar approach where every waste category is assigned to a combination of 26 different commodities.

Keyword

Waste, waste amounts, waste generation, future

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Foreword

The results presented in this report is a result of research done with support from the Swedish Environmental Protection Agency within the framework of the research programme "Towards Sustainable Waste Management". The results are a part of the project "Future waste quantities", which deals with projections of future waste quantities and with waste prevention. The work presented in this report has been carried out in close cooperation with the National Institute of Economic Research. The project as a whole involves also cooperation with the consultancy Profu.

Summary

The research presented in this report is part of the effort to estimate future Swedish waste quantities in the research programme Towards Sustainable Waste Management. More specifically, we estimate future waste coefficients that are designed to be fed into EMEC, a computational economic general equilibrium model at the National Institute of Economic Research. EMEC describes the Swedish economy in terms of 26 industrial sectors, a public sector, and households. Production in the model of industry and public sector requires input of labour, capital, energy, and other commidities. The model measures staff in terms of person-hours. All other production parameters are measured in economic terms, using the prices of the year 2006. With waste-intensity coefficients added to each production parameter in each sector, EMEC can calculate the future waste quantities generated in different economic scenarios.

To produce the waste-intensity coefficients, we make a survey of the current Swedish waste. Data on waste quantities from all Swedish sectors in the year 2006 is available from the Swedish Environmental Protection Agency who is responsible for the reporting according to the European Regulation on Waste Statistics. For each waste category from each sector we estimate whether the quantity depends primarily on the production in the sector, on the inputs of commodities, on the depreciation of capital goods, or on the size of the workforce in the sector. We calculate current waste-intensity coefficients by dividing the waste quantities by the parameter(s) to which they are assigned. We also present five different scenarios to describe how the waste intensity can develop until the year 2030.

As far as possible and when deemed to be relevant, we have set the industrial waste generation to depend on the use of a commodity or an energy carrier. The quantity of spent vehicles and most equipment is set to depend on the depreciation of capital goods. Some wastes have been allocated to the staff, for example household waste from business. The quantities of wastes from households have a similar approach where every waste category is assigned to a combination of 26 different commodities.

The five scenarios where developed specifically for Towards Sustainable Waste Management, as part of the project on a future-oriented synthesis. They are distinguished by their degree of global cooperation and the degree of political control and influence in matters that concern the environment and natural resources. There are four widely diverse, cornerstone scenarios and a reference scenario, where current trends and policy are not significantly altered.

The intensity of input-related waste is likely to decrease over time, due to technological development, an expected increase in the cost of natural resources, and possible policy instruments that make materials production more expensive. The rate of reduction is 1-3% per year in different scenarios, depending on the rate of technological development, the speed of the depletion of natural resources, and the strength of the policy instruments in the scenarios. The waste intensity related to the depreciation of capital goods can also decrease somewhat due to technological development. The intensity of staff-related waste and household waste increase or decrease in the scenarios depending, for example, on the consumption patterns and environmental awareness in different scenarios. The intensity of output-related waste, however, is assumed to be constant in all scenarios.

A sustained trend in the development of waste intensities can have a profound effect on the resulting waste intensity in the year 2030. For example, an annual reduction by 3% from the year 2006 makes the waste intensity 52% lower in 2030.

Contents

1 Introduction

1.1 The research program

Towards Sustainable Waste Management is an interdisciplinary research programme dedicated to investigating policy instruments and strategic decisions that can contribute to developing waste management in a more sustainable direction[1]. The primary target groups for the findings of Towards Sustainable Waste Management is the Swedish Environmental Protection Agency and other policymakers in the field of waste management at European, national, regional and local levels, recycling companies, waste management companies and R&D organisations in waste management.

The ten research projects in Towards Sustainable Waste Management are based on close co-operation and exchange of knowledge and results, see Figure 1. Each project adds important information and knowledge to the programme. These will be integrated in the project "Future-oriented synthesis", aiming at identifying decisions that contribute to the development of a more sustainable waste management system. In this way, the results of Towards Sustainable Waste Management will provide useful input to actual decision-making and strategy development in waste management and other related fields.

The current report is a part of Project 7 Future Waste Quantities.

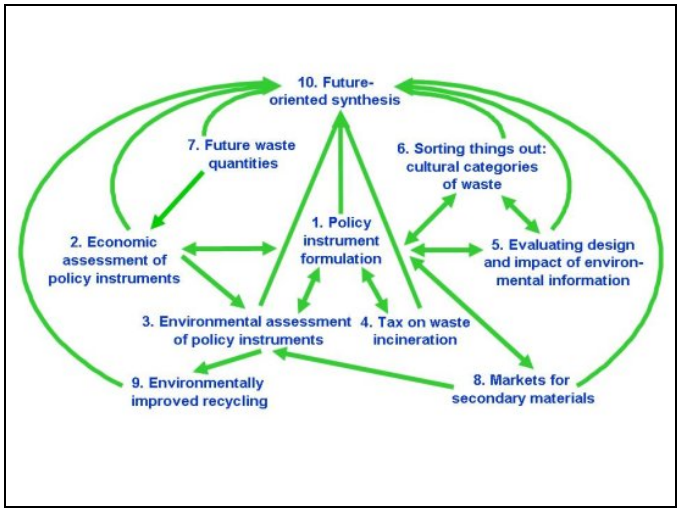

Figure 1. Projects in the program Towards Sustainable Waste Management and the connections between the projects.

[1] More information about the program is available at http://www.hallbaravfallshantering.se/

1.2 The project

In the project Future Waste Quantities, we investigate how the quantity of waste develops in different future scenarios. Estimates of the future waste quantities are important for analyses of the long-term consequences of policy instruments in the waste-management sector.

The project also investigates how the trend can be affected by policy measures aiming at waste prevention. Keeping the quantity of waste down is an important step towards sustainability since waste management affects the environment. Even more important, a reduction in waste flows often results in a reduction in material production, which reduces resource depletion as well as emissions to the environment. Analysing the options for waste prevention is therefore an important part of the programme.

The project includes four different activities:

- a top-down analysis of all Swedish waste flows, identifying the main causes of these flows and projecting how they can develop depending on the economic activities in different future scenarios,
- a separate model of the future scrap quantities from vehicles,
- a bottom-up analysis of the economic cost of waste prevention in specific cases, and
- the development of a structure of strategies for reducing the waste quantities through increases in the material efficiency of the society.

1.3 The report

This report presents part of the top-down analysis. It contains a survey of waste fractions from all economic sectors with the aim to estimate whether they depend primarily on the economic activity in the sector, on the physical input or output, or on the size of the workforce in the sector. We calculate current waste coefficients by dividing the waste quantities by the parameter to which they are assigned. We also present five different scenarios to describe how these waste coefficients can develop until the year 2030.

2 Method

Little research on future waste quantities has previously been done in Sweden. However, projections of future waste quantities have been published in, e.g, Norway (Bruvoll & Ibenholt 1997), Denmark (Andersen et al. 1999), and the European Union (Villeneuve et al. 2009). They calculate the future quantities of different waste fractions from different sectors in society as functions of the activity in these sectors, of technological progress, and of policy instruments. We have applied a similar approach, using an economic general equilibrium model at the National Institute of Economic Research (EMEC: Environmental Medium term EConomic model). We have added data on waste statistics to EMEC and developed a sub-model in EMEC that simulates the waste generation.

Recent data on wastes from all sectors in the society is available from the Swedish Environmental Protection Agency who is responsible for the reporting according to the European directive on waste statistics (EC 2002) (Swedish EPA 2008a). The Swedish Environmental Research Institute is

part of the consortium SMED,[2] which has been responsible for the production of the waste statistics.

2.1 EMEC

A detailed description of EMEC is given in a working paper (Östblom & Berg, 2006). EMEC is a computable general equilibrium (CGE) model of the Swedish economy developed and maintained by the National Institute of Economic Research for analysis of the interaction between the economy and the environment.

EMEC includes 26 industries producing 33 composite commodities, and a public sector producing a single commodity. Produced goods and services are exported and used together with imports to create composite commodities for domestic use. Composite commodities are used as inputs by industries and for capital formation. In addition, households consume composite commodities, and there are 26 consumer commodities.

Production requires primary factors (two kinds of labour and capital) as well as inputs of materials, transports and energy. The supply of each type of labour is exogenous for the economy as a whole, while capital is supplied to the economy at a given price. All factors can move freely between domestic sectors. Perfect competition and no economies of scale in production are assumed for all markets. The representative firm is assumed to choose an optimal mix of two types of labour and an optimal mix of energy in three stages. The firm, then, decides upon the mix of labour and physical capital in the creation of value added as well as the mix of energy and material in the creation of energy-material input. The various outputs and inputs must be transported, and the firm chooses an optimal transport solution (which allows for the use of several transport modes) in two steps. An optimal mix of value added and energy-material input is chosen at the highest level, to produce the firm's output.

The small country assumption is adopted for tradable goods and the problem of overspecialization is handled by the Armington assumption for imports and by a relative price dependent supply function for exported goods. This means that domestic goods are non-perfect substitutes for foreign goods in domestic as well as foreign use; i.e. in imports as well as in exports.

Households are distributed into six subgroups by disposal income and by place of residence. The model runs with exogenous interest rate and is closed with an exogenous ratio of the current account. The foreign price level is chosen as numeraire. The use of energy by firms or households is subject to an energy tax and pollution taxes. Also, the levels of various emissions can be bounded in the model to give the corresponding shadow prices of emission. Tax exemptions due to the use of CO_2 permits or for other reasons are reflected in the estimated tax rates. Consumer goods are also subject to a value-added tax as well as other indirect taxes. The use of labour is subject to social security fees and households pay income tax on labour income. Firms and households react on prices, including taxes, and adjust their mix of inputs or their bundle of consumer goods by substituting away from the relatively dearer input or good.

[2] The consortium consists of the Swedish Environmental Research Institute (IVL), Statistics Sweden (SCB), the Swedish University of Agricultural Sciences (SLU) and the Swedish Meteorological and Hydrological Institute (SMHI).

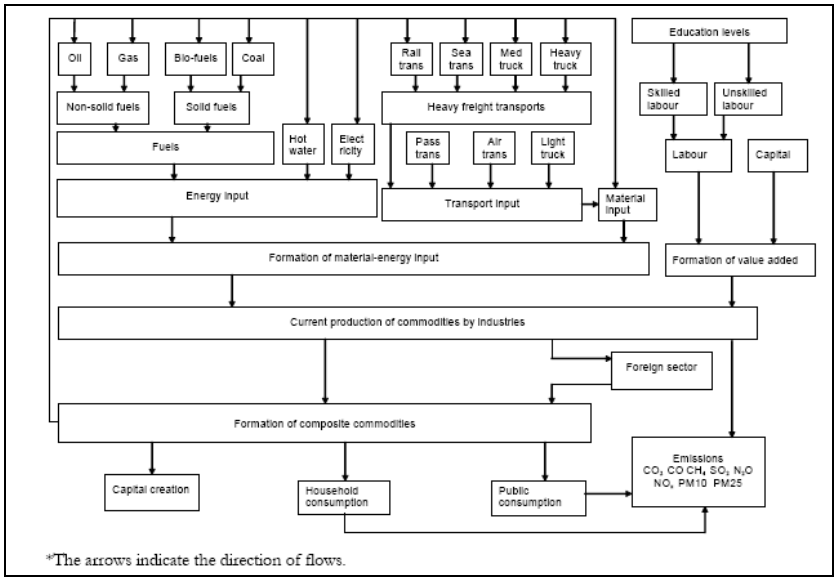

Figure 2. Flows of commodities, factors and emissions in EMEC.

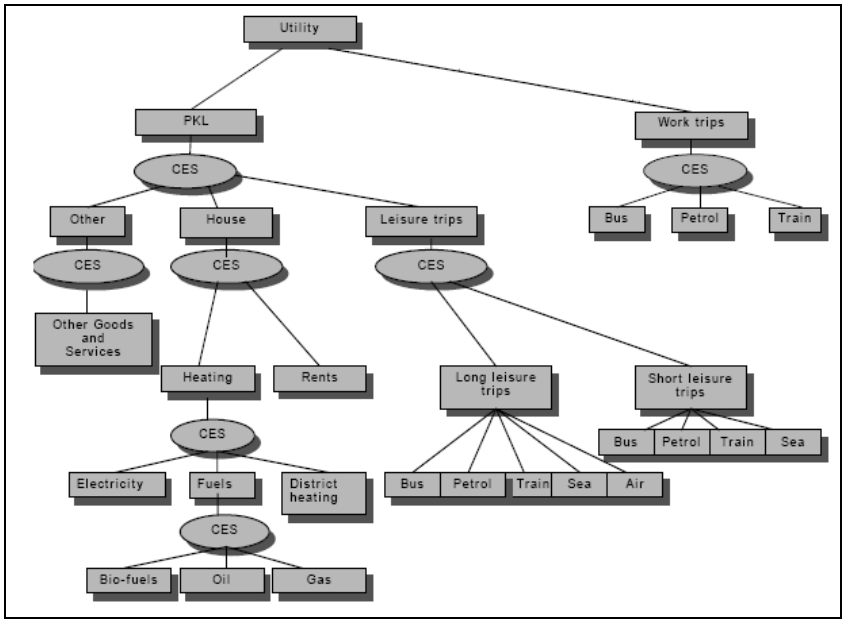

Figure 3. Consumer utility function. Remarks: CES = constant elasticity of substitution; the variable PKL is a CES aggregate of leisure trips, housing services and other consumer goods and services.

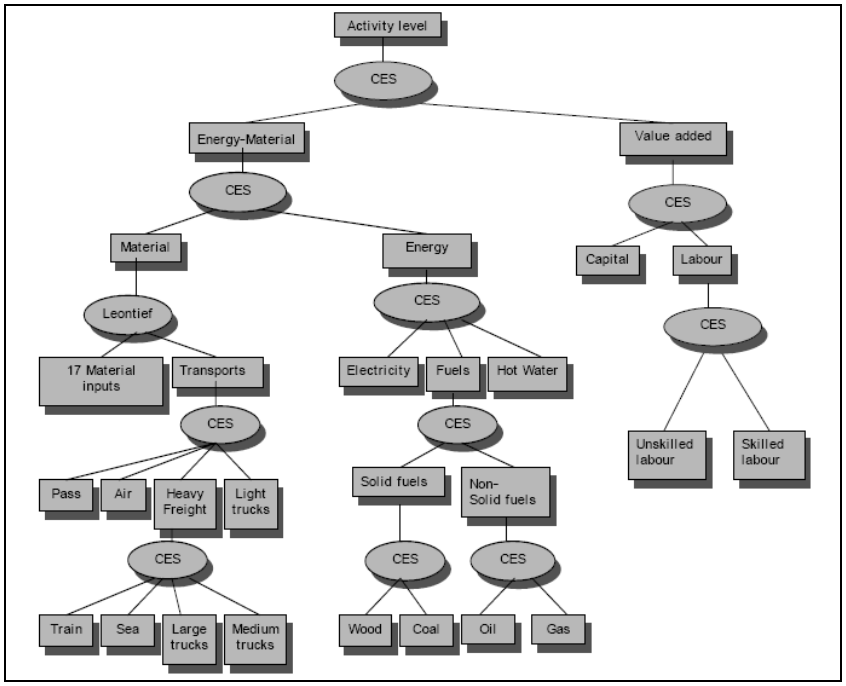

Figure 4. The input-activity specification in EMEC.

2.2 Waste Statistics

2.2.1 Sources for waste statistics

The Regulation of the European Parliament and the Council No 2150/2002 of 25 November 2002 on waste statistics (EC 2002; hereafter referred to as "the Waste Statistics Regulation" or "WStatR") contains rules for the reporting of waste statistics to the EU. Member states have to report in accordance with the regulation every second year. The first round of reporting by all member states was completed by 30 June 2006 and concerned waste generation and recovery and disposal of waste during 2004. The latest reporting was in the end of June 2008, and concerned the generation and treatment of waste in Sweden during 2006.

The available waste statistics from Sweden is published by Swedish EPA (2008a). The methods and quality attributes are published in the Quality Report (Swedish EPA 2008b). The format of this statistics is adapted to the Eurostat reporting format, which is governed by the Waste Statistic Regulation.

The generated quantities of waste are to be reported for a total of 20 different sectors including
- all economic activities (sections A-Q according to NACE Rev.1 or SNI 2002),
- waste arising from recovery and/or disposal operations, and
- waste generated by households.

The sector grouping used for the reporting is given in Table 1.

Table 1. Sectors for which waste statistics are compiled (according to NACE rev 1.)

Item	NACE		Sector
1	A	01 – 02	Agriculture, hunting and forestry
2	B	05	Fishing
3	C	11 – 14	Mining and quarrying
4	DA	15 – 16	Manufacture of food products, beverages and tobacco
5	DB + DC	17 – 19	Manufacture of textiles and textile products + manufacture of leather and leather products
6	DD	20	Manufacture of wood and wood products
7	DE	21 – 22	Manufacture of pulp, paper and paper products publishing and printing
8	DF	23	Manufacture of coke, refined petroleum products and nuclear fuel
9	DG + DH	24 – 25	Manufacture of chemicals, chemical products + manufacture of rubber and plastic products
10	DI	26	Manufacture of other non-metallic mineral products
11	DJ	27 – 28	Manufacture of basic metals and fabricated metal products
12	DK + DL + DM	29 – 35	Manufacture of machinery and equipment not elsewhere classified + manufacture of electrical and optical equipment + manufacture of transport equipment
13	DN excl. 37	36	Manufacturing not elsewhere classified
14	E	40 – 41	Electricity, gas and water supply
15	F	45	Construction
16	G-Q excl. 90 and 51.57	50 – 93 excl. 90 and 51.57	Services: Wholesale and retail trade; Repair of motor vehicles, motor cycles and personal and household goods + Hotels and Restaurants + Transports, storage and communications + Financial intermediation + Real estate, renting and business activities + Public administration, defence and compulsory social security + Education + Health and Social work + Other community, social and personal activities + Activities of households + Extra-territorial organisations and bodies
17	37		Recovery
18	51.57		Wholesale of waste and scrap
19	90		Sewage and refuse disposal, sanitation and similar activities
20	-		Waste generated by households

The generation of waste for these 20 sectors are to be given according to the EWC-Stat waste classification (EC 2004). EWC-Stat is a special material-based waste classification that is founded on the usual List of Waste (EC 2000) (earlier also called EWC or European Waste Catalogue). There are a total of 48 different categories of waste in EWC-Stat. Four of the waste categories are given in both wet amount and dry amount, the rest is given in wet amount.

The waste categories that are used in the reporting is given in Table 2.

Table 2. Waste Categories according to EWC-Stat

Waste category	
Hazardous waste	**Non-hazardous waste**
01.1 H Spent solvents	01.2 Acid, alkaline or saline wastes
01.2 H Acid, alkaline or saline wastes	01.4 Spent chemical catalysts
01.3 H Used oils	02 Chemical preparation wastes
01.4 H Spent chemical catalysts	03.1 Chemical deposits and residues
02 H Chemical preparation wastes	03.2 Industrial effluent sludges
03.1 H Chemical deposits and residues	*of which dry weight*
03.2 H Industrial effluent sludges	05 Health care and biological wastes
of which dry weight	06 Metallic wastes
05 H Health care and biological wastes	07.1 Glass wastes
06 H Metallic wastes	07.2 Paper and cardboard wastes
07.1 H Glass wastes	07.3 Rubber wastes
07.5 H Wood wastes	07.4 Plastic wastes
07.7 H Waste containing PCB	07.5 Wood wastes
08 H Discarded equipment	07.6 Textile wastes
08.1 H Discarded vehicles	08 Discarded equipment (excl. 08.1 and 08.41)
08.41 H Batteries and accumulators	08.1 Discarded vehicles
10.2 H Mixed and undifferentiated materials	08.41 Batteries and accumulators
10.3 H Sorting residues	09 Animal and vegetal wastes excl. 9.3 and 9.11
12 H Mineral waste 12.4 and 12.6	09.11 Animal wastes of food preparation and products
12.4 H Combustion wastes	09.3 Animal faeces, urine and manure
12.6 H Contaminated soils and dredging spoils	10.1 Household and similar wastes
13 H. Solidified, stabilised and vitrified wastes	10.2 Mixed and undifferentiated materials
	10.3 Sorting residues
	11 Common sludges excl. 11.3, wet weight
	of which dry weight
	11.3 Dredging spoils
	of which dry weight
	12 Mineral wastes excl. 12.4 and 12.6
	12.4 Combustion wastes
	12.6 Contaminated soils and dredging spoils
	13. Solidified, stabilised and vitrified wastes

A summary description of the categorisation is given in the earlier mentioned publication Avfall i Sverige 2006 (Swedish EPA 2008a) in both English and Swedish.

2.2.2 Adaptation of the waste statistics to EMEC

When adapting the available waste statistics from the Swedish EPA to the EMEC model we have made some changes and exclusions:

1. Some waste categories that occur in small quantities, and do not fully depend on the economic activities, have been excluded from the study: 06H Metallic wastes (hazardous), 07.7H Waste containing PCB (hazardous), and 07.1H Glass wastes (hazardous).

2. Some waste categories that are not related to production or economic activities have been excluded from this study, for example 11.3 Dredging spoils, 12.6H Contaminated soils and

dredging spoils, and excavated materials from the construction sector (part of 12 Mineral wastes).

3. We have aggregated some EWC-Stat categories to own categories. For example:
   a. The hazardous wastes 01.2H Acid, alkaline or saline wastes, 01.4H Spent chemical catalysts, 02H Chemical preparation wastes, and 03.1H Chemical deposits and residues has been aggregated into a group we call "Other chemical waste (hazardous)"
   b. The non-hazardous wastes 01.2 Acid, alkaline or saline wastes, 01.4 Spent chemical catalysts, 02 Chemical preparation wastes, and 03.1 Chemical deposits and residues has been aggregated into a group we call "Other chemical waste (non-hazardous)"
   c. The sludge categories 03.2 Industrial effluent sludges and 11 Common sludges have been aggregated into "sludges". Municipal sewage sludge has been excluded from the study

4. We have omitted wastes from mining. Wastes from mining make up about half of all generated waste in Sweden. It is possible to model wastes from mining with EMEC but we have made the decision to put the focus of the study on the other wastes. Waste resulting from prospecting, extraction, treatment and storage of mineral resources is excluded from the scope of the Waste directive (EC 2008) since they are governed by another directive.[3] Wastes from mining are generated at less than 20 different sites in Sweden and have been subject to special research programs. We have regarded wastes from mining to be oustide the scope the research program.

5. We have excluded ordinary excavated soils and sands from construction that contains only natural materials and is recovered as construction material. This waste is excluded from the scope of the waste directive. Excavated material that is landfilled is included in the study.

6. Secondary wastes from waste management in NACE 37, NACE 51.57 and NACE 90 (which all are different kind of waste management) have been excluded. We have only included direct wastes from production and consumption. The generation of secondary wastes is governed by how the waste is managed and not by the industrial and household activities (the waste management on the generation of secondary wastes is modelled in project 2: Economic modelling).

The waste statistics reported by Swedish EPA include some material streams that may be classified as by-products according to the new waste directive (EC 2008). We have omitted streams that we have judged are complying with the by-product definition in the waste directive. These streams are to a large extent already handled as a commodity in EMEC. It is for example felling residues from forestry and wood spills from saw mills used as fuel in the energy sector, wood and bark wastes used as fuel in the pulp- and paper industry, metal spills from the primary metal industry, and plastic spill from plastic industry.

[3] Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries

2.2.3 Generation of waste from industries and business

The model for future waste management is based on the assumption that the waste generation depends on different economic parameters according to the following.

First we assume that each waste stream (a waste category in a specific sector) is built up by five components:

$$Q_{tot} = Q_{prod} + Q_{energy} + Q_{depr} + Q_{staff} + Q_{com} \qquad \textit{(Formula 1)}$$

Where:

- Q_{tot} the generated amount of a certain waste type within a sector,
- Q_{prod} waste that is connected to production in general,
- Q_{energy} waste that is connected to the use of energy carriers, for example ash from combustion of wood fuel. Q_{energy} can be broken down into six different energy carriers (see Table 4),
- Q_{depr} waste that is connected to the use of long-lived products (the depreciation of products),
- Q_{staff} waste that is generated as a consequence of the staff, for example household wastes in business; Q_{staff} can be broken down in two components, one for low-income earners and one for high income earners (however, in the study we did not find any reason to make the distinction), and
- Q_{com} waste that is generated as a consequence of use of a certain commodity. Q_{com} can be broken down in 33 different commodities (see Table 3).

Q_{prod}, Q_{energy}, Q_{depr}, Q_{staff}, and Q_{com} are then calculated by

$$\begin{aligned}
Q_{\mathrm{Pr}od} &= x_{prod} * A \\
Q_{i,energy} &= x_{i,energy} * B_i \\
Q_{energy} &= \sum Q_{i,energy} \\
Q_{depr} &= x_{depr} * C \\
Q_{j,Staff} &= x_{j,staff} * D_j \\
Q_{staff} &= \sum_j Q_{j,staff} \\
Q_{k,com} &= x_{k,com} * E_k \\
Q_{com} &= \sum_k Q_{k,com}
\end{aligned} \qquad \textit{(Formula 2)}$$

Where

- A is the production (in SEK) in the sector according to EMEC,
- B_i is the consumption of energy carrier i (in SEK) (see Table 4),
- C is the depreciation in the sector in SEK,
- D_j is the quantity of staff employed in the sector in person-hours, divided into low-income and high income earners,
- E_k is the costs of commodities (33 different) and energy carriers in SEK (see Table 3), and

x_{prod}, x_{energy}, x_{depr}, x_{staff} and x_{com} are waste coefficients that have been estimated in this study. The waste factors can be varying with the time.

The full formula, combining the above formulas, is

$$Q_{tot} = x_{prod} * A + \sum_i x_{i,energy} * B_i + x_{depr} * C + \sum_j x_{j,staff} * D_j + \sum_k x_{k,com} * E_k \qquad \textit{(Formula 3)}$$

When deriving the x-factors we have introduced auxiliary factors a, b, c, d and e according to:

$$a = \frac{x_{prod} * A}{Q_{tot}} \qquad \textit{(Formula 4)}$$

$$b_i = \frac{x_{i,energy} * B_i}{Q_{tot}} \qquad \textit{(Formula 5)}$$

$$c = \frac{x_{depr} * C}{Q_{tot}} \qquad \textit{(Formula 6)}$$

$$d_j = \frac{x_{j,staff} * D_j}{Q_{tot}} \qquad \textit{(Formula 7)}$$

$$e_k = \frac{x_{k,com} * E_k}{Q_{tot}} \qquad \textit{(Formula 8)}$$

Where $a + \sum_i b_i + c + \sum_j d_j + \sum_k e_k = 1$ *(Formula 9)*

If a waste is generated exclusively by the staff, then $\Sigma d = 1$. This is true for example for household waste.

In EMEC, the waste coefficients are measured in terms of kg waste per SEK produced or spent on different goods, or in terms of kg waste per person-hour used in different economic sectors. The price of goods is measured in real terms, but the waste coefficients can still change over time due to technological development, waste prevention measures, etc. (see Section 2.4). If these changes are a percent or two per year, they will have a great impact on the quantity of waste generated in the long run.

Table 3. Definition of commodities in private sector in EMEC

Commodity in EMEC	**CPA code***	**Commodity label in the Swedish National Accounts**
1. Agricultural products	01	Products of agriculture and hunting
2. Fish	05	Fish and fishing products
3. Timber	02	Products of forestry and logging
4. Bio fuels	02 pt	Wastes from logging
5. Metal ores	13 14	Metal ores Other mining and quarrying products
6. Coal	10	Coal
7. Products n.e.c.	15,16 17-19 20	Food products, beverages and tobacco products Textiles and textile products Wood and wood products
8. Mineral products	26	Non-metallic mineral products
9. Pulp and paper	21 22	Pulp, paper and paper products Printed matter
10. Pharmacy products	244 245	Pharmaceuticals and medical chemicals Soap, detergents and cosmetics
11 Other chemical products	24 excl 244,245 25	Chemicals and chemical products Rubber and plastic products
12. Iron and steel	271-273	Basic iron and steel , tubes and wires
13. Other metals	274,275	Basic non-ferrous metals
14. Engineering products	28 29 30,31 32 33 34,35 36,37	Metal products Mechanical machines Electric machines and computers Communication equipment Measuring equipment Transport equipment Other manufactured products
15. Fuels	23200 pt	Heating oils
16. Motor fuels	23200 pt	Motor gasoline, diesel and jet fuels
17. Other petroleum products	23200 pt	Other refined petroleum products
18. Crude petroleum	11	Crude petroleum
19. Electricity	401	Electricity
20. Steam and hot water	403	Steam and hot water
21. Gas	402	Manufactured and distributed gas
22. Fresh water	41	Collected, purified and distributed water
23. Buildings	45	Construction works
24. Rail transports	601	Rail transports
25. Passenger transports	6021 pt,6023 6022	Passenger transports by bus Passenger transports by taxi
26. Large truck transports	6024 pt	Goods transports by trucks > 32 tons
27. Medium truck transports	6024 pt	Goods transports by trucks 3.5 - 32 tons
28. Small truck transports	6024 pt	Goods transports by trucks < 3.5 tons
29. Sea transports	61	Sea transports
30. Air transports	620	Air transports
31. Other transports	63 64	Other transport products Communication products
32. Services	50-52 55 65 66 71-74 75,80-85,90-95	Wholesale and retail trade products Restaurant and hotel services Financial services Insurance services Business services Other private services
33. Dwellings	70	Real estate services

* EU Classification of products by Activity (CPA).

Table 4. Definition of energy carriers in EMEC

Energy carrier	**Label in the Swedish Environmental Accounts**
Fuel oils	Domestic heating oil (EO1) Heavy fuel oils (EO2-5)
Gases	LPG Gas works gas Natural gas Coke oven gas Blast furnace gas LD-gas
Motor fuels	Motor gasoline Aviation gasoline Diesel oil Jet gasoline Jet kerosene
Coal	Coal Coke
Bio fuels	Wood-fuels Black liquor Tall oil Biogas Other biomass
Other fuels	Peat Wastes Other

2.2.4 Generation of waste from households

We have assumed that wastes from households are depending on the consumption of commodities in the private sector.

$$Q_{tot} = y_m * F_m \qquad \textit{(Formula 10)}$$

Where

Q_{tot} amount of a certain waste type from the household sector.
y_m waste factor.
F_m consumption of commodity *f* (see Table 5)

There are 26 different commodities modelled for private consumption in EMEC, see Table 5. It should also be noticed that the waste factor can change over time.

Table 5. Definitions of commodities in private consumption in EMEC

Commodity in EMEC	**COICOP code***	**Consumption label in the Swedish National Accounts**
1. Foods and beverages	1, 2	Food, beverages and tobacco
2. Clothing and footwear	3	Clothing and footwear
3. Furniture etc	51 52	Furniture, carpets and repairs Household textiles and other furnishings
4. Household goods	531, 532 54, 55 533	Major household appliances Glassware, tableware and household utensils Household services
5. Gross rents	41, 42	Gross rents and water charges
6. Recreation	9424 9421-3, 9425-7 941, 943 951-3 914, 931, 932 ,9341	Photographic equipment Entertainment and photo services Gambling, lotteries etc. Books, newspapers and magazines Other recreational goods and services
7. Private transport	71, 9211-3 721,7222 7241	Personal transport equipment Repair charges, parts and accessories Compulsory tests of cars
8. Road work trips	7321 pt, 735-6 pt	Bus and local traffic, Cabs, Removal
9. Road short leisure trips	7321 pt, 735-6 pt	Bus and local traffic, Cabs, Removal
10. Road long leisure trips	7321 pt, 735-6 pt	Bus and local traffic, Cabs, Removal
11. Rail work trips	7310 pt	Railway transports
12. Rail short leisure trips	7310 pt	Railway transports
13. Rail long leisure trips	7310 pt	Railway transports
14. Sea short leisure trips	734 pt	Sea transports
15. Sea long leisure trips	734 pt	Sea transports
16. Air long leisure trips	733 pt 960	Air transports Services of travel agencies and air charter
17. Services	432 562 723, 7241, 7243-5 81 911 915, 923 935 11, 121 125, 126 941, 124, 101 15 62,63	Household services excl. domestic services Domestic services Other expenditures on cars Communication Radio and television Repairs to recreational goods etc. Veterinary services Services of barber and beauty shops etc Financial services Services n.e.c. Purchases abroad and foreign purchases Medical care and health expenses
18. Goods n.e.c.	912-3, 921-2 61, 9342, 1232 431, 561, 551, 933 1212-3, 954, 12311	Other recreational goods Goods for personal care Goods not else classified Goods not else classified
19. Electricity	451	Electricity
20. Gas	452	Gas
21 Fuels	453 454 pt	Heating oils Other fuels
22. Gasoline work trips	7221 pt	Gasoline
23. Gasoline short leisure trips	7221 pt	Gasoline
24. Gasoline long leisure trips	7221 pt	Gasoline
25. Bio fuels	454 pt	Other fuels
26. Purchased heat	455	Purchased heat

* COICOP (Classification of Individual Consumption by Purpose), is an international classification of private consumption according to A System of National Accounts (SNA), United Nations, 1993.

2.3 Scenarios for the year 2030

As stated above, the waste coefficients can change over time due to, for example technological development. In the research programme Towards Sustainable Waste Management, EMEC calculates the quantities of waste in different scenarios for the year 2030. The future development is inherently uncertain. This is true for the development of waste coefficients, as well as for other aspects of the waste-management system and society at large.

When looking as far as the year 2030, these uncertainties are quite large. It is not meaningful to try to predict what the waste coefficients will be in 2030. Instead, we focus on describing the range of possible developments until this year. For this purpose, we use a set of explorative scenarios. These are defined by the fact that they respond to the question "What can happen?".

Börjesson et al. (2006) distinguish between two types of explorative scenarios: external scenarios and strategic scenarios. External scenarios focus only on factors beyond the control of the relevant actors. Waste management policies are not part of the scenarios but the external scenarios can then help the user to develop robust strategies, i.e. strategies that will survive several kinds of external development.

Strategic scenarios respond to the question: What can happen if we act in a certain way? They include policy measures at the hand of the intended scenario user to cope with the issue at stake. The aim of strategic scenarios is to describe a range of possible consequences of strategic decisions.

The waste coefficients developed for EMEC are intended to describe the situation before any additional policy instruments for sustainable waste management are implemented. Hence, what we need is a set of external scenarios, which describes how the waste intensities can develop as a result of technological development, global trends in consumption, and other factors beyond the control of Swedish authorities.

As basis for these scenarios, we use the common set of external scenarios developed for the research programme Towards Sustainable Waste Management, as part of the project Future-Oriented Synthesis (Dreborg & Tyskeng 2008). These four scenarios are distinguished by their degree of global cooperation and the degree of political control and influence in matters that concern the environment and natural resources (see below). In addition, Dreborg & Tyskeng (2008) present a reference scenario, where current trends and policy are not significantly altered. The scenarios are briefly presented here. They are described in more detail by Dreborg & Tyskeng (2008).

2.3.1 Scenario 1: Global sustainability

The trend towards globalisation continues. The trade of goods and services becomes increasingly free. The labour market also becomes increasingly international and flexible. Technological development is rapid. A global, political cooperation is established on common issues such as climate change and the management of natural resources. As a result, political control is strengthened regarding emissions and resource utilisation. Policy-makers can, for example, agree on a global cap for emissions and a system for tradeable emission rights under this cap. In rich countries the consumption becomes more directed towards services, second-hand trade increases, and the material intensity decreases. There is also an increase in cooperation to strengthen development and the management of conflict in poor regions. The authority and efficiency of the UN are enhanced.

2.3.2 Scenario 2: Global markets

Just like in Scenario 1, the trend towards globalisation continues. Economic growth is the dominating target, and free trade, international and flexible labour markets, etc. are the tools. As a result, raw materials prices grow to 2.5 times the real price in the reference scenario and Scenario 1. The gap between poor and rich countries becomes smaller, but the economic and social gaps within the countries remain or grow. Technological development is rapid. The political influence and public awareness is also weakened concerning environmental issues and resource management. The consumption focuses on physical products and on the experience industry. Global transports increase, as well as competition and conflicts over natural resources. These conflicts become difficult to solve, because the authority and efficiency of the UN and similar organisations are weakened.

2.3.3 Scenario 3: Regional markets

Here, the trend towards globalisation is broken. Instead, the regions of the world become more important. The EU is strong, for example, but relatively closed towards other parts of the world, for example through new regional trade barriers. As a consequence, the economic gap between North and South increases. Poor people remain poor also within many countries, since less effort is spent on economic and social equality. Technological development is slow. The political influence is weakened over environmental issues and resource management. The reduced international cooperation makes it difficult to deal with global issues such as climate change and natural resources. Instead, the political influence that remains focuses on acute regional and local issues. As a result, raw materials prices grow to 2 times the real price in the reference scenario and Scenario 1. The Swedish consumption focuses on physical products and on the experience industry.

2.3.4 Scenario 4: European sustainability

The current trend towards globalisation is eventually broken, and a more regional pattern of trade and cooperation is established. Technological development is slow. The UN and the global influence of USA are both weakened. The EU is strong but relatively closed towards other parts of the world. The economic gap between North and South remains, but the gap between rich and poorer countries in Europe is significantly reduced. Within EU there is a strong commitment to free trade, social and economic equality, and environmentally sustainable development. On a global level, the political influence is weak regarding environmental issues and the depletion of natural resources, but EU aims to set a good example and has ambitious targets and policies in these areas. Here, the consumption becomes more directed towards second-hand products, and the material intensity decreases somewhat.

3 Results and discussion

3.1 Quantifying the current waste coefficients

The result of this study is the waste coefficients for EMEC, or rather the "auxiliary waste coefficients" *a, b, c, d* and *e* as defined in Formulas 4 - 9 above. For each waste type in each sector we have assigned values for *a, b, c, d* and *e*. For each case we have made an assessment of what parameters are influencing the waste generation. We are limited to use the parameters that are defined and used in EMEC.

In Table 6 the general principles for the assignment of waste coefficients for industry and business are presented. The detailed, numeric results are presented in Appendix 1 with some comments.

Table 6. General principles for assigning auxiliary waste factors

EWC-Stat-kod	**Waste type**	**General principles for establishing waste factors**
	Non-hazardous waste	
01.2, 01.4, 02, 03.1	Other chemical wastes	The major part is green liquor dredge from the pulp industry, and some chemical residues from the chemical industry. Chemical wastes are generally considered to depend on the commodity: 11. Other chemical products.
03.2, 11, 11.3	Sludge (wet weight)	Sludges are usually allocated to the production. In some cases there are obvious connections to a commodity or to the staff. The sludges are allocated to the production, there is no relevant commodity that reflects the sludge generation. Sewage sludges are excluded.
6	Metallic wastes	Metallic wastes are considered to depend on the commodity 14. Engineering products. Usually a part of the metallic waste is allocated to the staff. About 50 % of the metallic waste reported as waste in Swedish EPA (2008a) has been regarded as by-product and has been excluded from the study.
07.1	Glass wastes	Glass wastes are connected to both the staff and the consumption of commodities (which commodity depends on the sector in question). In several cases the waste is packages, but it can also be other kind of glass. The largest amounts are from the mineral industry (glass manufacture).
07.2	Paper and cardboard wastes	Paper and cardboard wastes are mainly connected to the consumption of the commodity 11 Other chemical products. A minor part (e.g., beverage packages) is assumed to depend on the staff,. Paper waste from pulp and paper industry includes different kind of process wastes such as fiber reject, fiber sludge,
07.4	Plastic wastes	Plastic waste is to a large extent used packages. Plastic wastes are mainly connected to the consumption of the commodity 11 Other chemical products. A minor part is assumed to depend on the staff. A part of the reported waste from the plastic industry has been regarded as by-product and is not included in the figures.
07.5	Wood wastes	Wood wastes are mainly connected to the commodity 3 Timber. Smaller amounts can have connections with other commodities. Wood residues from wood manufacture (e.g., sawmills) have been regarded as by-product and has been excluded from this study.

EWC-Stat-kod	**Waste type**	**General principles for establishing waste factors**
8	Discarded equipment	In most sectors we have brought up discarded equipment into two parts: - one part (70 %) which is discarded long-lived products (longer than 3 – 5 years) and is connected to the depreciation - one part, consisting of more short-lived products, that is connected to the consumption of commodity 14 Engineering products
08.1	Discarded vehicles	Discarded vehicles, when reported in the waste statistics, are handled as discarded long-lived products (longer than 3 – 5 years) and are connected to the depreciation. There are only minor amounts of discarded vehicles reported in the industrial sectors, which can be an underestimate. However the total amounts of reported discarded vehicles is based on official statistics from Swedish Road Administration and has been allocated mainly to the sectors Households and Services.
08.41	Batteries and accumulators	Batteries and accumulators have in most cases been connected to the commodity 14 Engineering products (e.g., non-hazardous back-up batteries for industrial machineries), and a minor part connected to the staff (e.g., batteries for PC equipment).
9	Animal and vegetal wastes	Animal and vegetal wastes occur only in few sectors. In food industry it has been connected to the commodities 1 Agricultural services and 2 Fish. In the Service sector it has been connected to the commodity 32 Services, because this waste is mainly food waste from restaurants. Swedish EPA (2008a) reports larger amounts in the Agriculture and forestry sector (NACE 01-02). 3 Mton of this is felling residues from forestry, and has here been regarded as by-product and been excluded from the waste calculation. It should be observed that the item 10.1 Household waste contains a lot of unsorted biodegradable waste. The real amount depends on both the primary generation (the sum of sorted and unsorted biowaste) and how this is sorted in the restaurants, grocerystores etc.,
10.1	Household and similar wastes	Household and similar wastes are connected to the staff (depends on the number of employees). In the waste survey by Swedish EPA (2008a) the amount of household waste from business is often around 100 kg/employee. In the Service sector a part of the waste has been allocated to the commodity 32 Services to cover household waste generated in hotels and restaurants.
10.2	Mixed and undifferentiated materials	Mixed and undifferentiated materials are usually a general waste consisting of several materials. Often it is pre-sorted at source into "combustible waste" (paper, plastic and wood) and "rest waste" (inert materials). In most cases we have divided it into two parts: - one part (30 %) that depends on the staff - one part (70 %) that depends on the total consumption of commodities In the service sector we have assumed the shares to be 40 % respectively 60 %.
10.3	Sorting residues	Sorting residues is generated mainly in waste management sectors (NACE 37, NACE 51.57 and NACE 90.02). It is excluded from this study, but the amounts are calculated in other projects in the research program. Sorting residues in Pulp and paper industry is reject from pulping of waste paper and is included in the study.

EWC-Stat-kod	**Waste type**	**General principles for establishing waste factors**
12	Mineral wastes, excluding 12.4 (waste from thermal treatment) (and excluding mineral wastes from mining)	Excavated soils and mining waste is excluded in this study. The amount is generally considered to depend on the total use of commodities. The larger amounts are from - the food industry (soil from washing potatoes, carrots and other root-crops) - the mineral industry (NACE 26) there are different kind of process wastes: concrete residues, glass slag, and similar - the metal industry (NACE 27-28) there are different kind of bricks from kilns and furnaces. - the mechanical industry there are especially foundry sand - construction (the amounts that are landfilled have been regarded as waste) - street cleansing: collected sand from streets (after sanding on icy and snowy streets and roads)
12.4	Combustion wastes	Combustions wastes are generated by different combustion and other thermal processes, both for energy production (e.g., in wood industry and pulp and paper industry) and for processes (e.g., in metal industry). The waste is generally depending on the use of energy carrier. Ashes from incineration of waste is not included (it is modelled separately in another project in the research program).
	Hazardous wastes	
01.1 H	Spent solvents	Spent solvents are mainly generated in chemical industry, plus minor amounts in metal industry and mechanical industry. It has been allocated to the commodity 11. Other chemical products.
01.3 H	Used oils	Used oils are reported in minor quantities from all industrial sectors with machinery and vehicles. The largest amounts are generated in metal industry, mechanical industry and the service sector. It is mainly lubricating oil, hydraulic oil and similar from changes of oil, and process oil residues (in metal and mechanical industries), and some fuel oil residues (service sector). It has been allocated to the commodity 17. Petroleum products.
01.2 H, 01.4 H, 02 H, 03.1 H	Other chemical wastes	Other chemical wastes are containing several different kinds of chemical wastes. Also contaminated packages, classified as hazardous waste, is included. In most sectors this waste has been allocated to the commodity 11. Other chemical products.
03.2 H	Sludges (wet weight)	Hazardous sludges are generated in mainly chemical industry, metal industry and mechanical industry. Also the service sector has some amounts. The sludges are allocated to the production, there is no relevant commodity that reflects the sludge generation.
07.5 H	Wood wastes	Hazardous wood waste is mainly impregnated wood that has been discarded. A great part is from construction and demolition projects in all sectors. There is also some impregnated wood used for wood packages or part of wood packages or wood pallets.
8 H	Discarded equipment	Hazardous discarded equipment is mainly electric and electronic scrap (WEEE), from long-lived products. It has been connected to depreciation.
08.41 H	Batteries and accumulators	Hazardous batteries and accumulators are generated in small amounts in most sectors. This waste have to a part (90 %) been connected to the commodity 14 Engineering products (e.g., back-up batteries for industrial machineries and accumulators for trucks), and a minor part (10 %) connected to the staff (e.g., batteries for PC equipment).
10.2 H	Mixed and undifferentiated materials	Hazardous mixed and undifferentiated materials are several different wastes. Included are for example discarded laboratory chemicals, sorbents, rags etc. We have allocated it to the total consumption of commodities.

EWC-Stat-kod	**Waste type**	**General principles for establishing waste factors**
12 H	Mineral wastes, excl. 12.4 and 12.6	Hazardous mineral wastes is mainly reported from the construction sector, and is, for example, PAH asphalt and other construction and demolition waste containing hazardous substances. The figure in Swedish EPA (2008a) is probably an overestimate. In all sectors it has been allocated to the total production. The amount from the construction sector is probable more or less temporary. It occurs for the moment when a lot of roads with PAH asphalt is demolished or reconstructed.
12.4 H	Combustion wastes	Hazardous combustion wastes are generated in the metal industry with minor amounts from chemical industry, mechanical industry and service sector (from cleaning of flue gases at crematoriums). It has been allocated to the use of energy carriers.
12.6 H	Contaminated soil and dredging spoils	Contaminated soil and dredging spoils has been excluded from this study, because it is difficult to model since it probably has real relationship to the economic parameters this waste study is based on. To a part it can be assumed to depend on, for example, the construction activities, but to a large part it also depends on political decisions.

Table 7. General principles for assigning auxiliary waste factors for households.

Waste type		**Amount *ktons***	**General principle for establishing waste factors**
Non-hazardous waste			
3.2, 11	Sludges	879	Sludges from households are sludges from septic tanks and similar onsite wastewater treatment equipment. The amount is mostly depending on how many estates that are not connected to the municipal sewage system, and does not depend on neither the population nor the economic development.
6	Metal wastes	165	Metal wastes are metal packages and different kind of household scrap (to a great part bulky scrap). The generation has been assumed to depend on the commodities Food and beverages, Household goods, and Goods
7.1	Glass wastes	266	Glass waste is mainly beverage packages. It is assumed to depend on the commodities. The generation has been assumed to depend on the commodities Food and beverages, and Household goods
7.2	Paper and cardboard wastes	537	Paper and cardboard are both newsprint, catalogues and different of paper packages, also tetra packages are included. The generation has been assumed to depend on the commodities Food and beverages, and Household goods
7.3	Rubber wastes	31	Rubber waste is discarded rubber tires. It has been collected to the commodity Private transports.
7.4	Plastic wastes	48	Plastic waste is mainly plastic packages that have been collected separately (construction plastics is usually included in the bulky household waste, included in the item "Household waste"). The generation has been assumed to depend on the commodities Food and beverages, and Household goods
8.41	Batteries and accumulators	1	This waste is non-hazardous batteries. It has been allocated to the commodity Household goods.

Waste type		Amount *ktons*	General principle for establishing waste factors
9	Animal and vegetal waste	386	This waste is biodegradable waste that has been collected separately from other household waste for composting or anaerobic digestion. It has been allocated to the commodity Food and beverages. It should be observed that the item 10.1 Household waste contains a lot of unsorted biodegradable waste. The real amount depends on both the primary generation (the sum of sorted and unsorted biowaste) and how this is sorted in the households,
10.1	Household waste	2 328	Household waste is both the waste the household brings in the dustbin, sack or similar and the mixed bulky waste that the households bring to the recycling centres. We have assumed that this waste depends on several household commodities: Food and beverages, Furniture, Household goods, recreation, private transports, Services, Goods not eelse classified, and Biofuels.
Total non-hazardous wastes		**4 643**	
Hazardous waste			
1.1 H	Spent solvent	1	Solvents are used as detergents or cleaning agents in several activities: cleaning clothes, cleaning the house, cleaning and maintenance of cars and other equipment.
1.3 H	Used oil	1	Oil wastes are generated mainly from maintenance of cars, lawn mowers, and similar (changing oil). It has been allocated to private transports
1.2 H, 1.4 H, 2 H, 3.1 H	Other chemical wastes	15	Other chemical wastes are mainly consisting of paint wastes, but some other chemicals may occur. This waste is assumed to be used in the same way as solvents: cleaning clothes, cleaning the house, cleaning and maintenance of cars and other equipment.
7.5 H	Wood wastes	15	Hazardous wood waste is especially impregnated wood, used in home construction projects. The commodity Goods not else classified is assumed to influence the generation of hazardous wood waste.
8 H	Discarded equipment	139	Discarded equipment is mainly electric and electronic scrap that has been collected separately. The generation is assumed to depend on the consumption of household goods.
8.1 H	Discarded vehicles	305	Discarded vehicles are all cars that private persons discard and hand over to car disassemblers. It has been allocated to the commodity Private transports.
8.41 H	Batteries and accumulators	7	Batteries and accumulators are used in household goods and cars, and are allocated to commodities household goods and private transports.
10.2 H	Mixed and undifferentiated materials	3	Hazardous mixed wastes are different kind of "small chemicals", for example from photo home laboratories. Also medicines and similar is included. This waste has been allocated to several of the household commodities (see Appendix 1)
12 H	Mineral wastes	2	Hazardous mineral waste is asbestos waste that has been collected from household construction projects. It is difficult to find a relevant allocation parameter, but the commodity Goods not else classified is probably the best estimate. Asbestos waste occurs probably more or less temporary and are generated when old building are renovated (by private persons). Since asbestos has been phased out and is not occurring in newer buildings, it will probably decrease in the future, independent of the economic development.
Total hazardous waste		**489**	

3.2 Development of waste coefficients until 2030

The assumed development over time of waste coefficients in the different EMEC scenarios is presented in Tables 8 and 9. The basis for these assumptions is presented below.

Table 8. Assumed annual changes in waste coefficients (% per year until 2030)

	Reference scenario	Scenario 1: Global sustainability	Scenario 2: Global markets	Scenario 3: Regional markets	Scenario 4: European sustainability
Waste from households (y_m)	0	-2	+1	+1	-2.5
Input-related waste from industry and services ($x_{k,com}$ and $x_{i,energy}$)	-1	-3	-3	-1	-1.5
Staff-related waste from industry and services ($x_{j,staff}$)	0	-1	+1	+1	-1
Depreciation-related waste from industry and services (x_{depr})	-0.5	-1	-1	0	0
Output-related waste from industry and services (x_{prod})	0	0	0	0	0

Table 9. Assumed total changes in waste coefficients from 2006 to 2030

	Reference scenario	Scenario 1: Global sustainability	Scenario 2: Global markets	Scenario 3: Regional markets	Scenario 4: European sustainability
Waste from households (y_m)	±0%	-38%	+27%	+27%	-46%
Input-related waste from industry and services ($x_{k,com}$ and $x_{i,energy}$)	-21%	-52%	-52%	-21%	-30%
Staff-related waste from industry and services ($x_{j,staff}$)	±0%	-21%	+27%	+27%	-21%
Depreciation-related waste from industry and services (x_{depr})	-11%	-21%	-21%	±0%	±0%
Output-related waste from industry and services (x_{prod})	±0%	±0%	±0%	±0%	±0%

3.2.1 Waste from households

The coefficients of waste from households (y_m in Section 2.3.2) are in EMEC given in terms of kg waste per SEK spent on different groups of consumption goods and services.

The total waste quantity from households has been roughly proportional to household spending and over the long run, and this means that the total waste coefficient of households has been

roughly constant over time. OECD (2008) records a decoupling of municipal solid waste (MSW) quantities from economic growth after the year 2000: MSW grew by 2.5% per year from 1980 to 2000 in OECD, but by only 0.9% per year from 2000 to 2005, despite continued economic growth of over 2% per year. This indicates that the household waste coefficients have been reduced by 1-1.5% per year since 2000. However, OECD (2008) states that the recorded decoupling does not necessarily reflect the real situation. The uncertainties in the recorded data are large, and recent trends in the drivers of MSW generation do not suggest such a decoupling.

In the reference scenario, we assume that the waste coefficients of households remain constant until 2030. We assume this is true not only for the overall waste coefficient, but also for each waste fraction and for each group of consumption goods. This is consistent with the long-term past development in Sweden, where the quantity of household waste has grown roughly in proportion to the private consumption and the overall economic growth.

In Scenario 1 (Global sustainability), free global trade is established and the technology development is rapid (see Section 2.4.1). The technological development can serve to further reducing the material content per item. Political instruments aiming at reducing environmental impacts and resource depletion are also likely to make materials more expensive, further reducing the material content of products. In addition, the consumption is directed more towards services, and second-hand trade increases. The environmental awareness of many households is high, which can also result in reduced quantities of food waste. All in all, most significant factors reduce the waste intensity of households in this scenario. Here we assume the coefficient to be reduced by 2% annually for all types of household waste, which means that it will be reduced by 38% from the year 2006 to 2030. This means that the quantity of household waste will grow only slowly despite a rapid growth in household spending.

In Scenario 2 (Global markets), free global trade is also established and the technology development is rapid. Political instruments do not make materials significantly more expensive, but the prices of raw materials increase much more rapidly compared to the reference scenario. Hence, technological development can still make the products leaner. The consumption is more directed towards physical high-tech products and the experience industry. The former results in scrapped goods, but the latter does not result in significant quantities of Swedish household waste. The Swedish economy is abundant and the environmental awareness is low, which means that kitchen waste is likely to increase. All in all, we assume that the waste coefficient of households increases by 1% annually, which means that the coefficient will increase by 27% from the year 2006 to 2030.

In Scenario 3 (Regional markets), trade is regional and technology development is slow. As a result, the products are more slowly improved. Again, the consumption is directed towards high-tech products and the experience industry. The economy is not as abundant, compared to Scenario 2, but the environmental awareness is still low. This means that kitchen waste is likely to increase somewhat. As a result, we assume the coefficient to increase by 1% annually for all types of household waste, which means that it will increase by 27% from the year 2006 to 2030.

In Scenario 4 (Sustainable Europe), trade is regional and technology development is slow. Hence, products are slowly improved. On the other hand, trade barriers and environmental policy instruments make products more expensive, particularly when they contain much material. The second-hand trade also increases. The economic growth is slow and the environmental awareness of many households is high, which means that the quantities of food waste can be expected to be significantly reduced. As a result, we assume that the waste coefficients of households are reduced by 2.5% annually, which means that they will be reduced by 46% from the year 2006 to 2030. This

corresponds roughly to the long-term increase in household waste, and means that the quantity of household waste will be nearly constant despite a continued growth in household spending.

As stated above, the reference scenario is consistent with the long-term past development in Sweden. Scenarios 2 and 3 are somewhat more pessimistic. Scenarios 1 and 4, on the other hand, include a somewhat greater decoupling of waste quantities from economic growth than that which is indicated by recent OECD statistics (OECD 2008). The development in Scenarios 1 and 4 also correspond roughly to the development in Scenario Civic Renewal in a recent study on household waste quantities in the UK: the food-related waste is reduced in absolute terms, while other household waste streams increase to make the total quantity approximately constant until the year 2030 (Brook Lyndhurst 2007).

3.2.2 Input-related waste from industry and services

The input-related waste coefficients ($x_{k,com}$ and $x_{i,energy}$ in Section 2.3.1) depend on the price of the input materials and energy in the year 2006, and the ratio of these flows that becomes production scrap and ashes.

The demand for natural resources grows in the reference scenario. For this reason, the real price of material used in manufacturing industry is likely to increase. This will stimulate the industry to develop processes where less material becomes waste, which will reduce the input-related waste coefficient. In the reference scenario, the input-related waste coefficients are assumed to be reduced by 1% annually, which means a reduction by 21% from the year 2006 to 2030.

Our assumption is consistent with the historic development. Between 1993 and 2006, the quantity in fixed prices of input materials and energy to Swedish industry (excl. mining) grew faster than the total quantity of waste recorded in this part of the Swedish economy. The difference in growth rate is approximately 1% per year (SCB, 2001; SCB, 2008; Swedish EPA, 2008). It should be noted, however, that it is difficult to compare waste statistics from 1993 and 2006 because of large uncertainties in the data and because of differences in the methods used to estimate and collect data on waste quantities.

Scenario 1 includes more rapid technological development, compared to the reference scenario. In addition, the use of materials will be made more expensive by policy instruments aiming at reducing environmental impacts and resource depletion. Both of these factors serve to stimulate a more rapid reduction in the quantity of production scrap. For this reason, we assume the waste coefficients to be reduced by 3% annually, which means they will be reduced by 52% by 2030.

Scenario 2 also includes more rapid technological development, compared to the reference scenario. In addition, the real price of raw materials increases much more rapidly than in the reference scenario. On the other hand, there will be few and weak policy instruments that makes material use expensive. For this reason, we assume the waste coefficients to be reduced at the same rate as in Scenario 1: 3% annually, and 52% by 2030.

Scenario 3 has a slower technological development, compared to the reference scenario. In addition, there will be few and weak policy instruments that makes material use expensive. On the other hand, the real price of raw materials increases more rapidly than in the reference scenario. For this reason, we assume the waste coefficients to be reduced at the same rate as in the reference scenario: 1% annually, and 21% by 2030.

Scenario 4 includes a slow technological development, but the use of materials will be made more expensive by policy instruments aiming at reducing environmental impacts and resource depletion. These factors work in opposite directions, compared to the reference scenario. We believe the increase in policy instruments will be the slightly stronger force. For this reason, we assume the waste coefficients to be reduced slightly more compared to the reference scenario: a reduction of 1.5% annually, and 30% by 2030.

3.2.3 Staff-related waste from industry and services

Staff-related waste includes waste from the cantines etc. The waste coefficients ($x_{j,staff}$) are measured in terms of kg waste per hour worked. In the reference scenario, current perceptions and procedures are basically unaltered. For this reason we assume these waste coefficients to be constant until 2030.

Scenarios 1 and 4: we assume the increased environmental awareness in these scenarios to result in a reduction in the waste coefficients by 1% annually, and 21% by 2030.

Scenarios 2 and 3: we assume the reduced environmental awareness in these scenarios to result in an increase in the waste coefficients by 1% annually, and 27% by 2030.

3.2.4 Depreciation-related waste from industry and services

Waste that arises as a result of the depreciation of vehicles and equipment is in EMEC related to the capital costs. The waste coefficient (x_{depr}) is measured in terms of kg waste per SEK of capital depreciation in 2006 prices.

The depreciation waste coefficient could be affected by, for example, the technological development. This is likely to make vehicles and equipment more advanced. It can also result in miniaturisation of certain equipment and in light-weight vehicles. This would reduce the quantity of material and, hence, waste per item.

The reference scenario includes moderate technological development. We assume this to result in an annual reduction in the depreciation waste coefficient by 0.5%. Until the year 2030, it will be reduced by 11%.

Scenarios 1 and 2 includes more rapid technological development, compared to the reference scenario. For this reason, we assume the depreciation waste coefficient to be reduced by 1% annually, which means that it will be reduced by 21% until 2030.

Scenarios 3 and 4 has a slower technological development, compared to the reference scenario. We assume the depreciation waste coefficient to be constant in these scenarios.

3.2.5 Output-related waste from industry and services

Here, the waste coefficient (x_{prod}) essentially depends on the price in 2006 of the products produced and the quantity of waste generated per item.

The different scenarios all include technology development at various rates. This will allow for the production of more advanced products that, at least sometimes, generate more waste in production.

On the other hand, part of the technological development will also be process improvements that reduce the quantity of waste per produced item.

We assume that these forces roughly balance out in the all scenarios, which means that the output-related waste coefficients of the manufacturing industry remains constant until 2030.

3.3 Aggregation and related uncertainties

This top-down study addresses nearly all waste flows in the Swedish economy. As a consequence, both the economic sectors and the waste types are highly aggregated. Each sector in this study consists of several different sub-sectors that can have quite different waste characteristics. Each waste type in the study is also an aggregate of several other specific wastes.

This model presumes that each sector can regarded as homogenous. However, in the reality each sector in EMEC, and each sector in the waste statistics, consists of several sub-sectors. The food industry and wood industry is, for example, aggregated to the same sector in EMEC. As long as both sub-sectors are developed equally, the model should give appropriate predictions. However, if one sub-sector is developing and another is declining the model can give wrong predictions. To a large extent this is handled by how the waste is connected to different commodities. In the case of food industry and wood manufacture, and in several other cases, the larger waste flows are allocated to specified commodities. So is the case with Animal and vegetal waste and Wood wastes. If the food industry and wood industry develop in different directions, the predictions of these waste quantities will probably still be rather good. However, errors can occur in waste types that have been allocated to the staff or to the production.

3.4 Examples of waste prevention

Waste prevention measures do not necessarily take place in the process where the waste is generated; instead, they often are implemented in up-streams processes. There can be several steps between the actual measure and the step where the waste is generated. Measures that significantly affect the waste quantities of downstreams processes might not even have an apparent connection to waste prevention when they are implemented. Here are some examples of different measures that can reduce the quantity of waste:

- Materials-related wastes (paper, plastics, metals, and also hazardous materials such as oils, solvents paints, etc) can often be reduced by better materials management. Packages and discarded equipment can also be referred to this category, as can a lot of wastes from construction. Often a commodity is purchased in excess, and the excess may have to be discarded. By better planning of purchases, and planning of the management of different materials, some reductions in the waste quantity should be possible.

- Ashes from energy production (classified as EWC-Stat 12.4 Combustion wastes) are closely connected to the consumption of fuels. Different fuels have different concentration of ashes. Oil has, for example, almost no ash while biofuel has about 1 weight-% (different for different biofuels). Firing oil instead of biofuel leads to a decreased amount of ash. However, in this case there are other environmental goals that are governing so this is probably not an option for waste prevention. However, there

are also possibilities to increase the efficiency of the thermal facilities (e.g., a heating plant or power plant). If the thermal efficiency is increased, less fuel will be consumed (per MJ produced energy) and, as a consequence, also the quantity of ash will decrease. Another possibility in an industrial manufacturing plant is to take different measures to recover energy from different waste energy streams. This can decrease the consumption of ordinary fuels, and thus reduce the quantity of ash.

- Slag from metal works is another waste classified as Combustion wastes. This waste consists of two major constituents: a) non-metallic compunds in the raw material and b) spent slag agents (e.g., lime). Neither is possible to avoid; in fact, between 1994 and 2004 the waste per ton produced steel increased about 15 %, because the production was changed into more high-quality steel which required more slag agents. However the waste amount per SEK (or $ or €) did probably decrease

- Sludges are usually the result of other environmental protection measures, especially purification of contaminated wastewater. At a first glance it seems difficult to reduce these wastes. However, the wastewater is sometimes the result of different losses from production (in industrial sectors). If these losses can be reduced, the wastewater will be less contaminated and give rise to less amounts of sludge in the wastewater cleaning process. There is also a trend to re-route the biological fraction of household waste to the wastewater streams that could increase the waste from sludge. The purpose in this case is energy recovery from the sludge to produce bio-gas.

- Animal and vegetable waste flows from the food and beverage industry are typically some kind of material losses. Often it is materials of secondary quality, which is necessary to bleed out from the process because of quality requirements. A lot of this waste (about 53 % of the reported animal and vegetal waste) is recovered as animal feed today, and should be regarded as a by-product rather than a waste flow. Different waste prevention measures will probably be directed towards making by-products rather than decreasing the gross amount of losses.

- Food waste (included in the EWC-Stat 09. Animal and vegetal wastes) is also generated as a consequence of handling of food in shops, restaurants and homes. For the moment the Swedish EPA has brought this issue to focus, and it is under discussion. A lot of the food wastes are a result of bad "materials management" mentioned above.

- In the household sector, most of the waste is generated as a consequence of consumption of materials and equipment. An example of waste prevention is to change the consumption from material to services or to consume more material-lean products.

These examples show that there is a potential for waste prevention in industry and households. The examples also show that waste prevention may follow as a consequence of efforts to reach other aims, for example an increase in energy efficiency. Another strategy in waste prevention is to turn the waste into by-products, this is however not real waste prevention. Still another measure is improved material management.

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Appendix 1. Presentation of waste coefficients

1. Agriculture and forestry

The Swedish EPA (2008a) reports waste amounts according to Table 10. Manure that is used as fertiliser is not included, nor is straw and similar. Felling residues from forestry which are brought out of the forest and used as fuel (3 000 kton) is included in animal and vegetal wastes. The metallic waste that is reported is to a large extent tools, also some agriculture and forestry equipment can be included.

Table 10. Generation of waste in NACE 01- 02 Agriculture and forestry (Swedish EPA, 2008a)

Waste type	**Waste generation 2006 1000 tons**
Generation of hazardous waste	
01.3 Used oils	3
02 Chemical preparation wastes	0
03.1 Chemical deposits and residues	0
08 Discarded equipment	0
08.1 Discarded vehicles	13
08.41 Batteries and accumulators	1
Sum	**17**
Generation of non-hazardous waste	
06 Metallic wastes	59
07.2 Paper and cardboard wastes	3
07.3 Rubber wastes	7
07.4 Plastic wastes	18
08 Discarded equipment	1
08.41 Batteries and accumulators	0
09 Animal and vegetal wastes (excl. 09.11 and 09.03)	3 122
09.3 Animal faeces, urine and manure	74
10.1 Household and similar wastes	4
Sum	**3 286**
Total generation of waste	**3 304**

Remarks

The figure 0 indicates that the waste type is generated, but have been rounded downwards to 0 (the actual quantity is less than 0.5 kton)

The proposed input to EMEC for the sector is shown in Table 11. We have not included 3 000 kton of 09 Animal and vegetal waste that is felling residues from forestry, which is a by-product and handled as a commodity in EMEC. Manure is also excluded from 09 Animal and vegetal wastes.

Table 11. NACE 01-02: Input to EMEC: NACE 01 – 02 Agriculture and forestry

Waste type (EWC-Stat)		**Waste amount kton**	**Proposed waste coefficients**					
			a (production)	*b* (Energy carrier) Specification of energy carrier	*c* (depreciation) Specification of depreciation	*d* (staff)	*e* (commodities)	Specification of commodity
Non-hazardous waste								
6	Metallic waste	**59**				0.10	0.90	14. Engineering products
07.2	Paper and cardboard wastes	**3**				0.10	0.90	9. Pulp and paper
07.3	Rubber wastes	**7**					1.00	11. Other chem. prod
07.4	Plastic wastes	**18**				0.00	1.00	11. Other chem. prod
8	Discarded equipment	**1**			0.70		0.30	14. Engineering products
08.41	Batteries and accumulators	**0**	0.90			0.10		
10.1	Household and similar wastes	**4**				1.00		
	Total	**92**						
Hazardous waste								
01.3	Used oils	**3**	0.95			0.05		
01.2, 01.4, 02, 03.1	Other chemical wastes	**0**	0.95			0.05		
8	Discarded equipment	**0**			0.70		0.30	14. Engineering products
08.1	Discarded vehicles	**13**			1.00			
08.41	Batteries and accumulators	**1**	0.90			0.10		
	Total	**17**						

This model assumes that the apportionment between Agriculture and Forestry is the same as today. If one of these sub-sectors develops more than the other, the model can make poor predictions of the future waste. That is also the case if there is another apportioning within the Agriculture or Forestry sector, e.g. change from edible crops to energy crops. However, the waste amounts from Agriculture and Forestry are relatively small compared to other sectors.

2. Fishing

The Swedish EPA (2008a) reports waste amounts according to Table 12. Guttings and similar that are disposed in the sea is not included.

The input to EMEC is shown in Table 13.

Table 12. Generation of waste in NACE 05 Fishing

Waste type	Waste generation 2006 1000 tons
Generation of hazardous waste	
01.3 Used oils	1
03.1 Chemical deposits and residues	0
08.1 Discarded vehicles	1
08.41 Batteries and accumulators	0
Sum	**2**
Generation of non-hazardous waste	
06 Metallic wastes	0
07.1 Glass wastes	0
07.2 Paper and cardboard wastes	0
07.3 Rubber wastes	0
07.4 Plastic wastes	0
08 Discarded equipment	0
09 Animal and vegetal wastes (excl. 09.11 and 09.03)	1
10.1 Household and similar wastes	0
10.2 Mixed and undifferentiated materials	0
11 Common sludges excl. 11.3, wet weight	27
of which dry weight	*7*
Sum	**29**
Total generation of waste	**31**

Remarks
0 The figure 0 indicates that the waste type is generated, but have been rounded downwards to 0 (the actual quantity is less than 0.5 kton)

Table 13. NACE B (NACE 05): Input to EMEC

Waste type (EWC-Stat)		**Waste amount *kton***	**Proposed waste coefficients**					
			a (production)	*b* (Energy carrier) Specification of energy carrier	*c* (depreciation) Specification of depreciation	*d* (staff)	*e* (commodities)	Specification of commodity
Non-hazardous waste								
03.2, 11, 11.3	Sludge (wet weight)	**27**	1.00					
6	Metallic wastes	**0**				0.10	0.90	14. Engineering products
07.1	Glass wastes	**0**				0.60	0.40	14. Engineering products
07.2	Paper and cardboard wastes	**0**				0.10	0.90	9. Pulp and paper
07.3	Rubber wastes	**0**					1.00	11. Other chem. prod
07.4	Plastic wastes	**0**				0.10	0.90	11. Other chem. prod
08	Discarded equipment	**0**			0.70		0.30	14. Engineering products
09	Animal and vegetal wastes	**1**					1.00	2. Fish

10.1	Household and similar wastes	**0**				1.00		
10.2	Mixed and undifferentiated materials	**0**				0.30	0.70	2. Fish
	Total	**28**						
Hazardous wastes								
01.3	Used oils	**1**					1.00	17. Petroleum products
01.2, 01.4, 02, 03.1	Other chemical wastes	**0**					1.00	11. Other chemical products
08.1	Discarded vehicles	**1**			1.00			
08.41	Batteries and accumulators	**0**				0.10	0.90	14. Engineering products
	Total	**2**						

The waste amounts in the sector are small, and in this case the sector is of small importance.

3. NACE 10 – 14 Mining and quarrying

Swedish EPA (2008a) report waste quantities according to Table 14 . The input to EMEC is shown in Table 15.

The largest amount is the mineral waste from mining (62 Mton), which is about 50 % of all waste that is generated in Sweden. This waste has been excluded from the study.

Table 14. Waste generation in NACE 10 – 14 Mining and quarrying

Waste type	**Waste generation 2006 1000 tons**
Generation of hazardous waste	
01.1 Spent solvents	0
01.2 Acid, alkaline or saline wastes	xxx
01.3 Used oils	2
01.4 Spent chemical catalysts	0
02 Chemical preparation wastes	0
03.1 Chemical deposits and residues	1
03.2 Industrial effluent sludges	0
of which dry weight	*0*
07.5 Wood wastes	1
08 Discarded equipment	0
08.41 Batteries and accumulators	0
10.2 Mixed and undifferentiated materials	0
12 Mineral wastes excl. 12.4 and 12.6	0
12.4 Combustion wastes	xxx
12.6 Contaminated soils and dredging spoils	0
Sum	**5**
Generation of non-hazardous waste	
02 Chemical preparation wastes	0
03.1 Chemical deposits and residues	
03.2 Industrial effluent sludges	xxx
of which dry weight	*xxx*

Waste type	**Waste generation 2006 1000 tons**
06 Metallic wastes	20
07.1 Glass wastes	0
07.2 Paper and cardboard wastes	0
07.3 Rubber wastes	0
07.4 Plastic wastes	0
07.5 Wood wastes	1
08 Discarded equipment	0
08.1 Discarded vehicles	xxx
08.41 Batteries and accumulators	0
10.1 Household and similar wastes	1
10.2 Mixed and undifferentiated materials	4
11 Common sludges excl. 11.3, wet weight	6
of which dry weight	*1*
12 Mineral wastes excl. 12.4 and 12.6	62 031
12.4 Combustion wastes	xxx
Sum	**62 114**
Total generation of waste	**62 119**

Remarks
0 The figure 0 indicates that the waste type is generated, but have been rounded downwards to 0 (the actual quantity is less than 0.5 kton)
xxx The figure cannot be presented due to confidentiality rules.

Table 15. Input to EMEC: NACE 10 – 14 Mining and quarrying

Waste type (EWC-Stat)		**Amount *kton***	**Proposed waste coefficients**						
			a (production)	*b* (Energy carrier)	Specification of energy carrier	*c* (depreciation)	Specification of depreciation	*d* (staff)	*e* (commodities)	Specification of commodity
Non-hazardous waste										
03.2, 11, 11.3	Sludge (wet weight)	xxx	1.00							
6	Metallic wastes	20						0.10	0.90	14. Engineering products
07.1	Glass wastes	0							1.00	14. Engineering products
07.2	Paper and cardboard wastes	0						0.10	0.90	9. Pulp and paper
07.3	Rubber wastes	0							1.00	11. Other chem. prod
07.4	Plastic wastes	0						0.10	0.90	11. Other chem. prod
07.5	Wood wastes	1							1.00	14. Engineering products
8	Discarded equipment	0				0.70			0.30	14. Engineering products
08.1	Discarded vehicles	xxx				1.00				14. Engineering products
08.41	Batteries and accumulators	0						0.10	0.90	14. Engineering products
10.1	Household and similar wastes	1						1.00		

10.2	Mixed and undifferentiated materials	4				0.30	0.70	All
12	Mineral wastes, excluding 12.4 and 12.6 (and excluding mining waste)	0					1.00	Total consumption of commodities
12.4	Combustion wastes	xxx		1.00				
	Total	**82**						
Hazardous wastes								
01.1	Spent solvents	0					1.00	11. Other chemical products
01.3	Used oils	2					1.00	17. Petroleum products
01.2, 01.4, 02, 03.1	Other chemical wastes	xxx					1.00	11. Other chemical products
03.2	Sludges (wet weight)	0	1.00					
07.5	Wood wastes	1					1.00	Total consumption of commodities
8	Discarded equipment	0			0.70		0.30	14. Engineering products
08.41	Batteries and accumulators	0				0.10	0.90	14. Engineering products
10.2	Mixed and undifferentiated materials	0					1.00	Total consumption of commodities
12	Mineral wastes, excl. 12.4 and 12.6	0	1.00					
12.4	Combustion wastes	xxx		1.00				
	Total	**5**						

The sector has only small amounts when the mineral waste is excluded.

NACE 10 -14 includes several different activities. The major activities are mining of iron ores and copper ores. Also Extraction and agglomeration of peat and Operation of gravel and sand pits are included. If all these sub-sections are developed different, the model can give wrong predictions.

4. Manufacture of food products, beverages and tobacco; Manufacture of textiles and textile products, and manufacture of leather and leather products; Manufacture of wood and wood products

The NACE sectors 15 – 20 are in EMEC aggregated to one sector, while the statistics from Swedish EPA (2008a) is aggregated to three sectors. The waste amounts in these sectors according to Swedish EPA are shown in Table 16. The input to EMEC is shown in Table 17. In the input to EMEC the major part wood wastes from Manufacture from wood and wood products have been excluded, because they are by-products and are handled as a commodity in EMEC.

These three sectors are handles as one sector in EMEC. They have quit different waste characteristics, and different development in these three sectors may cause wrong predictions by the model. However, since the waste in most cases are connected to sector-specific commodities (e.g. 1. Agricultural products and 2. Fish), the errors will probably be of minor importance.

Table 16. Generated waste in NACE 15 – 16 (Manufacture of food products, beverages and tobacco), NACE 17-19 (Manufacture of textiles and textile products and manufacture of leather and leather products) and NACE 20 (Manufacture of wood and wood products)

	NACE 15 – 16 Food, beverage, tobacco	**NACE 17 – 19 Textile, leather**	**NACE 20 Wood**
Waste type	**Waste generation 2006** ***1000 tons***	**Waste generation 2006** ***1000 tons***	**Waste generation 2006** ***1000 tons***
Generation of hazardous waste			
01.1 Spent solvents	0		0
01.2 Acid, alkaline or saline wastes	0		0
01.3 Used oils	0	0	1
01.4 Spent chemical catalysts	xxx		xxx
02 Chemical preparation wastes	0	0	0
03.1 Chemical deposits and residues	0	0	1
03.2 Industrial effluent sludges	0		0
of which dry weight	*0*		*0*
05 Health care and biological wastes	xxx		
07.1 Glass wastes	xxx		
07.5 Wood wastes			0
07.7 Waste containing PCB	0		0
08 Discarded equipment	0		0
08.1 Discarded vehicles			xxx
08.41 Batteries and accumulators	0		0
10.2 Mixed and undifferentiated materials	xxx		0
12 Mineral wastes excl. 12.4 and 12.6	0		0
12.4 Combustion wastes	0		2
12.6 Contaminated soils and dredging spoils	1		
Sum	**2**	**0**	**5**
Generation of non-hazardous waste			
01 Acid, alkaline or saline wastes			xxx
02 Chemical preparation wastes	xxx		11
03.1 Chemical deposits and residues	xxx		xxx
03.2 Industrial effluent sludges	273	1	0
of which dry weight	*62*	*0*	*0*
05 Health care and biological wastes	xxx		
06 Metallic wastes	7	0	8
07.1 Glass wastes	6		3
07.2 Paper and cardboard wastes	20	1	1
07.3 Rubber wastes	0		0
07.4 Plastic wastes	9		2
07.5 Wood wastes	7	0	17 780
07.6 Textile wastes		19	
08 Discarded equipment	0		0
08.1 Discarded vehicles	xxx		
08.41 Batteries and accumulators	0		0
09 Animal and vegetal wastes (excl. 09.11 and 09.03)	456		
09.11 Animal wastes of food preparation and products	145		

09.3 Animal faeces, urine and manure	13		
10.1 Household and similar wastes	13	2	3
10.2 Mixed and undifferentiated materials	41	9	10
11 Common sludges excl. 11.3, wet weight	108		1
of which dry weight	*17*		*0*
12 Mineral wastes excl. 12.4 and 12.6	189		0
12.4 Combustion wastes			32
Sum	**1 288**	**32**	**17 852**
Total generation of waste	**1 290**	**32**	**17 857**

Table 17. Input to EMEC: NACE 15 – 16 (Manufacture of food products, beverages and tobacco), NACE 17-19 (Manufacture of textiles and textile products and manufacture of leather and leather products) and NACE 20 (Manufacture of wood and wood products)

					Specification of waste coefficients					
Waste type (EWC-Stat)		**NACE 15-16 Manufac-ture of food products beverages and tobacco** Amount, kton	**NACE 17-19 Manufac-ture of textiles and textile products and manufacture of leather and leather products** Amount, kton	**NACE 20 Manufacture of wood and wood products** Amount, kton	*a* (production)	*b* (Energy carrier) Specification of energy carrier	*c* (depreciation) Specification of depreciation	*d* (staff)	*e* (commodities) Specification of commodity	
Non-hazardous waste										
01.2, 01.4, 02, 03.1	Other chemical wastes	**xxx**		**xxx**					1.00	11. Other chem. prod
03.2, 11, 11.3	Sludge (wet weight)	**381**	**1**	**1**	1.00					
6	Metallic wastes	**7**	**0**	**8**					1.00	14. Engineering products
07.1	Glass wastes	**6**		**3**				0.10	0.90	14. Engineering products
07.2	Paper and cardboard wastes	**20**	**1**	**1**				0.10	0.90	9. Pulp and paper
07.3	Rubber wastes	**0**		**xxx**					1.00	11. Other chem. prod
07.4	Plastic wastes	**9**		**2**				0.10	0.90	11. Other chem. prod
07.5	Wood wastes	**7**	**0**	**280**					1.00	3. Timber
	Wood wastes - by-products (not included)			**17 500**						
07.6	Textile wastes		**19**							
8	Discarded equipment	**0**		**0**			0.70		0.30	14. Engineering products
08.1	Discarded vehicles	**xxx**					1.00			
08.41	Batteries and accumulators	**0**		**0**				0.10	0.90	14. Engineering products

9	Animal and vegetal wastes	**614**							1.00 1. Agricultural products + 2. Fish
10.1	Household and similar wastes	**13**	**2**	**3**				1.00	
10.2	Mixed and undifferentiated materials	**41**	**9**	**10**				0.30	0.70 Total consumption of commodities
12	Mineral wastes, excluding 12.4 and 12.6	**189**		**0**					1.00 1. Agricultural products + 2. Fish
12.4	Combustion wastes			**32**		1.00			
	Total non-hazardous waste (excl. Wood by-products)	**1 289**	**32**	**17 851** **(351)**					
Hazardous wastes									
01.1	Spent solvents	**0**		**0**					1.00 11. Other chemical products
01.3	Used oils	**0**	**0**	**1**					1.00 17. Petroleum products
01.2, 01.4, 02, 03.1	Other chemical wastes	**xxx**	**0**	**xxx**					1.00 11. Other chemical products
03.2	Sludges (wet weight)	**0**		**0**	1.00				
07.5	Wood wastes			**0**	0.00				1.00 Total consumption of commodities
8	Discarded equipment	**0**		**0**			0.70		0.30 14. Engineering products
08.1	Discarded vehicles			**xxx**			1.00		14. Engineering products
08.41	Batteries and accumulators	**0**		**0**				0.10	0.90 14. Engineering products
10.2	Mixed and undifferentiated materials	**xxx**		**0**	0.00				1.00 Total consumption of commodities
12	Mineral wastes, excl. 12.4 and 12.6	**0**		**0**	1.00				
12.4	Combustion wastes	**0**		**2**		1.00			
	Total hazardous wastes	**2**	**0**	**5**					

5. Manufacture of pulp, paper and paper products; publishing and printing

Swedish EPA (2008a) reports the amounts according to Table 18. The input to EMEC is shown in Table 20. There are 4,1 Mton of wood wastes that is included in Swedish EPA, but has been excluded because they are considered as by-products.

Table 19. Generated wastes in NACE 21 – 22 Manufacture of pulp, paper and paper products; publishing and printing (Swedish EPA 2008a)

Waste type	**Waste generation 2006** ***1000 tons***
Generation of hazardous waste	
01.1 Spent solvents	xxx
01.2 Acid, alkaline or saline wastes	1
01.3 Used oils	4
01.4 Spent chemical catalysts	0
02 Chemical preparation wastes	1
03.1 Chemical deposits and residues	2
03.2 Industrial effluent sludges	xxx
of which dry weight	*xxx*
06 Metallic wastes	0
07.1 Glass wastes	0
07.5 Wood wastes	xxx
08 Discarded equipment	3
08.1 Discarded vehicles	xxx
08.41 Batteries and accumulators	0
10.2 Mixed and undifferentiated materials	0
10.3 Sorting residues	
12 Mineral wastes excl. 12.4 and 12.6	0
12.4 Combustion wastes	xxx
Sum	**14**
Generation of non-hazardous waste	
01.2 Acid, alkaline or saline wastes	172
02 Chemical preparation wastes	1
03.1 Chemical deposits and residues	255
03.2 Industrial effluent sludges	314
of which dry weight	*185*
06 Metallic wastes	97
07.1 Glass wastes	0
07.2 Paper and cardboard wastes	1 519
07.3 Rubber wastes	0
07.4 Plastic wastes	58
07.5 Wood wastes	4 102
07.6 Textile wastes	xxx
08 Discarded equipment	2
08.41 Batteries and accumulators	0
09 Animal and vegetal wastes (excl. 09.11 and 09.03)	0
09.11 Animal wastes of food preparation and products	xxx
10.1 Household and similar wastes	5
10.2 Mixed and undifferentiated materials	25
10.3 Sorting residues	92
11 Common sludges excl. 11.3, wet weight	902
of which dry weight	*128*
11.3 Dredging spoils	

of which dry weight	
12 Mineral wastes excl. 12.4 and 12.6	xxx
12.4 Combustion wastes	319
Sum	**7 863**
Total generation of waste	**7 877**

Remarks
0 The figure 0 indicates that the waste type is generated, but have been rounded downwards to 0 (the actual quantity is less than 0.5 kton)
xxx The figure cannot be presented due to confidentiality rules.

Table 20. Input to EMEC: NACE 21 – 22 Manufacture of pulp, paper and paper products; publishing and printing

Waste type (EWC-Stat)			**Proposed waste factors**						
			a (production)	*b* (Energy carrier) Specification of energy carrier	*c* (depreciation)	Specification of depreciation	*d* (staff)	*e* (commodities)	Specification of commodity
Non-hazardous waste									
01.2, 01.4, 02, 03.1	Other chemical wastes	**428**						1.00	11. Other chem. prod
03.2, 11, 11.3	Sludge (wet weight)	**1216**	1.00						
6	Metallic wastes	**97**						1.00	14. Engineering products
07.1	Glass wastes	**0**					0.10	0.90	Total consumption of commodities
07.2	Paper and cardboard wastes	**1 519**						1.00	9. Pulp and paper
07.3	Rubber wastes	**0**						1.00	11. Other chem. prod
07.4	Plastic wastes	**58**					0.10	0.90	11. Other chem. prod
07.5	Wood wastes	**2**						1.00	3. Timber
	Wood wastes – by-products	**4 100**							
8	Discarded equipment	**2**			0.70			0.30	14. Engineering products
08.1	Discarded vehicles				1.00				
08.41	Batteries and accumulators	**0**					0.10	0.90	14. Engineering products
9	Animal and vegetal wastes	**xxx**						1.00	Total consumption of commodities
10.1	Household and similar wastes	**5**					1.00		
10.2	Mixed and undifferentiated materials	**25**					0.30	0.70	Total consumption of commodities II
10.3	Sorting residues	**92**	1.00						
12	Mineral wastes, excluding 12.4 and 12.6	**xxx**						1.00	Total consumption of commodities I

12.4	Combustion wastes	**319**		1.00 Energy carriers: Biofuel				
	TOTAL non-hazardous wastes (excl. wood by-products)	**7 863 (3 763)**						
Hazardous wastes								
01.1	Spent solvents	**xxx**						1.00 11. Other chemical products
01.3	Used oils	**4**						1.00 17. Petroleum products
01.2, 01.4, 02, 03.1	Other chemical wastes	**4**						1.00 11. Other chemical products
03.2	Sludges (wet weight)	**xxx**	1.00					
07.5	Wood wastes	**xxx**						1.00 Total consumption of commodities
8	Discarded equipment	**3**			0.70			0.30 14. Engineering products
08.1	Discarded vehicles	**xxx**			1.00			
08.41	Batteries and accumulators	**0**					0.10	0.90 14. Engineering products
10.2	Mixed and undifferentiated materials	**0**						1.00 Total consumption of commodities
12	Mineral wastes, excl. 12.4 and 12.6	**0**	1.00					
12.4	Combustion wastes	**xxx**		1.00 Energy carriers: Bio-fuel				
	Total hazardous wastes	**14**						

Manufacture of pulp and paper is of major economic interest in Sweden. The sector also generates major amounts of waste. However, pulp and paper is not a homogenous sector. From a waste perspective there are several sub-sectors that have different waste characteristics, for example Manufacture of mechanical or semi-chemical pulp, Manufacture of sulphate pulp, Manufacture of sulphite pulp and manufacture of secondary pulp. The model presumes that all sub-sectors are developed equally.

6. Manufacture of coke, refined petroleum products and nuclear fuel

Swedish EPA (2008a) reports the amounts according to Table 21. The input to EMEC is shown in Table 22 .

Table 21. Generated wastes in NACE 23 Manufacturing of coke, refined petroleum products and nuclear fuel.

Waste type	**Waste generation 2006** ***1000 tons***
Generation of hazardous waste	
01.1 Spent solvents	0
01.2 Acid, alkaline or saline wastes	xxx
01.3 Used oils	1
01.4 Spent chemical catalysts	xxx
02 Chemical preparation wastes	0
03.1 Chemical deposits and residues	21
03.2 Industrial effluent sludges	1
of which dry weight	0
05 Health care and biological wastes	0
08 Discarded equipment	0
08.41 Batteries and accumulators	0
12 Mineral wastes excl. 12.4 and 12.6	1
Sum	**25**
Generation of non-hazardous waste	
02 Chemical preparation wastes	xxx
03.2 Industrial effluent sludges	xxx
of which dry weight	*xxx*
05 Health care and biological wastes	0
06 Metallic wastes	1
07.1 Glass wastes	0
07.2 Paper and cardboard wastes	0
07.4 Plastic wastes	0
07.5 Wood wastes	0
07.6 Textile wastes	0
08 Discarded equipment	0
08.41 Batteries and accumulators	0
09 Animal and vegetal wastes (excl. 09.11 and 09.03)	0
10.1 Household and similar wastes	0
10.2 Mixed and undifferentiated materials	xxx
12 Mineral wastes excl. 12.4 and 12.6	2
12.4 Combustion wastes	12
Sum	**12**
Total generation of waste	**37**

Remarks
0 The figure 0 indicates that the waste type is generated, but have been rounded downwards to 0 (the actual quantity is less than 0.5 kton)
xxx The figure cannot be presented due to confidentiality rules.

Table 22. Input to EMEC: NACE 23 Manufacturing of coke, refined petroleum products and nuclear fuel

Waste type (EWC-Stat)		**Amount, kton**	**Proposed waste factors**						
			a (production)	*b* (Energy carrier) Specification of energy carrier	*c* (depreciation)	Specification of depreciation	*d* (staff)	*e* (commodities)	Specification of commodity
Non-hazardous waste									
01.2, 01.4, 02, 03.1	Other chemical wastes	**xxx**						1.00	11. Other chem. prod
03.2, 11, 11.3	Sludge (wet weight)	**xxx**	1.00						
6	Metallic wastes	**1**						1.00	14. Engineering products
07.1	Glass wastes	**0**					0.10	0.90	
07.2	Paper and cardboard wastes	**0**					0.10	0.90	9. Pulp and paper
07.4	Plastic wastes	**0**					0.10	0.90	11. Other chem. prod
07.5	Wood wastes	**0**						1.00	
8	Discarded equipment	**0**			0.70			0.30	14. Engineering products
9	Animal and vegetal wastes	**0**						1.00	Total consumption of commodities
10.1	Household and similar wastes	**0**					1.00		
10.2	Mixed and undifferentiated materials	**2**					0.30	0.70	Total consumption of commodities
10.3	Sorting residues	**0**	x				x	x	
12	Mineral wastes, excluding 12.4 and 12.6	**2**	0.00					1.00	Total consumption of commodities
	Total non-hazardous wastes	**11**							
Hazardous wastes									
01.1	Spent solvents	**xxx**						1.00	11. Other chemical products
01.3	Used oils	**1**						1.00	17. Petroleum products
01.2, 01.4, 02, 03.1	Other chemical wastes	**xxx**						1.00	11. Other chemical products
03.2	Sludges (wet weight)	**1**	1.00						
8	Discarded equipment	**0**			0.70			0.30	14. Engineering products
08.41	Batteries and accumulators	**0**					0.10	0.90	14. Engineering products
10.2	Mixed and undifferentiated materials	**0**						1.00	Total consumption of commodities
12	Mineral wastes, excl. 12.4 and 12.6	**0**	1.00						
	Total hazardous wastes	**25**							

This sector is dominated by the refineries. It is relatively small amounts of wastes that are generated.

7. Manufacture of chemicals and chemical products and manufacture of rubber and plastic products

Swedish EPA (2008a) reports the amounts according to Table 23. The input to EMEC is shown in Table 24.

About 50 % of the plastic waste reported in Swedish EPA (2008b) in this sector has been estimated to be by-products.

Table 23. Generated wastes in NACE 24 – 25 Manufacturing of chemicals and chemical products and manufacture of rubber and plastic products (Swedish EPA, 2008a)

Waste type	**Waste generation 2006** ***1000 tons***
Generation of hazardous waste	
01.1 Spent solvents	33
01.2 Acid, alkaline or saline wastes	2
01.3 Used oils	5
01.4 Spent chemical catalysts	xxx
02 Chemical preparation wastes	8
03.1 Chemical deposits and residues	13
03.2 Industrial effluent sludges	34
of which dry weight	*1*
05 Health care and biological wastes	0
06 Metallic wastes	1
07.1 Glass wastes	0
07.5 Wood wastes	0
07.7 Waste containing PCB	xxx
08 Discarded equipment	0
08.41 Batteries and accumulators	0
10.2 Mixed and undifferentiated materials	2
12 Mineral wastes excl. 12.4 and 12.6	0
12.4 Combustion wastes	xxx
12.6 Contaminated soils and dredging spoils	10
13. Solidified, stabilised and vitrified wastes	
Sum	**111**
Generation of non-hazardous waste	
01.2 Acid, alkaline or saline wastes	3
01.4 Spent chemical catalysts	xxx
02 Chemical preparation wastes	16
03.1 Chemical deposits and residues	41
03.2 Industrial effluent sludges	53
of which dry weight	9
05 Health care and biological wastes	xxx
06 Metallic wastes	12
07.1 Glass wastes	0
07.2 Paper and cardboard wastes	11
07.3 Rubber wastes	5
07.4 Plastic wastes	32
07.5 Wood wastes	10
07.6 Textile wastes	
08 Discarded equipment	0

08.41 Batteries and accumulators	0
09 Animal and vegetal wastes (excl. 09.11 and 09.03)	1
09.11 Animal wastes of food preparation and products	
10.1 Household and similar wastes	3
10.2 Mixed and undifferentiated materials	44
11 Common sludges excl. 11.3, wet weight	15
of which dry weight	*3*
12 Mineral wastes excl. 12.4 and 12.6	28
12.4 Combustion wastes	xxx
Sum	**280**
Total generation of waste	**390**

Remarks
0 The figure 0 indicates that the waste type is generated, but have been rounded downwards to 0 (the actual quantity is less than 0.5 kton)
xxx The figure cannot be presented due to confidentiality rules.

Table 24. Input to EMEC: NACE 24-25 Manufacture of chemicals and chemical products and manufacture of rubber and plastic products (Swedish EPA, 2008a)

Waste type (EWC-Stat)		**Amount, kton**	**Proposed waste coefficients**						
			a (production)	*b* (Energy carrier)	Specification of energy carrier	*c* (depreciation)	Specification of depreciation	*d* (staff)	*e* (commodities)	Specification of commodity
Non-hazardous waste										
01.2, 01.4, 02, 03.1	Other chemical wastes	**xxx**							1.00	11. Other chem. prod
03.2, 11, 11.3	Sludge (wet weight)	**68**	1.00						0.00	11. Other chem. prod
6	Metallic wastes	**12**							1.00	14. Engineering products
07.1	Glass wastes	**0**						0.10	0.90	Total consumption of commodities
07.2	Paper and cardboard wastes	**11**						0.10	0.90	9. Pulp and paper
07.3	Rubber wastes	**5**							1.00	11. Other chem. prod
07.4	Plastic wastes	**16**						0.10	0.90	11. Other chem. prod
	Plastic wastes by-products	**16**								
07.5	Wood wastes	**10**	0.00						1.00	Total consumption of commodities
8	Discarded equipment	**0**				0.70			0.30	14. Engineering products
08.41	Batteries and accumulators	**0**						0.10	0.90	14. Engineering products
9	Animal and vegetal wastes	**1**							1.00	Total consumption of commodities
10.1	Household and similar wastes	**3**						1.00		
10.2	Mixed and undifferentiated materials	**44**	0.00					0.30	0.70	Total consumption of commodities
12	Mineral wastes, excluding 12.4 and 12.6	**28**							1.00	Total consumption of commodities
12.4	Combustion wastes	**xxx**		1.00	Coal + bio-fuels + oth-er fuels					
	Total non-hazardous wastes	**278**								

Hazardous wastes								
01.1	Spent solvents	**33**					1.00	11. Other chemical products
01.3	Used oils	**5**					1.00	17. Petroleum products
01.2, 01.4, 02, 03.1	Other chemical wastes	**xxx**					1.00	11. Other chemical products
03.2	Sludges (wet weight)	**34**	1.00					
07.5	Wood wastes	**0**	0.00				1.00	Total consumption of commodities
8	Discarded equipment	**1**			0.70		0.30	14. Engineering products
08.1	Discarded vehicles				1.00			14. Engineering products
08.41	Batteries and accumulators	**0**				0.10	0.90	14. Engineering products
10.2	Mixed and undifferentiated materials	**2**					1.00	Total consumption of commodities
12	Mineral wastes, excl. 12.4 and 12.6	**0**	1.00					
12.4	Combustion wastes	**xxx**		1.00 Coal + bio-fuels + other fuels				
	Total hazardous wastes	**99**						

This sector consists of several different sub-sectors which have different waste characteristics: paint manufacture, pharmaceutical industry, basic chemical industry, plastic industry and rubber industry. Neither EMEC nor the waste statistics make any differences of these sub-sectors. If different sub-sectors have different development the model can make wrong predictions.

8. Manufacture of other non-metallic mineral products

Swedish EPA (2008a) reports the amounts according to Table 25. The input to EMEC is shown in Table 26.

Table 25. Generated wastes in NACE 26 Manufacture of other non-metallic mineral products (Swedish EPA, 2008a)

Waste type	**Waste generation 2006** ***1000 tons***
Generation of hazardous waste	
01.1 Spent solvents	0
01.2 Acid, alkaline or saline wastes	1
01.3 Used oils	1
02 Chemical preparation wastes	1
03.1 Chemical deposits and residues	1
03.2 Industrial effluent sludges	xxx
of which dry weight	*xxx*
07.1 Glass wastes	xxx
07.7 Waste containing PCB	xxx
08 Discarded equipment	0
08.41 Batteries and accumulators	0
10.2 Mixed and undifferentiated materials	xxx
12 Mineral wastes excl. 12.4 and 12.6	0
12.4 Combustion wastes	1
12.6 Contaminated soils and dredging spoils	xxx
Sum	**5**

Generation of non-hazardous waste	
01.2 Acid, alkaline or saline wastes	
02 Chemical preparation wastes	0
03.1 Chemical deposits and residues	xxx
03.2 Industrial effluent sludges	8
of which dry weight	4
06 Metallic wastes	6
07.1 Glass wastes	39
07.2 Paper and cardboard wastes	4
07.3 Rubber wastes	xxx
07.4 Plastic wastes	2
07.5 Wood wastes	8
07.6 Textile wastes	
08 Discarded equipment	0
08.41 Batteries and accumulators	xxx
10.1 Household and similar wastes	2
10.2 Mixed and undifferentiated materials	7
11 Common sludges excl. 11.3, wet weight	4
of which dry weight	1
12 Mineral wastes excl. 12.4 and 12.6	118
12.4 Combustion wastes	44
Sum	**244**
Total generation of waste	**248**

Remarks
0 The figure 0 indicates that the waste type is generated, but have been rounded downwards to 0 (the actual quantity is less than 0.5 kton)
xxx The figure cannot be presented due to confidentiality rules.

Table 26. Input to EMEC: NACE 26 Manufacture of other non-metallic mineral products.

Waste type (EWC-Stat)		**Amount, kton**	**Proposed waste coefficients**					
			a (production)	*b* (Energy carrier) Specification of energy carrier	*c* (depreciation)	*d* (staff)	e (commodities)	Specification of commodity
Non-hazardous waste								
01.2, 01.4, 02, 03.1	Other chemical waste	**xxx**					1.00	11. Other chem. prod
03.2, 11, 11.3	Sludges (wet weight)	**12**	1.00					
6	Metallic wastes	**6**					1.00	14. Engineering products
07.1	Glass wastes	**39**				0.10	0.90	Total consumption of commodities
07.2	Paper- and cardboard wastes	**4**				0.10	0.90	9. Pulp and paper
07.3	Rubber wastes	**xxx**					1.00	11. Other chem. prod
07.4	Plastic wastes	**2**				0.10	0.90	11. Other chem. prod
07.5	Wood wastes	**8**					1.00	Total consumption of commodities
8	Discarded equipment	**0**			0.70		0.30	14. Engineering products
08.41	Batteries and accumulators	**xxx**				0.10	0.90	14. Engineering products
10.1	Household waste and	**2**				1.00		

	similar						
10.2	Mixed and undifferentiated materials	**7**				0.30	0.70 Total consumption of commodities
12	Mineral waste, excl. 12.4 and 12.6	**118**	0.00				1.00 Total consumption of commodities
12.4	Waste from combustion	**44**		1.00 Coal + bio-fuels + other fuels			
	Total non-hazardous wastes	**244**					
Hazardous waste							
01.1	Spent solvents	**0**					1.00 11. Other chemical products
01.3	Used oils	**1**					1.00 17. Petroleum products
01.2, 01.4, 02, 03.1	Other chemical wastes	**3**					1.00 11. Other chemical products
03.2	Sludges (wet weight)	**xxx**	1.00				
8	Discarded equipment	**0**			0.70		0.30 14. Engineering products
08.41	Batteries and accumulators	**0**				0.10	0.90 14. Engineering products
10.2	Mixed and undifferentiated materials	**xxx**					1.00 Total consumption of commodities
12	Mineral wastes, excl 12.4 and 12.6	**0**	1.00				
12.4	Wastes from combustion	**1**		1.00 Coal + bio-fuels + other fuels			
	Total hazardous wastes	**5**					

9. Manufacture of basic metals and fabricated metal products

Swedish EPA (2008a) reports the amounts according to Table 27. The input to EMEC is shown in Table 28.

About 50 % of the reported amount of metallic waste from this sector has been assumed to be by-products and not waste (bi-products is included in the commodities in EMEC).

Table 27. Generated wastes in NACE 27 – 28 Manufacture of basic metals and fabricated metal products (Swedish EPA, 2008a)

Waste type	**Waste generation 2006** ***1000 tons***
Generation of hazardous waste	
01.1 Spent solvents	1
01.2 Acid, alkaline or saline wastes	74
01.3 Used oils	44
01.4 Spent chemical catalysts	xxx
02 Chemical preparation wastes	3
03.1 Chemical deposits and residues	xxx
03.2 Industrial effluent sludges	64
of which dry weight	*16*
06 Metallic wastes	9
07.5 Wood wastes	0
07.7 Waste containing PCB	
08 Discarded equipment	0
08.1 Discarded vehicles	

08.41 Batteries and accumulators	0
10.2 Mixed and undifferentiated materials	1
10.3 Sorting residues	
12 Mineral wastes excl. 12.4 and 12.6	9
12.4 Combustion wastes	88
12.6 Contaminated soils and dredging spoils	
Sum	**342**
Generation of non-hazardous waste	
01.2 Acid, alkaline or saline wastes	1
02 Chemical preparation wastes	6
03.1 Chemical deposits and residues	114
03.2 Industrial effluent sludges	44
of which dry weight	*5*
06 Metallic wastes	606
07.1 Glass wastes	0
07.2 Paper and cardboard wastes	19
07.3 Rubber wastes	0
07.4 Plastic wastes	2
07.5 Wood wastes	23
07.6 Textile wastes	0
08 Discarded equipment	0
08.41 Batteries and accumulators	0
09 Animal and vegetal wastes (excl. 09.11 and 09.03)	0
09.11 Animal wastes of food preparation and products	
10.1 Household and similar wastes	8
10.2 Mixed and undifferentiated materials	xxx
10.3 Sorting residues	xxx
11 Common sludges excl. 11.3, wet weight	0
of which dry weight	0
12 Mineral wastes excl. 12.4 and 12.6	109
12.4 Combustion wastes	1 701
13. Solidified, stabilised and vitrified wastes	0
Sum	**2 671**
Total generation of waste	**3 013**

Remarks

0 The figure 0 indicates that the waste type is generated, but have been rounded downwards to 0 (the actual quantity is less than 0.5 kton)

xxx The figure cannot be presented due to confidentiality rules.

Table 28. Input to EMEC: NACE 27 – 28 Manufacture of basic metals and fabricated metal products

Waste type (EWC-Stat)		**Waste amount, kton**	**Proposed waste coefficients**					
			a (production)	*b* (Energy carrier) Specification of energy carrier	*c* (depreciation)	*d* (staff)	*e* (commodities)	Specification of commodity
Non-hazardous waste								
01.2, 01.4, 02, 03.1	Other chemical wastes	**121**					1.00	11. Other chem. prod
03.2, 11, 11.3	Sludge (wet weight)	**44**	1.00				0.00	5. Metal ores
6	Metallic wastes	**306**	0.05				0.95	14. Engineering products
	Metallic wastes - by-products	**300**						
07.1	Glass wastes	**0**				0.10	0.9	Total consumption of commodities
07.2	Paper and cardboard wastes	**19**				0.10	0.90	9. Pulp and paper
07.3	Rubber wastes	**0**					1.00	11. Other chem. prod
07.4	Plastic wastes	**2**				0.10	0.90	11. Other chem. prod
07.5	Wood wastes	**23**					1.00	Total consumption of commodities
8	Discarded equipment	**0**			0.70		0.30	14. Engineering products
08.41	Batteries and accumulators	**0**				0.10	0.90	14. Engineering products
9	Animal and vegetal wastes	**0**					1.00	Total consumption of commodities
10.1	Household and similar wastes	**8**				1.00		
10.2	Mixed and undifferentiated materials	**xxx**				0.30	0.70	Total consumption of commodities I
10.3	Sorting residues	**xxx**						
12	Mineral wastes, excluding 12.4 and 12.6	**109**					1.00	Total consumption of commodities
12.4	Combustion wastes	**1 701**		1.00 Coal + other fuels				
	Total non-hazardous wastes	**2 670**						
Hazardous wastes								
01.1	Spent solvents	**1**					1.00	11. Other chemical products
01.3	Used oils	**44**					1.00	17. Petroleum products
01.2, 01.4, 02, 03.1	Other chemical wastes	**xxx**					1.00	11. Other chemical products
03.2	Sludges (wet weight)	**64**	1.00					
07.5	Wood wastes	**0**					1.00	Total consumption of commodities
8	Discarded equipment	**0**			0.70		0.30	14. Engineering products
08.1	Discarded vehicles				1.00			14. Engineering products

08.41	Batteries and accumulators	**0**				0.10	0.90 14. Engineering products
10.2	Mixed and undifferentiated materials	**xxx**					1.00 Total consumption of commodities
12	Mineral wastes, excl. 12.4 and 12.6	**9**	1.00				
12.4	Combustion wastes	**88**		1.00 Coal + other fuels			
	Total hazardous wastes	**333**					

10. Manufacture of machinery and equipment, manufacture of electrical and optical equipment, and manufacture of transport equipment

Swedish EPA (2008a) reports the amounts according toTable 29. The input to EMEC is shown in Table 30.

About 50 % of the reported amount of metallic waste has been assumed to be by-products and not waste (by-products is included in the commodities in EMEC).

Table 29. Generated wastes in NACE 29 – 35 Manufacture of machinery and equipment, Manufacture of electrical and optical equipment, and Manufacture of transport equipment and NACE 36 Manufacture n.e.c. (Swedish EPA, 2008a)

Waste type	**NACE 29-35 Waste generation 2006 1000 tons**	**NACE 36 Waste generation 2006 *1000 tons***
Generation of hazardous waste		
01.1 Spent solvents	1	1
01.2 Acid, alkaline or saline wastes	6	
01.3 Used oils	27	1
01.4 Spent chemical catalysts		
02 Chemical preparation wastes	8	1
03.1 Chemical deposits and residues	8	1
03.2 Industrial effluent sludges	9	1
of which dry weight	*2*	
06 Metallic wastes	1	
07.1 Glass wastes	0	
07.5 Wood wastes	0	
07.7 Waste containing PCB	0	
08 Discarded equipment	1	0
08.1 Discarded vehicles	0	
08.41 Batteries and accumulators	0	0
10.2 Mixed and undifferentiated materials	0	
12 Mineral wastes excl. 12.4 and 12.6	1	
12.4 Combustion wastes	0	
12.6 Contaminated soils and dredging spoils	1	
13. Solidified, stabilised and vitrified wastes		
Sum	**64**	**3**
Generation of non-hazardous waste		
01.2 Acid, alkaline or saline wastes	3	
01.4 Spent chemical catalysts	xxx	

02 Chemical preparation wastes	1	1
03.1 Chemical deposits and residues	1	1
03.2 Industrial effluent sludges	1	1
of which dry weight	*0*	*0*
05 Health care and biological wastes	xxx	
06 Metallic wastes	589	10
07.1 Glass wastes	1	1
07.2 Paper and cardboard wastes	20	1
07.3 Rubber wastes	xxx	1
07.4 Plastic wastes	7	5
07.5 Wood wastes	30	5
07.6 Textile wastes		1
08 Discarded equipment	1	0
08.41 Batteries and accumulators	0	
09 Animal and vegetal wastes (excl. 09.11 and 09.03)	xxx	
10.1 Household and similar wastes	10	2
10.2 Mixed and undifferentiated materials	52	56
10.3 Sorting residues	xxx	
11 Common sludges excl. 11.3, wet weight	0	
of which dry weight	0	
11.3 Dredging spoils		
of which dry weight		
12 Mineral wastes excl. 12.4 and 12.6	135	1
12.4 Combustion wastes	16	
13. Solidified, stabilised and vitrified wastes	0	
Sum	**867**	**85**
Total generation of waste	**930**	**88**

Remarks
0 The figure 0 indicates that the waste type is generated, but have been rounded downwards to 0 (the actual quantity is less than 0.5 kton)
xxx The figure cannot be presented due to confidentiality rules.

Table 30. Input to EMEC: NACE 29 – 35 Manufacture of machinery and equipment, Manufacture of electrical and optical equipment, and Manufacture of transport equipment and NACE 36 Manufacture n.e.c.

Waste type (EWC-Stat)		**NACE 29-35 Amount kton**	**NACE 36 Amount kton**	**Proposed waste coefficients**					
				a (production)	*b* (Energy carrier) Specification of energy carrier	*c* (depreciation)	*d* (staff)	*e* (commodities)	Specification of commodity
Non-hazardous waste									
01.2, 01.4, 02, 03.1	Other chemical wastes	**xxx**	**1**					1.00	11. Other chem. prod
03.2, 11, 11.3	Sludge (wet weight)	**1**	**1**	1.00					
6	Metallic wastes	**295**	**10**					1.00	14. Engineering products
	Metallic wastes - by-products	**294**							
07.1	Glass wastes	**1**	**1**				0.10	0.9	Total consumption of commodities
07.2	Paper and cardboard wastes	**20**	**1**				0.10	0.90	9. Pulp and paper

07.3	Rubber wastes	**xxx**	**1**					1.00 11. Other chem. prod
07.4	Plastic wastes	**7**	**5**				0.10	0.90 11. Other chem. prod
07.5	Wood wastes	**30**	**5**					1.00 Total consumption of commodities
07.6	Textile wastes		**1**	1.00				
8	Discarded equipment	**1**	**0**			0.70		0.30 14. Engineering products
08.1	Discarded vehicles					1.00		
08.41	Batteries and accumulators	**0**					0.10	0.90 14. Engineering products
9	Animal and vegetal wastes	**xxx**						1.00 Total consumption of commodities I
10.1	Household and similar wastes	**10**	**2**				1.00	
10.2	Mixed and undifferentiated materials	**52**	**56**				0.30	0.70 Total consumption of commodities I
10.3	Sorting residues	**xxx**		1.00				
12	Mineral wastes, excluding 12.4 and 12.6	**135**	**1**					1.00 Total consumption of commodities
12.4	Combustion wastes	**16**			1.00			
	Total non-hazardous wastes	**867**	**85**					
Hazardous wastes								
01.1	Spent solvents	**1**	**1**					1.00 11. Other chemical products
01.3	Used oils	**27**	**1**					1.00 17. Petroleum products
01.2, 01.4, 02, 03.1	Other chemical wastes	**22**	**1**					1.00 11. Other chemical products
03.2	Sludges (wet weight)	**9**	**1**	1.00				
6	Metallic waste	**1**						1.00 Total consumption of commodities
07.1	Glass wastes	**0**		1.00				
07.5	Wood wastes	**0**						
8	Discarded equipment	**1**				0.70		0.30 14. Engineering products
08.1	Discarded vehicles	**0**	**0**			1.00		
08.41	Batteries and accumulators	**0**					0.10	0.90 14. Engineering products
10.2	Mixed and undifferentiated materials	**0**	**0**	1.00				
12	Mineral wastes, excl. 12.4 and 12.6	**1**		1.00				
12.4	Combustion wastes	**0**			1.00 Coal + other fuel			
	Total hazardous wastes	**63**						

This sector consists of several different sub-sectors with quite different characteristics. If different sub-sectors develop differently, there is a risk that the model will make wrong predictions.

12. Electricity, gas and water supply

Swedish EPA (2008a) reports the amounts according to Table 31. The input to EMEC is shown in Table 32.

Sludge from tap water production has been excluded from the input to EMEC.

Table 31. Generated wastes in NACE 40 – 41 Electricity, gas and water supply

Waste type	**Waste generation 2006** ***1000 tons***
Generation of hazardous waste	
01.1 Spent solvents	0
01.2 Acid, alkaline or saline wastes	xxx
01.3 Used oils	2
02 Chemical preparation wastes	xxx
03.1 Chemical deposits and residues	0
03.2 Industrial effluent sludges	1
of which dry weight	*0*
05 Health care and biological wastes	0
06 Metallic wastes	0
07.1 Glass wastes	xxx
07.5 Wood wastes	5
07.7 Waste containing PCB	0
08 Discarded equipment	2
08.1 Discarded vehicles	0
08.41 Batteries and accumulators	0
10.2 Mixed and undifferentiated materials	1
12 Mineral wastes excl. 12.4 and 12.6	4
12.4 Combustion wastes	168
12.6 Contaminated soils and dredging spoils	8
13. Solidified, stabilised and vitrified wastes	
Sum	**191**
Generation of non-hazardous waste	
01.2 Acid, alkaline or saline wastes	0
01.4 Spent chemical catalysts	0
02 Chemical preparation wastes	0
03.1 Chemical deposits and residues	0
03.2 Industrial effluent sludges	2
of which dry weight	*0*
05 Health care and biological wastes	xxx
06 Metallic wastes	47
07.1 Glass wastes	0
07.2 Paper and cardboard wastes	2
07.3 Rubber wastes	xxx
07.4 Plastic wastes	0
07.5 Wood wastes	1
07.6 Textile wastes	xxx
08 Discarded equipment	1
08.1 Discarded vehicles	0
08.41 Batteries and accumulators	0
09 Animal and vegetal wastes (excl. 09.11 and 09.03)	0
10.1 Household and similar wastes	2
10.2 Mixed and undifferentiated materials	9
10.3 Sorting residues	1
11 Common sludges excl. 11.3, wet weight	1 067
of which dry weight	9

11.3 Dredging spoils	0
of which dry weight	0
12 Mineral wastes excl. 12.4 and 12.6	6
12.4 Combustion wastes	1007
13. Solidified, stabilised and vitrified wastes	40
Sum	**2 188**
Total generation of waste	**2 379**

Remarks
0 The figure 0 indicates that the waste type is generated, but have been rounded downwards to 0 (the actual quantity is less than 0.5 kton)
xxx The figure cannot be presented due to confidentiality rules.

Table 32. Input to EMEC: NACE 40 – 41 Electricity, gas and water supply

Waste type (EWC-Stat)		**Amount kton**	**Proposed waste coefficients**					
			a (production)	*b* (Energy carrier) Specification of energy carrier	*c* (depreciation)	*d* (staff)	*e* (commodities)	Specification of commodity
	Non-hazardous waste							
01.2, 01.4, 02, 03.1	Other chemical wastes	**1**					1.00	11. Other chem. prod
03.2, 11, 11.3	Sludge (wet weight)	**3**	1.00					
11	Sludge from tap water production (excluded from the study)	**1067**						
6	Metallic wastes	**47**					1.00	14. Engineering products
07.1	Glass wastes	**0**				0.10	0.9	Total consumption of commodities
07.2	Paper and cardboard wastes	**2**				0.10	0.90	9. Pulp and paper
07.3	Rubber wastes	**xxx**					1.00	11. Other chem. prod
07.4	Plastic wastes	**0**				0.10	0.90	11. Other chem. prod
07.5	Wood wastes	**1**					1.00	Total consumption of commodities
07.6	Textile wastes	**xxx**						
8	Discarded equipment	**1**			0.70		0.30	14. Engineering products
08.1	Discarded vehicles	**0**			1.00			
08.41	Batteries and accumulators	**0**				0.10	0.90	14. Engineering products
9	Animal and vegetal wastes	**0**					1.00	Total consumption of commodities
10.1	Household and similar wastes	**2**				1.00		
10.2	Mixed and undifferentiated materials	**9**				0.30	0.70	Total consumption of commodities
10.3	Sorting residues	**1**	1.00					
12	Mineral wastes, excluding 12.4 and 12.6	**6**	0.00				1.00	Total consumption of commodities
12.4	Combustion wastes	**408**		1.00 Other				

				fuels (wastes)			
	Total non-hazardous wastes	**1548**					
Hazardous wastes							
01.1	Spent solvents	**xxx**					1.00 11. Other chemical products
01.3	Used oils	**2**					1.00 17. Petroleum products
01.2, 01.4, 02, 03.1	Other chemical wastes	**0.6**					1.00 11. Other chemical products
03.2	Sludges (wet weight)	**xxx**	1.00				
07.5	Wood wastes	**5**	0.00				1.00 Total consumption of commodities I
8	Discarded equipment	**2**			0.70		0.30 14. Engineering products
08.1	Discarded vehicles	**0**			1.00		14. Engineering products
08.41	Batteries and accumulators	**0**				0.10	0.90 14. Engineering products
10.2	Mixed and undifferentiated materials	**1**	0.00				1.00 Total consumption of commodities
10.3	Sorting residues		1.00				
12	Mineral wastes, excl. 12.4 and 12.6	**4**	1.00				
12.4	Combustion wastes	**0**		1.00 Other fuels (wastes)			
	Total hazardous wastes	**191**					

Combustion wastes from waste incineration are excluded because this is calculated for in NatWaste.

13. Construction

Swedish EPA (2008a) reports the amounts according to Table 33. The input to EMEC is shown in Table 34.

Clean materials from excavaitng have been reported as waste in the Swedish EPA (2008a) (included in mineral waste), but we have excluded this waste in the input to EMEC.

Table 33. Generated wastes in NACE 45 Construction

Waste type	**Waste generation 2006** ***1000 tons***	**Uncertainty***
Generation of hazardous waste		
01.1 Spent solvents	0	F
01.2 Acid, alkaline or saline wastes	1	F
01.3 Used oils	7	F
02 Chemical preparation wastes	5	F
03.1 Chemical deposits and residues	14	F
03.2 Industrial effluent sludges	1	F
of which dry weight	*0*	*F*
06 Metallic wastes	0	F
07.5 Wood wastes	0	F
07.7 Waste containing PCB	0	F
08 Discarded equipment	2	F
08.41 Batteries and accumulators	1	F
10.2 Mixed and undifferentiated materials	0	F
12 Mineral wastes excl. 12.4 and 12.6	464	F
12.6 Contaminated soils and dredging spoils	398	F
Sum	**894**	**E**
Generation of non-hazardous waste		
02 Chemical preparation wastes	0	F
03.1 Chemical deposits and residues	0	F
03.2 Industrial effluent sludges	0	F
of which dry weight	*0*	*F*
06 Metallic wastes	196	F
07.1 Glass wastes	1	F
07.2 Paper and cardboard wastes	9	F
07.3 Rubber wastes	0	F
07.4 Plastic wastes	0	F
07.5 Wood wastes	8	F
08 Discarded equipment	1	F
08.41 Batteries and accumulators	0	F
09 Animal and vegetal wastes (excl. 09.11 and 09.03)	0	F
10.1 Household and similar wastes	20	E
10.2 Mixed and undifferentiated materials	1 110	F
11 Common sludges excl. 11.3, wet weight	0	F
of which dry weight	0	F
11.3 Dredging spoils	277	F
of which dry weight	21	F
12 Mineral wastes excl. 12.4 and 12.6	6 567	F
Sum	**8 189**	**E**
Total generation of waste	**9 083**	

Remarks
0 The figure 0 indicates that the waste type is generated, but have been rounded downwards to 0 (the actual quantity is less than 0.5 kton)

The waste amounts in Swedish EPA (2008a) is connected with unceratinties. Most figures are based on extrapolation from a specific region

Table 34. Input to EMEC: NACE 45 Construction

Waste type (EWC-Stat)		Amount kton	Proposed waste coefficients					
			a (production)	*b* (Energy carrier) Specification of energy carrier	*c* (depreciation)	*d* (staff)	*e* (commodities)	Specification of commodity
Non-hazardous waste								
01.2, 01.4, 02, 03.1	Other chemical wastes	**0**					1.00	11. Other chem. prod
03.2, 11, 11.3	Sludge (wet weight), including dredging spoils	**0**	1.00					
6	Metallic wastes	**196**					1.00	14. Engineering products
07.1	Glass wastes	**1**				0.10	0.9	Total consumption of commodities
07.2	Paper and cardboard wastes	**9**				0.10	0.90	9. Pulp and paper
07.3	Rubber wastes	**0**					1.00	11. Other chem. prod
07.4	Plastic wastes	**0**				0.10	0.90	11. Other chem. prod
07.5	Wood wastes	**8**					1.00	Total consumption of commodities
8	Discarded equipment	**1**			0.70		0.30	14. Engineering products
08.41	Batteries and accumulators	**0**				0.10	0.90	14. Engineering products
9	Animal and vegetal wastes	**0**					1.00	Total consumption of commodities
10.1	Household and similar wastes	**20**				1.00		
10.2	Mixed and undifferentiated materials	**1 110**				0.30	0.70	Total consumption of commodities
12	Mineral wastes, excluding 12.4 and 12.6	**1 242**					1.00	Total consumption of commodities
12	Excavating soils	**4 659**						
	Total non-hazardous wastes	**7 246**						
Hazardous wastes								
01.1	Spent solvents	**0**					1.00	11. Other chemical products
01.3	Used oils	**7**					1.00	17. Petroleum products
01.2, 01.4, 02, 03.1	Other chemical wastes	**20**					1.00	11. Other chemical products
03.2	Sludges (wet weight)	**1**	1.00					
07.5	Wood wastes	**0**					1.00	Total consumption of commodities
08	Discarded equipment	**2**			0.70		0.30	14. Engineering products
08.41	Batteries and accumulators	**0.5**				0.10	0.90	14. Engineering products
10.2	Mixed and undifferentiated materials	**0.1**					1.00	Total consumption of commodities
12	Mineral waste, excl. 12.4 and 12.6	**464**	1.00					
	Total hazardous wastes	**496**						

Dredged spoils are excluded.

14. Services

Swedish EPA (2008a) reports the amounts according to Table 35. The input to EMEC is shown in Table 36. Sewage sludges have not been included in the input to EMEC. It follows the population more than the economics.

Table 35. Waste generation in NACE 50 – 93 (excl. 51.57 and 90) Services

Waste type	**Waste generation 2006** ***1000 tons***
Generation of hazardous waste	
01.1 Spent solvents	1
01.2 Acid, alkaline or saline wastes	3
01.3 Used oils	22
02 Chemical preparation wastes	7
03.1 Chemical deposits and residues	122
03.2 Industrial effluent sludges	25
of which dry weight	*5*
05 Health care and biological wastes	3
06 Metallic wastes	0
07.5 Wood wastes	2
07.7 Waste containing PCB	0
08 Discarded equipment	5
08.1 Discarded vehicles	152
08.41 Batteries and accumulators	27
10.2 Mixed and undifferentiated materials	2
12 Mineral wastes excl. 12.4 and 12.6	1
12.4 Combustion wastes	0
12.6 Contaminated soils and dredging spoils	4
13. Solidified, stabilised and vitrified wastes	
Sum	**377**
Generation of non-hazardous waste	
02 Chemical preparation wastes	0
05 Health care and biological wastes	8
06 Metallic wastes	3
07.1 Glass wastes	2
07.2 Paper and cardboard wastes	181
07.3 Rubber wastes	0
07.4 Plastic wastes	1
07.5 Wood wastes	2
08 Discarded equipment	0
08.41 Batteries and accumulators	0
09 Animal and vegetal wastes (excl. 09.11 and 09.03)	429
09.11 Animal wastes of food preparation and products	0
09.3 Animal faeces, urine and manure	3
10.1 Household and similar wastes	254
10.2 Mixed and undifferentiated materials	272
10.3 Sorting residues	0
11 Common sludges excl. 11.3, wet weight	15
of which dry weight	4
12 Mineral wastes excl. 12.4 and 12.6	0
12.4 Combustion wastes	0
Sum	**1 171**
Total generation of waste	**1 547**

Remarks

0 The figure 0 indicates that the waste type is generated, but have been rounded downwards to 0 (the actual quantity is less than 0.5 kton)
The waste generation in the sector were not invented in 2004.

Table 36. Input to EMEC: NACE 50 – 93 Services

EWC-Stat-code		**Waste amounts in different sectors within NACE 50 - 93 Service sector**							**Proposed waste coefficients**					
		Total NACE 50 – 93 (excl. 51.57 and 90) *kton*	**NACE 61 Water transport and 62 Air transport** *kton*	**NACE 75 Public administration and defence; compulsory social security** *kton*	**NACE 85 Health and social work** *kton*	**NACE 90.01 Sewage** *kton*	**NACE 90.03 Sanitation, remediation and similar activities** *kton*	**Other sectors in NACE 50-93** *kton*	*a* (production)	*b* (Energy carrier) Specification of energy carrier	*c* (depreciation)	*d* (staff)	*e* (commodities) Specification of commodity	
Non-hazardous waste														
01.2, 01.4, 02, 03.1	Other chemical wastes	**0**			0				1.00					
03.2, 11, 11.3	Sludge (wet weight)	**0**	0	0		0	0	0	0.80			0.20		11. Other chem. prod
11	Sludge from municipal sewage treatment					840								
6	Metallic wastes	**3**	0	2	1			0	0.90			0.10		
07.1	Glass wastes	**2**	0	0	1				0.90			0.10		
07.2	Paper and cardboard wastes	**181**	2	4	8			167	0.90			0.10		
07.3	Rubber wastes	**0**	0						0.90			0.10		
07.4	Plastic wastes	**1**	0	0	0			0	0.90			0.10		
07.5	Wood wastes	**2**	0	1	0			0	0.90			0.10		
07.6	Textile wastes													
8	Discarded equipment	**0**	0		0						0.70		0.30	Total consumption of commodities
08.1	Discarded vehicles										1.00			14. Engineering products
08.41	Batteries and accumulators	**0**			0							0.10	0.90	14. Engineering products
9	Animal and vegetal wastes	**86**	0	3	3		53	27	0.00			0.40	0.60	14. Engineering products
10.1	Household and similar wastes	**442**	6		24		14	398	0.40			0.60		32. Services

10.2	Mixed and undifferentiated materials	**272**	261	7	4		0	0	0.00			0.40	0.60	32. Services
10.3	Sorting residues	**0**		0	0				1.00					32. Services
12	Mineral wastes, excluding 12.4 and 12.6	**247**	0		0		247		0.00				1.00	Total consumption of commodities
12.4	Combustion wastes	**0**		0				0	0.00				1.00	Total consumption of commodities
	Total non-hazardous wastes	**1236**	**269**	**17**	**41**	**0**	**314**	**592**						
Hazardous wastes														
01.1	Spent solvents	**1**	0	0	0			0.8	0.10			0.20	0.70	Total consumption of commodities
01.3	Used oils	**22**	0.3	0.5	0			21.2	0.10			0.20	0.70	11. Other chemical products
01.2, 01.4, 02, 03.1	Other chemical wastes	**132**	34,1	2,5	0.6			94,8	0.10			0.20	0.70	17. Petroleum products
03.2	Sludges (wet weight)	**25**	0	0				24,9	1.00				0.00	11. Other chemical products
07.5	Wood wastes	**2**		0	0			2	0.00			0.70	0.30	Total consumption of commodities
8	Discarded equipment	**5**	0	0.3	1,2			3	0.00		0.70		0.30	Total consumption of commodities
08.1	Discarded vehicles	**152**						151.6	0.00		1.00	0.00	0.00	14. Engineering products
08.41	Batteries and accumulators	**27**	0	0.3	0.1			26,7	0.10			0.70	0.20	14. Engineering products
10.2	Mixed and undifferentiated materials	**2**	1,3	0	0.2			0.7	0.00			0.40	0.60	14. Engineering products
10.3	Sorting residues	**0**							1.00					
12	Mineral wastes, excl. 12.4 and 12.6	**2**	0	0	0			1.4	1.00					
12.4	Combustion wastes	**0**						0.1	0.00				1.00	Total consumption of commodities
	Total hazardous wastes	**369**												

The service sector includes several different sub-sectors with different characteristics. If different sub-sectors are developed differently the model can make wrong predictions.

The statistics from Swedish EPA includes for 09 – Animal and vegetable wastes organic wastes from grocery stores, resturants etc that are actually not sorted out today. To be able to show the potential we have allocated them to 10.1 – Household waste instead.

15. Wastes generated in households

Swedish EPA (2008a) reports the amounts according to Table 37. The input to EMEC is shown in Table 38.

Sludges from households are sludges from septic tanks and similar onsite wastewater treatment equipment. The amount is mostly depending on how many estates that are connected to the municipal sewage system, and does not depends on neither the population nor the economic development. It has been excluded from the input to EMEC.

Table 37. Generated wastes in households (Swedish EPA 2008a)

Waste type	**Waste generation 2006** ***1000 tons***
Generation of hazardous waste	
01.1 Spent solvents	1
01.2 Acid, alkaline or saline wastes	1
01.3 Used oils	3
02 Chemical preparation wastes	14
07.5 Wood wastes	15
08 Discarded equipment	139
08.1 Discarded vehicles	305
08.41 Batteries and accumulators	7
10.2 Mixed and undifferentiated materials	3
12 Mineral wastes excl. 12.4 and 12.6	2
Sum	**489**
Generation of non-hazardous waste	
02 Chemical preparation wastes	1
06 Metallic wastes	165
07.1 Glass wastes	266
07.2 Paper and cardboard wastes	537
07.3 Rubber wastes	31
07.4 Plastic wastes	48
08.41 Batteries and accumulators	1
09 Animal and vegetal wastes (excl. 09.11 and 09.03)	386
10.1 Household and similar wastes	2328
11 Common sludges excl. 11.3, wet weight	879
of which dry weight	88
Sum	**4 643**
Total generation of waste	**5 132**

Remarks
0 The figure 0 indicates that the waste type is generated, but have been rounded downwards to 0 (the actual quantity is less than 0.5 kton)

Table 38. Input to EMEC: Household

Waste type (EWC-Stat)		Amounts ktons	Proposed waste coefficients																									
			C1	C2	C3	C4	C5	C6	C7	C8	C11	C9	C12	C10	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C-TOT
			Food and beverages	Clothing and footwear	Furniture etc	Household goods	Gross rents	Recreation	Private transports	Road work trips	Rail work trips	Road short leisure trips	Rail short leisure trips	Road long leisure trips	Rail long leisure trips	Sea short leisure trips	Sea long leisure trips	Air long leisure trips	Services	Goods n.e.c.	Electricity	Gas	Fuels	Gasoline work trips	Gasoline short leisure trips	Gasoline long leisure trips	Biofuels	Purchased heat	TOTAL
Hazardous waste																													
1.1	Spent solvents	**1**		0.14		0.14		0.14												0.14				0.14	0.14	0.14			
1.3	Used oils	**3**																						0.33	0.33	0.33			
1.2, 1.4, 2, 3.1	Other chemicals	**15**		0.14		0.14		0.14												0.14				0.14	0.14	0.14			
8.5	Wood wastes	**15**																		1.00									
8	Discarded equipment	**139**				1.00																							
8.1	Discarded vehicles	**305**							1.00																				
8.41	Batteries and accumulators	**7**				1.00																							
10.2	Mixed and undifferentiated materials	**3**		0.14		0.14		0.14												0.14				0.14	0.14	0.14			
Non-hazardous waste																													
02	Chemical preparation wastes	**1**					0.5													0.5									
3.2, 11	Sludge	**879**																											
6	Metallic wastes	**165**	0.33			0.33														0.33									
7.1	Glass wastes	**266**	0.5			0.5																							
7.2	Paper wastes	**537**	0.5			0.5																							
7.3	Rubber wastes	**31**							1.00																				
7.4	Plastic wastes	**39**	0.5			0.5																							
8.41	Batteries and accumulators	**1**				1.0																							
9	Animal and vegetal wastes	**456**	1.0																										
10.1	Household wastes	**2 328**	0.125		0.125	0.125		0.125	0.125										0.125	0.125							0.125		