

Quality Report

for statistics on generation and recovery
and disposal of waste in Sweden 2004
according to EU Regulation on Waste
Statistics 2150/2002

REPORT 5594 • JUNE 2006



Quality Report

for statistics on generation and recovery and disposal of waste in Sweden 2004
according to EU Regulation on Waste Statistics 2150/2002

15-06-2006

SWEDISH ENVIRONMENTAL
PROTECTION AGENCY

Orders

Phone: + 46 (0)8-505 933 40

Fax: + 46 (0)8-505 933 99

E-mail: natur@cm.se

Address: CM-Gruppen, Box 110 93, SE-161 11 Bromma, Sweden

Internet: www.naturvardsverket.se/bokhandeln

The Swedish Environmental Protection Agency

Phone: + 46 (0)8-698 10 00, Fax: + 46 (0)8-20 29 25

E-mail: natur@naturvardsverket.se

Address: Naturvårdsverket, SE-106 48 Stockholm, Sweden

Internet: www.naturvardsverket.se

ISBN 91-620-5594-1

ISSN 0282-7298

© Naturvårdsverket 2006

Preface

The Regulation of the European Parliament and the Council No 2150/2002 of 25 November 2002 on waste statistics contains rules for the reporting of waste statistics to the EU. Reporting according to the regulation is to take place every second year. Reporting shall be submitted each time 18 months after the end of the reporting period. The first reporting is to be submitted by 30 June 2006 at the latest.

This report contains the quality declaration for the data reported in June 2006, referring to the generation of waste and the recovery and disposal of waste during 2004. The report is produced by the consortium SMED by order of the Swedish Environmental Protection Agency.

Table of contents

PREFACE	3
INTRODUCTION AND GUIDELINES	9
General information on the EU Regulation on Waste Statistics	9
Report description	10
PART I	
DESCRIPTION OF THE DATA	11
Identification	11
Contact person	11
Organisation of reporting	11
General description of methods used	13
General information on the scope and limitations of the statistics	14
Overview of methods	17
Investigation regarding Agriculture, hunting and forestry (NACE A) and fishing (NACE B)	22
Survey regarding Mining and quarrying (NACE C) and Manufacturing (NACE D):	22
Survey regarding Electricity, gas and water supply (NACE E)	22
Survey regarding Construction (NACE F)	22
Survey regarding Services (NACE G-Q excluding 51.57 and 90)	23
Survey regarding Recycling (NACE 37)	23
Survey regarding Wholesale of waste and scrap (NACE 51.57)	23
Survey regarding Dismantling of end-of-life-vehicles within NACE 37 and NACE 51.57	24
Survey regarding Sewage and refuse disposal, sanitation and similar activities (NACE 90)	24
Survey regarding waste generated by households	24
Changes since the previous reference year	25
Expected changes to the 2008 reporting on 2006	25
PART II	
QUALITY ATTRIBUTES	26
1 Relevance	26
2 Accuracy	27
2.1 Sampling errors	30
2.2 Non-sampling errors	30
3 Timeliness	38
4 Accessibility and clarity	39
5 Comparability	39
5.1 Comparability with other member states and between sectors	39
5.2 Regional comparability of waste treatment	40
5.3 Comparability over time	40

6	Coherence	41
7	Burden on respondents	41
DEFINITIONS, UNITS AND ABBREVIATIONS		43
APPENDIX 1		
AGRICULTURE, HUNTING AND FORESTRY (NACE A) AND FISHING (NACE B)		46
APPENDIX 2		
MINING AND QUARRYING (NACE C) AND MANUFACTURING (NACE D)		48
1	Sources	48
2	Accuracy of data	49
2.1	Sampling errors	49
2.2	Non-sampling errors	49
5	Comparability	59
5.2	Regional comparability of waste treatment	59
APPENDIX 3		
ELECTRICITY, GAS, STEAM, HOT WATER AND WATER SUPPLY (NACE E)		61
1	Sources	61
1.1	Enterprises with energy production from combustion	61
1.2	Nuclear power plants	62
1.3	Manufacture of gas	62
1.4	Hydroelectric power stations	62
1.5	Wind power stations	62
1.6	Electricity network enterprises	62
1.7	Electricity trade enterprises	63
1.8	Water supply	63
1.9	Household waste generated by the whole industry	63
2	Accuracy of data	63
2.1	Sampling errors	63
2.2	Non-sampling errors	63
5	Comparability	71
5.2	Regional comparability of waste treatment	71
APPENDIX 4		
CONSTRUCTION(NACE F)		73
1	Sources	73
2	Accuracy of data	73
2.1	Sampling errors	74
2.2	Non-sampling errors	74
5	Comparability	75
5.2	Regional comparability of waste treatment	75

APPENDIX 5	
SERVICES (NACE G-Q)	76
1 Sources	76
2 Accuracy of data	77
2.1 Sampling errors	77
2.2 Non-sampling errors	77
5 Comparability	79
5.2 Regional comparability of waste treatment	79
APPENDIX 6	
RECYCLING (NACE 37)	80
1 Sources	80
2 Accuracy of data	80
2.1 Sampling errors	80
2.2 Non-sampling errors	81
5 Comparability	84
5.2 Regional comparability of waste treatment	84
APPENDIX 7	
WHOLESALE OF WASTE AND SCRAP (NACE 51.57)	85
1 Sources	85
2 Accuracy of data	85
2.1 Sampling errors	85
2.2 Non-sampling errors	86
5 Comparability	89
5.2 Regional comparability of waste treatment	89
APPENDIX 8	
DISMANTLING OF END-OF-LIFE-VEHICLES WITHIN NACE 37 AND 51.57	90
1 Sources	90
2 Accuracy of data	90
2.1 Sampling errors	90
2.2 Non-sampling errors	91
5 Comparability	92
5.2 Regional comparability of waste treatment	92
APPENDIX 9	
COLLECTION AND TREATMENT OF SEWAGE (NACE 90.01)	93
1 Sources	93
2 Accuracy of data	93
2.1 Sampling errors	93
2.2 Non-sampling errors	93
5 Comparability	95
5.2 Regional comparability of waste treatment	95

APPENDIX 10	
COLLECTION AND TREATMENT OF OTHER WASTE (NACE 90.02)	96
1. Sources	96
2 Accuracy of data	97
2.1 Sampling errors	97
2.2 Non-sampling errors	97
5 Comparability	100
5.2 Regional comparability of waste treatment	100
APPENDIX 11	
SANITATION AND RELATED ACTIVITIES (NACE 90.03)	101
1 Sources	101
2 Accuracy of data	101
2.1 Sampling errors	101
2.2 Non-sampling errors	101
5 Comparability	102
5.2 Regional comparability of waste treatment	102
APPENDIX 12	
HOUSEHOLDS	103
1 Sources	103
2 Accuracy of data	104
2.1 Sampling errors	104
2.2 Non-sampling errors	104
5 Comparability	106
5.2 Regional comparability of waste treatment	106
APPENDIX 13	
RECOVERY AND DISPOSAL OF WASTE	107
1 Sources	107
2 Accuracy	108
2.1 Sampling errors	108
2.2 Non-sampling errors	108
5 Comparability	112
5.2 Regional comparability of waste treatment	112
APPENDIX 14	
UNCERTAINTY ESTIMATES OF KEY AGGREGATES	113
1 Uncertainty in the questionnaire surveys	113
2 Uncertainty in other sources	113
3 List of uncertainties in key aggregates	114

Introduction and guidelines

General information on the EU Regulation on Waste Statistics

The Regulation of the European Parliament and the Council No 2150/2002 of 25 November 2002 on waste statistics (hereafter referred to as "the waste statistics regulation" or "WStatR"¹) contains rules for the reporting of waste statistics to the EU². Reporting according to the regulation is to take place every second year. Reporting shall be submitted each time 18 months after the end of the reporting period. The first reporting is to be submitted by 30 June 2006 at the latest and should refer to the generation of waste and the recovery and disposal of waste during 2004. The regulation contains three annexes that describe in more detail what should be reported:

Annex I: 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
- waste generated by households.

The generation of waste for these 20 sectors should be given according to the waste classification EWC-Stat. EWC-Stat is a special material-based waste classification that is founded on the usual waste listings. There are a total of 48 different types of waste in EWC-Stat.

Annex II: The treatment of waste is to be reported by waste amount for the different types of waste according to EWC-Stat and method of treatment. The method of treatment relates to various recovery and disposal operations³ (also called R and D operations). These are compiled into 5 different groups:

- 1) Incineration: Use principally as a fuel or other means to generate energy
- 2) Incineration: Incineration on land
- 3) Recovery excluding energy recovery
- 4) Disposal operations: depositing, deep injection, impoundment, permanent storage
- 5) Disposal operations: land treatment, release into water

¹ WStatR refers in this context to the Waste Statistics Regulation

² An "EU regulation" implies that the legislation is immediately applicable in all member states (in contrast to a directive which becomes applicable in every member state only once it has been incorporated into the country's own legislation).

³ Processes for recovery and disposal are defined in Annexes 4 and 5 of the Swedish Waste Ordinance (2001:1063) and in Annexes IIA and IIB of the EU Framework Directive on Waste (1975/442/EEC). The different recovery processes are classified as R1 to R13 (R stands for Recovery) and there are 16 different disposal processes classified as D1 to D16 (D stands for Disposal)

Certain recovery and disposal operations that constitute pre-treatment should not be reported.

According to Annex II, the number of treatment facilities and the capacity for different treatments should also be reported regionally according to NUTS 2 (i.e. 8 aggregates of counties for Sweden).

Annex III presents a division of the types of waste according to EWC-Stat.

Report description

The following report constitutes one part of the obligatory delivery to the EU. According to the waste statistics regulation, every member state should submit a report on the coverage and quality of the statistics. The report is also published in Sweden in Swedish for Swedish users of statistics. The contents and structure of the report have been determined by the European Commission in a specific regulation⁴. The report is structured in conformity with this regulation.

The report is divided into three parts:

- **Part I: Description of the data.** This part contains primarily
 - General information, for example, on the responsibility and organisation of the reporting
 - General description of the methods used. An overview of how the data have been produced
- **Part II: Quality attributes.** This part includes a description of the various aspects that affect the quality of the produced data, in particular, in relation to Section 2 Accuracy. The headings are taken from the European Commission's regulation on the contents of quality reports.
- **Appendices to Part II:** A more detailed description of the more important quality attributes of the sub-surveys that were carried out.

⁴ COMMISSION REGULATION (EC) No 1445/2005 of 5 September 2005, defining the proper quality evaluation criteria and the contents of the quality reports for waste statistics for the purposes of Regulation (EC) No 2150/2002 of the European Parliament and of the Council

Part I

Description of the data

This part deals first with some obligatory formal details. This is followed by a general description of the methods used to compile the data.

Identification

Country: *Sweden*

Reference year: *2004*

Datasets:

WASTE_GENER_A2_SE_2004_0000

WASTE_INCIN_A2_SE_2004_0000

WASTE_RECOV_A2_SE_2004_0000

WASTE_DISPO_A2_SE_2004_0000

WASTE_REGIO_A2_SE_2004_0000

Transmission date: *20-06-2006*

Contact person

Name: *Helena Looström Urban*

Telephone: *+46 8 698 10 00*

E-mail: *helena.loostrom.urban@naturvardsverket.se*

Organisation: *Swedish Environmental Protection Agency
SE-106 48 Stockholm, Sweden*

For the 2006 reporting, Sweden has been granted derogations for the reporting regarding the generation of waste in NACE A, NACE B and NACE G-Q (excluding 51.57 and 90).

Organisation of reporting

There are a number of laws and regulations governing the work with waste statistics. The European Union's waste statistics regulation (WStatR) relates directly to this as well as the Swedish Official Statistics Act and Ordinance⁵. The waste statistics regulation governs the contents, reporting frequency and format of the statistics to be re-reported to the EU. The Swedish Ordinance on official statistics allocates responsibility for the official statistics on waste to the Swedish Environmental Protection Agency as well as the right of decision-making on the scope and content of the statistics.

⁵ Official Statistics Act (2001:99) and Ordinance on official statistics (2001:100)

Adjacent legislation and conventions that primarily indirectly govern the responsibility of the Swedish Environmental Protection Agency relating to statistics production and reporting include the Secrecy Act⁶, the Personal Data Act⁷, Ordinance concerning government authorities' collection of data⁸, the SimpLex Ordinance⁹ and also the Århus Convention¹⁰ regarding data on emissions. According to this convention, data on emissions should not be confidential. Enterprises' obligations to document waste management for the purposes of environmental protection are primarily governed by the Environmental Code¹¹ and the Waste Ordinance¹², the ordinance on environmentally harmful operations and environmental protection¹³ and others.

In addition to these, there are several other directives and ordinances in the field of waste that govern Sweden's commitments regarding international reporting, including statistics and data on waste¹⁴.

With the aim of complying with the reporting according to the waste statistics regulation and of supplying cost-effective national waste data, Sweden has organised the work into two semi-parallel phases:

- In preparation for the reporting in 2006 and 2008, the development of methodologies and an inventory of waste flows according to the format requirements in the waste statistics regulation. Data collection has been based on statistical legislation and has been optional for enterprises.
- In preparation for the reporting in 2010, the analysis and development of a waste reporting system. The aim is to produce good quality statistics to enable the follow-up of waste issues in environmental policies both nationally and internationally, the implementation of measures within the national strategy for a non-toxic and resource-effective ecocycle, the minimising of the burden on respondents, a reduction in the costs to society and, as far as possible, the capacity to utilise the same data for both national and international purposes.¹⁴

In Sweden, the Swedish Environmental Protection Agency is responsible for producing, publishing and reporting national waste statistics. The Swedish Environmental Protection Agency has a framework agreement with the SMED consor-

⁶ Secrecy Act (1980: 100) and the Secrecy Ordinance 1980

⁷ Personal Data Act (1998:204)

⁸ SFS 1982:668 Ordinance concerning government authorities collection of data

⁹ Simplex ordinance SFS 1998:1820, Ordinance on individual analysis of consequences of the effect of legislation on conditions for small enterprises

¹⁰ Århus Convention Ds 2004:29

¹¹ Environmental Code 1998:808

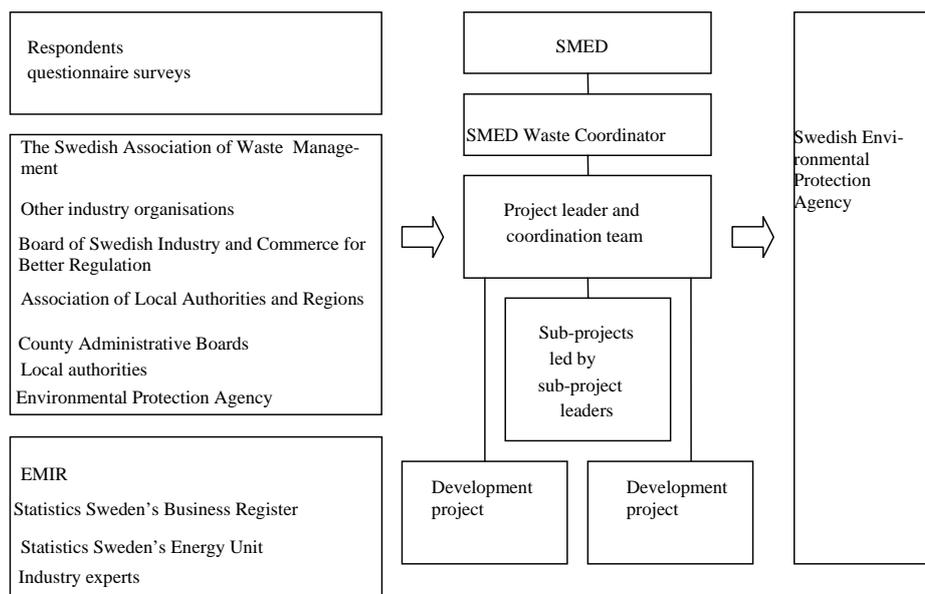
¹² Waste Ordinance (2001:1063)

¹³ Ordinance on environmentally harmful operations and environmental protection (1998:899)

¹⁴ How to produce better and cheaper waste statistics? Preliminary study on Swedish reporting systems for waste data, Swedish Environmental Protection Agency, Report 5530:Dec 2005.

tium (Swedish Methodology for Environmental Data)¹⁵ for the provision of services regarding data collection, statistics production and the development of methodology for reporting activities. The waste statistics with accompanying documentation have been produced by SMED.

In preparation for the 2006 reporting, the work has been organised as follows:



For the reporting according to the waste statistics regulation, a quality system has been developed covering the areas of responsibility for SMED¹⁶ and the Swedish Environmental Protection Agency¹⁷. These ensure the possibility to repeat and trace the work carried out.

General description of methods used

The statistics on the generation of waste and the recovery and disposal of waste are based on a comprehensive inventory of waste flows in Sweden. A variety of methods have been used: questionnaire surveys, waste factors, calculation models and expert assessments. An overall description of the scope and limitations of the inventory is given below. There is also a general overview of the methods applied, with reference to the appendices where more detailed information on the various sub-surveys can be found.

¹⁵ The consortium consists of the Swedish Meteorological and Hydrological Institute (SMHI), the Swedish University of Agricultural Sciences (SLU), the Swedish Environmental Research Institute (IVL) and Statistics Sweden.

¹⁶ Manual for SMED's Quality System for waste reporting according to WStatR, 2006-04-10

¹⁷ Swedish Environmental Protection Agency Quality Manual for reporting of waste statistics according to EU Regulation No 2150/2002.

General information on the scope and limitations of the statistics

SECTORS AND HOUSEHOLDS

The statistics cover the generation of waste in all economic sectors and households, with the exception of certain parts of the service sector (NACE G-Q excluding 51.57 and 90) and the agriculture, hunting and forestry sector (NACE A) and fishing sector (NACE B). They cover waste activities of both small and large enterprises. In Sweden, there are 800 000 enterprises and slightly under 5 million households.

WASTE GENERATION AND DEFINITIONS OF WASTE

Waste is, according to Sweden's national encyclopaedia, all remains that are considered to lack any utility value. However, that which is considered waste differs among the different sectors of society. In EU legislation, waste is any item that the owner of the item wishes to get rid of, regardless of its value. The EU's waste definition¹⁸ is repeated in the Swedish Environmental Code¹⁹ and reads:

Waste shall mean any substance or object included in one of the waste categories and which the holder discards or intends or is required to discard²⁰.

The EU's definition of waste has also been judged in several cases in the European Court of Justice (ECJ). On the basis of these judgements, the following conclusions can be drawn:

- A material can be waste even if it has an economic value²¹.
- By-products are, in many cases, waste. Only when a by-product is produced deliberately rather than unintentionally can it be declassified²².
- In conjunction with recycling, waste ceases to be waste first when it has become a new product in the process²³.

These points are developed further below.

Within the EU, a list of waste has also been compiled²⁴. This list is also found as Annex 2 in the Swedish Waste Ordinance²⁵. The list contains close to 850 different types of waste and also indicates the various types of waste that should be classified as hazardous. The list of waste also specifies a number of criteria for assessing whether waste should be classified as hazardous.

¹⁸ Council Directive 15 July 1975 on waste (75/442/EEC)

¹⁹ Environmental Code 1998:808, Chapter 15, § 1

²⁰ Annex 1 in the Swedish Waste Ordinance (2001:1063) lists 16 different waste categories, Q1 to Q16.

²¹ The ECJ's ruling in the combined cases C-206/88 and C-207/88, Vessoso and Zanetti (REG 1990, s. I-1461), point 9

²² ECJ ruling C-457/02 (Niselli); ECJ ruling C-235/02 (Saetti & Frediani)

²³ ECJ ruling C- 444/00 (Mayer Parry)

²⁴ COMMISSION DECISION of 3 May 2000 (2000/532/EEC)

²⁵ Waste Ordinance 2001:1063

In this survey, we have applied the definition of waste broadly. At the same time, we have experienced that respondents (those generating and treating waste) do not, in practice, interpret the definition in the same way. Drawing a line between a by-product and waste is difficult, particularly when the waste/by-product is recycled or sold. The statistics therefore cover many waste types/by-products from industrial processes which are not understood as waste in the daily industrial operations, or in general. One example of this is sawdust and other wood waste from sawmills, and also metal scrap.

In this survey, we have often interpreted these borderline cases as waste. A different interpretation of the concept of waste in these cases would give a significantly different result in the waste statistics.

Generated waste quantities may be counted twice when the waste first appears as one type of waste and then, after some treatment, the quantity of material is transformed into another type of waste. An example of this: 258 000 tonnes of discarded vehicle (hazardous waste) that, after dismantling of the hazardous parts, generates 219 000 tonnes of discarded vehicle (non-hazardous waste). The quantity of waste generated in these statistics is not therefore a measurement of the primary waste generated in society as a result of consumption and production. It is instead a gross sum of both primary waste and secondary waste generated, where the latter is a result of waste treatment.

INTERPRETATION OF WASTE AND BY-PRODUCTS

The ECJ ruling in the case Saetti & Frediani (C-235/02) states that it is not necessary to classify a by-product as waste if the production (generation) of the by-product is the result of a technical choice and the by-product is not necessarily produced in the actual process. This means that the by-product does not necessarily have to be generated by the actual process but it has been chosen to generate this product because of its market value. In the survey, it has usually been difficult to determine when a by-product is generated "voluntarily" or "necessarily". We have in general applied a fairly strict interpretation. For example, the following "by-products" (occurring in large quantities) have been classified as waste:

- Wood waste from sawmills. This is sold to heating plants or the pulp industry.
- Metal waste (scrap) from the metal industry. This is sold to the scrap industry (normally in NACE 37 or 51.57), who then sell it on to metal works (NACE 28).
- Excavated material. The majority of excavated material dug-up during construction or foundation projects is reused in other construction projects.

INTERPRETATION OF RECYCLING AND RECOVERY

The ECJ case Mayer Parry (C-444/00) states that waste ceases to be waste first when it becomes a new product. We have interpreted this so that recycling is the moment when waste becomes a new product. Previously, the general interpretation has been that waste ceases to be waste when it can be used as a raw material in a manufacturing process. When looking at recyclable paper, for example, waste paper can be considered waste until it has become new pulp or new paper at a pulp/paper factory. This means that pre-treatment, sorting, etc. does not constitute recycling. Sorting and such like occurs within NACE 37 Recycling but one consequence of the Mayer-Parry case is that recycling no longer occurs in practice within NACE 37 but most commonly within the manufacturing industry (NACE D).

The concepts of recycling and recovery also include the production of soil improvement fertilisers from composting or anaerobic digestion. The use of ashes, slag, mineral waste as construction materials in roads, for example, is also included in recycling and recovery. This is also the case when various by-products are used as material for the coverage and packing of landfill sites. In all these cases, the waste is considered to replace another material.

When reporting recovery, we have included only the "final" recovery or "final" recycling when the waste becomes a new product, not pre-treatment and sorting. This interpretation ensures that recovery is not reported twice, as one particular waste flow is only reported once in the statistics on the recovery of waste.

LANDFILLING

Waste from mining is included in the survey in the Sector Mining and quarrying (NACE C). Some of the waste from mining is used in various ways to restore the mining pits (terracing, landscaping and such like). We have classified this as depositing D1.

IMPORTS AND EXPORTS

Statistics do not cover imports and exports of waste. However imported waste quantities can be seen as a subset of the statistics when the waste is treated in Sweden.

KEY AGGREGATES AND AGGREGATION OF SLUDGE AND DREDGING SPOILS

According to the waste statistics regulation, a number of summations and aggregations of types of wastes shall be calculated. In the Swedish statistics these have been done as follows:

- In the Key Aggregates, the amounts of all types of waste are included in their normal wet condition. This is also the case for the types of waste Industrial effluent sludges (03.2) and Common sludges (11).
- In the summations of "total hazardous waste", "total non-hazardous waste" and "total amount of waste", the amounts of all types of waste are

included in their normal wet condition. This is also the case for the types of waste Industrial effluent sludges (03.2) and Common sludges (11).

- In the tables for incineration and disposal of waste, the type of waste 11, Common sludges including dredging spoils (11.3), is included. Both the amount in normal wet condition and the quantity of dry matter content should be reported. In the given wet weight, both sludge and dredging spoils are included in wet condition. In the dry matter content, the amount of dry common sludges (excluding dredging spoils) and an estimated dry matter content of dredging spoils are included. The dry matter content for dredging spoils has, on good grounds, been assumed to be 7.5% of the wet dredging spoils.

Overview of methods

Table I.1 presents an overview of the methods used to compile the data on the generation and the recovery and disposal of waste. When selecting the methods to be used, we have based the choice on the desire to increase knowledge on the magnitude of the generation and treatment of different types of waste. Particular focus has been placed on obtaining data on the larger waste flows and the flows of hazardous waste, which have made it possible to produce the statistics more effectively in the long-term.

According to the waste statistics regulation, enterprises with less than ten employees are exempt from the surveys, unless they contribute significantly to the generation of waste. Questionnaire surveys have therefore not been used in the majority of cases on small enterprises (fewer than 10 employees). Other methods have been applied. However, small enterprises in some sectors have been surveyed using questionnaires, when experts have assessed that these enterprise populations can be responsible for large and, from an environmental perspective, significant flows of waste.

The questionnaire surveys carried out (see Table I.1) have been optional for respondents. The surveys have been carried out using paper questionnaires. Questionnaire surveys have been covered by statistical confidentiality²⁶. As a result of this, partial results can be confidential if the data originate from only a few questionnaire responses or can, in some way, indirectly or directly, be attributed to a specific local unit, facility or enterprise.

In some sectors, the questionnaire surveys have been total, i.e. covering all local units/facilities/enterprises in the industry, while sample surveys have been used in other sectors. With the sample surveys, a division into different strata or sub-populations has been done first (by number of employees). A random sample of facilities who will receive the questionnaire was then taken from every stratum. When data are then compiled, a proportional extrapolation is carried out of the waste quantities received within each stratum, i.e. those responding within each stratum are considered representative of the stratum as a whole.

²⁶ Secrecy Act 1980:100 and Secrecy Ordinance 1980:657

An overall description of the methods used is given below, with reference to the more detailed descriptions of methodology for the different industry sectors.

The inventory work has been divided into several sub-surveys. The division of sectors described in Annex I in the waste statistics regulation, i.e. the sectors for which generation of waste are to be reported, have been used as a basis for the division into sub-surveys. Every sub-survey has involved an inventory of both data on waste generated and data on the recovery and disposal of waste, including capacity in the section, division, group or class of NACE in question. Table I.1 gives an overview of the methods used.

Table I.1. Overview of methods used for inventory work

Item	NACE	Description	Methods – data on generation of waste	Methods – data on recovery and disposal (including capacity)
1	A	Agriculture, hunting and forestry	No statistics produced for 2006. ²⁷	No waste treatment is thought to occur in this sector, see Appendix 1.
2	B	Fishing	No statistics produced for 2006. ²⁸	No waste treatment is thought to occur in this sector, see Appendix 1.
3	C	Mining and quarrying	Questionnaire survey – sample survey*, model calculation for enterprises with less than 10 employees. See Appendix 2.	Questionnaire survey – sample survey* (waste treatment only assumed to occur in larger enterprises). See Appendix 2 and Appendix 13.
4	DA	Manufacture of food products, beverages and tobacco	Questionnaire survey – sample survey*, model calculation for enterprises with less than 10 employees. See Appendix 2.	Questionnaire survey – sample survey*. See Appendix 2 and Appendix 13.
5	DB + DC	Manufacture of textiles and textile products + manufacture of leather and leather products	Extrapolation of data from survey on Industrial waste 2002. Expert assessments on the distribution of total quantities of different types of waste. See Appendix 2.	No waste treatment has been identified in this sector in previous surveys. See Appendix 2 and Appendix 13.
6	DD	Manufacture of wood and wood products	Questionnaire survey – sample survey*. Model calculation for enterprises with less than 10 employees. See Appendix 2.	Questionnaire survey – sample survey* See Appendix 2 and Appendix 13
7	DE	Manufacture of pulp, paper and paper products; publishing and printing	Questionnaire survey – sample survey* Model calculation for enterprises with less than 10 employees. See Appendix 2.	Questionnaire survey – sample survey* See Appendix 2 and Appendix 13
8	DF	Manufacturing of coke, refined petroleum products and nuclear fuel	Questionnaire survey – sample survey* Model calculation for enterprises with less than 10 employees. See Appendix 2	Questionnaire survey – sample survey* See Appendix 2 and Appendix 13

²⁷ Sweden has been granted a derogation for the reporting according to the waste statistics regulation for the generation of waste in this sector (COMMISSION REGULATION (EC) No 784/2005 of 24 May 2005)

²⁸ Sweden has been granted a derogation for the reporting according to the waste statistics regulation for the generation of waste in this sector (COMMISSION REGULATION (EC) No 784/2005 of 24 May 2005).

9	DG + DH	Manufacturing of chemicals and chemical products + manufacture of rubber and plastic products	Questionnaire survey – sample survey* Model calculation for enterprises with less than 10 employees. See Appendix 2	Questionnaire survey – sample survey* See Appendix 2 and Appendix 13
10	DI	Manufacture of other non-metallic mineral products	Questionnaire survey – sample survey* Model calculation for enterprises with less than 10 employees. See Appendix 2	Questionnaire survey – sample survey* See Appendix 2 and Appendix 13
11	DJ	Manufacture of basic metals and fabricated metal products	Questionnaire survey – sample survey* Model calculation for enterprises with less than 10 employees. See Appendix 2	Questionnaire survey – sample survey* See Appendix 2 and Appendix 13
12	DK + DL + DM	Manufacture of machinery and equipment n.e.c + manufacture of electrical and optical equipment + manufacture of transport equipment	Questionnaire survey – sample survey* Model calculation for enterprises with less than 10 employees. See Appendix 2	Questionnaire survey – sample survey* See Appendix 2 and Appendix 13
13	DN excl. 37	Manufacturing n.e.c	Extrapolation of data from survey on Industrial waste 2002. Expert assessments on the distribution of total quantities of different types of waste. See Appendix 2	No waste treatment has been identified in this sector in previous surveys See Appendix 2 and Appendix 13
14	E	Electricity, gas and water supply	Incineration facilities: Questionnaire survey – total population survey of incineration facilities. Investigation (telephone inquiries, environmental reports, etc) of gas works, nuclear power stations, electricity distribution companies, etc Water supply: waste factors. See Appendix 3	Questionnaire survey – total population survey of incineration facilities. See Appendix 3 and Appendix 13
15	F	Construction	Expert panel assessments See Appendix 4	Expert panel – only recovery of excavation materials (mineral waste) occurs at construction sites, see Appendix 4 and Appendix 13
6	G-Q excl. 90 and	Services: wholesale and retail trade; repair of motor vehicles, household and personal articles + hotels and restaurants + transport, storage	No statistics produced for 2006. ²⁹	Investigation of occurrence of treatment. Telephone and e-mail contact with enterprises/facility/local unit where waste treatment has been identified See Appendix 5 and Appendix 13

²⁹ Sweden has been granted a derogation for the reporting according to the waste statistics regulation for the generation of waste for this sector (COMMISSION REGULATION (EC) No 784/2005 of 24 May 2005)

	51.57	and communication + financial mediation + real estate, rental and business activities + public service, defence and compulsory social insurance + education + health and social services; + other community, social and personal service activities + activities in households + extra-territorial organisations and bodies		
17	37	Recovery	Questionnaire survey – total population survey. Waste factors for dismantling of cars. See Appendices 6 and 8	Questionnaire survey – total population survey See Appendices 6 and 8 and 13
18	51.57	Wholesale trade in waste and scrap	Questionnaire survey – sample survey. Waste factors for dismantling of cars. See Appendices 7 and 8	Questionnaire survey – sample survey See Appendices 7 and 8 and 13
19	90	Sewage and refuse disposal, sanitation and similar activities	Collection and treatment of sewage: assessments from previous surveys Collection and treatment of waste: Questionnaire survey - total population survey of treatment facilities (other NACE 90 facilities are assumed to contribute minimal quantities of waste) Waste from sanitation activities: pilot surveys - questions to a limited number of municipalities See Appendices 9-11	Questionnaire survey – total population survey to all waste treatment facilities See Appendices 9-11 and Appendix 13
20	-	Waste generated by households	Data from industry organisations (Swedish Association of Waste Management), producer responsibility enterprises, etc. See Appendix 12	No waste treatment is considered to occur (home composting is considered to be internal recycling). See Appendix 12.

Note: *All local units with more than 100 employees are included in the sample.

As can be seen in the table, the inventory has been divided up into different sub-surveys as follows:

Investigation regarding Agriculture, hunting and forestry (NACE A) and fishing (NACE B)

Sweden has been granted a derogation for the compilation of statistics on the generation of waste for these sectors. A separate investigation on the recovery and disposal of waste has been carried out within the sector. The conclusion from the investigation was that no treatment of waste, in the sense intended in the waste statistics regulation, occurs in the sector.

Survey regarding Mining and quarrying (NACE C) and Manufacturing (NACE D):

The sectors Mining and quarrying (NACE C) and Manufacturing (NACE D) cover a total of 11 different items in the reporting on the generation of waste. Recovery and disposal occurs in many of these industries/sub-industries. All industries within NACE C and D have been surveyed in a combined survey covering both generation and recovery and disposal. The survey was based on a sample survey using paper questionnaires. A total of 2 000 enterprises were questioned, of which all had more than 100 employees. The questionnaire survey was supplemented with data from industry organisations. For smaller local units that were not included in the sample, an extrapolation was carried out based on the number of employees.

Survey regarding Electricity, gas and water supply (NACE E)

The sector Electricity, gas and water supply (NACE E) has been studied in a separate study including both the generation of waste and recovery and disposal of waste.

Enterprises producing energy from combustion were covered by a total population survey using paper questionnaires. This survey included all enterprises that incinerate household and similar wastes. For other enterprises within the energy sector (NACE 40, i.e. nuclear power stations, manufacturers of gas, hydroelectric power stations, wind power stations, electricity network enterprises and electricity trade enterprises) data from telephone interviews, environmental reports and the enterprises' websites were used.

For the sub-sector, water supply, waste factors were produced using questionnaires to a smaller number of waterworks. The study was carried out in cooperation with the industry organisation Swedish Water and Waste Water Association.

Survey regarding Construction (NACE F)

A separate study based on expert assessments was carried out. These expert assessments were put together by representatives from the waste and construction industries.

Survey regarding Services (NACE G-Q excluding 51.57 and 90)

This reporting item does not include Wholesale of waste and scrap (NACE 51.57) and Sewage and refuse disposal, sanitation and similar activities (NACE 90) as these constitute their own reporting items, see below. Sweden received a derogation for the reporting of generation of waste in the service sector (NACE G-Q excluding 51.57 and 90). A separate study was carried out on recovery and disposal within the sector. Data on treatment have been collected via telephone interviews to the relevant facilities where the treatment of waste is carried out.

Survey regarding Recycling (NACE 37)

The sector Recycling (NACE 37) has been studied in a survey covering both the generation of waste and the recovery and disposal of waste. The sector has been divided into two groups: dismantling of end-of-life vehicles and other recycling.

The group "other recycling" was covered by a questionnaire survey. The survey, in the form of paper questionnaires, covered all local units within the group. Extrapolation of data within the group "other recycling" to the total population was carried out using proportional statistical extrapolation.

When calculating quantities of waste from dismantling of end-of-life-vehicles, a common procedure for all local units within NACE 37 and NACE 51.57 was used, based on waste factors (see below).

The treatment of waste occurring in the industry is considered to be pre-treatment and has therefore not been included in the statistics on recovery and disposal.

Survey regarding Wholesale of waste and scrap (NACE 51.57)

Wholesale of waste and scrap (NACE 51.57) has been studied in a survey covering received waste, preparation for recovery and disposal of waste (sorting) and generation of waste. The treatment of waste occurring in the industry is considered to be pre-treatment and has not been included in the statistics on recovery and disposal.

The sector has been divided into two groups: dismantling of end-of-life vehicles and other.

Data for the group "other" have been collected using a sample survey with paper questionnaires. Extrapolation of data to the total population has been done using proportional statistical extrapolation.

When calculating quantities of waste from dismantling of end-of-life vehicles, a common procedure for all local units within NACE 37 and NACE 51.57 was used, based on waste factors (see below).

Survey regarding Dismantling of end-of-life-vehicles within NACE 37 and NACE 51.57

Calculations have been carried out using waste factors based on data on the number of scrapping certificates taken from industry organisation the Swedish Car Recyclers Association (SBR). Total waste quantities have been obtained using SBR's annual questionnaire, which was used to estimate waste factors per scrapping certificate for each type of waste. The calculated waste factors and data from the Swedish Road Administration on the number of issued scrapping certificates were used to estimate the total quantities of waste within the car dismantling industry for 2004. The dismantling of cars has been classified as a form of pre-treatment and is not included in the statistics on recovered and disposed waste. The total quantity of waste is divided into facilities in NACE 37 and NACE 51.57 according to the proportionality principle.

Survey regarding Sewage and refuse disposal, sanitation and similar activities (NACE 90)

The sector has been covered in three different studies using different procedures:

- 1) Collection and treatment of sewage (NACE 90.01): For this sub-sector, only data on sludge have been produced. Types of waste not reported include screenings and such like, which are considered only to generate relatively small quantities. Data are estimates/expert assessments taken from international reporting from Sweden on emissions from sewage facilities from the slightly over 400 facilities which have a licence to carry out the final treatment of sludge. This sludge originates to some extent also from smaller sewage facilities and individual sewers. Data on sludge is entered as "Generated waste". Liquid water-containing waste that is released into sewers has not been included as disposed waste.
- 2) Collection and treatment of other waste (NACE 90.02): A total population survey has been carried out of waste treatment facilities covering the generation of waste, the recovery and disposal of waste as well as treatment capacities. The survey method was a questionnaire survey with paper questionnaires as the measurement instrument.
- 3) Sanitation, remediation and similar activities (NACE 90.03): A very limited telephone survey on the generation of waste was carried out to a sample of the technical offices at Sweden's municipalities, or equivalent. The results were thereafter adjusted upwards to a national level using population data. Data collected were entered under "Generated waste".

Survey regarding waste generated by households

Waste generated by households has been studied in a separate survey. The survey was based on data from the Swedish Association of Waste Management for "municipal" household waste and from the various producer responsibility enterprises for waste covered by producer responsibility. For every waste flow, an expert assessment was carried out on how much of the waste originated from

households and how much from business activities. No waste treatment is considered to occur (home composting is considered as equal to internal recycling).

Changes since the previous reference year

These statistics, produced for the reporting according to the waste statistics regulation, differ considerably from previous waste statistics in Sweden. The scope and limitations are, in many respects, new.

Expected changes to the 2008 reporting on 2006

The planning in preparation for the 2008 publication and reporting of data was started during 2006. The starting point for this planning was to largely continue with the same methods and level of ambition as for the 2006 reporting. However, there are some necessary adjustments to be carried out with regards to the scope and level of ambition in order to manage the reporting within the cost limitations and statistical quality requirements. Certain changes can be carried out to reduce the costs to society of the statistics production and to raise the level of ambition regarding statistical quality for some sectors/types of waste. Compared to the 2006 reporting, the important waste flows according to the Key Aggregates and those for which there is considerable risk for environmental impact will be prioritised.

A more comprehensive rationalisation regarding inventory methodology is planned before the 2010 reporting.

Part II

Quality attributes

This report on quality attributes includes various different descriptions of the quality of the statistics. Important aspects of the description of quality are the relevance of the statistics, their reliability and accuracy, accessibility and clarity, comparability, coherence and the burden on respondents.

The content of Part II describes the quality of the statistics primarily in relation to these aspects. The descriptions given are general. More detailed descriptions for each sub-survey are given in Appendices 1 – 13.

1 Relevance

Relevance refers here to how the statistics are used on a national level and how complete the produced statistics are (using the requirements in the waste statistics regulation as a starting point).

Statistics on waste generation and recovery and disposal of waste are needed in Sweden for the follow-up and development of environmental policies and action plans.

The work relating to the environment is structured into 16 environmental quality objectives³⁰ that need to be achieved in order to solve the major environmental problems within one generation. Waste flows and waste management have an impact on developments within the objectives for a good built environment, reduced climate impact and a non-toxic environment. A national waste plan has been drawn up³¹ to help achieve these objectives, in which the different objectives and control instruments available within the field of waste are put into context. The impact of the measures that have been taken is discussed and the areas which need to be prioritised in the work in the field of waste over the coming years are highlighted.

The existing waste statistics were considered to be useful for both the follow-up and the development of the action plan in this field, even if the measurement of follow-up and other used of the new statistics need to be developed.

There are many different users of waste statistics - citizens, politicians, municipal, regional and national authorities, central government offices, industry, researchers, etc. This is because development for a sustainable environment is seen as every-one's responsibility. Authorities with responsibility for the follow-up and analysis of measures regarding the waste-related aspects of the environmental quality objectives, such as the National Board of Housing, Building and Planning, the Swedish Environmental Protection Agency, the National Chemicals Inspector-

³⁰ www.miljomal.nu

³¹ Strategy for sustainable waste management. Sweden's waste plan. Swedish Environmental Protection Agency 2005

ate and county administrative boards and municipalities are considered to be more dependent on the statistics.

The datasets are complete. The value zero (0) has been reported in some cases, based on expert assessments that the quantity of waste of a certain category is practically zero. The European Commission's regulation on reporting formats³² states that member states may write "L" (logically impossible) instead of 0 for some waste types to indicate that a certain type of waste can absolutely not occur within a certain industry. Sweden has not classified data as "L" in this reporting as we consider that it has been difficult to truly identify when a type of waste is "logically impossible".

2 Accuracy

Table II.1 presents the key aggregates reported.

Table II.1.1 Key aggregates for generated and treated waste in 2004.

Country: Sweden Reference year: 2004		Total hazardous waste (key aggregate) 000 tonnes	Total non- hazardous waste (key aggregate) 000 tonnes	Coefficient of variation hazardous waste %	Coefficient of variation non- hazardous waste %
Generation of waste					
1	Households	372.617	4 458,730	10	15
2	Enterprises	981.127	113 482,302	6	4
Recovery and disposal of waste					
1	Incineration: use principally as a fuel or other means to generate energy R1	310.802	10 771.750	14	13
2	Incineration: incin- eration on land D10	71.120	0,742	1	8
3	Recovery (exclud- ing energy recov- ery) R2-R11	291.560	17 544,391	13	13
4	Disposal operations Landfilling: D1, D3, D4, D5, D12. Land treatment and release to water D2, D6, D7	494,124	66 412,751	2	2

Appendix 14 shows how uncertainty estimates for these key aggregates have been done.

³² COMMISSION REGULATION (EC) No 782/2005 of 24 May 2005 setting out the format for the transmission of results on waste statistics

In the Key Aggregates, the amounts for each type of waste are included in their normal wet condition. This is also the case for the types of waste Industrial effluent sludges (03.2) and Common sludges (11).

In order to interpret the key aggregates correctly, the following information should be noted:

- 1) Waste generated in some sectors is not included as Sweden has received a derogation for these, as follows:
 - Agriculture, hunting and forestry (NACE A)
 - Fishing (NACE B)
 - Services (NACE G-Q, excl. NACE 37 Recycling and NACE 51.57 Wholesale trade in waste and scrap)

- 2) The largest items of generated waste (wet weight) are
 - mineral waste from mining
 - wood waste from sawmills
 - leachate water from landfill sites.

These three types of waste together account for 70% of the total generated wet weight of waste.

- 3) The quantity of wood waste generated can be overestimated due to a model calculation of wood waste in small local units (less than 10 employees) in the Manufacture of wood and wood products (NACE DD). There are a large number of sawmills with less than 10 employees, and the quantity of generated waste for these has been calculated using waste factors based on quantity of waste per employee in local units with less than 10 employees. However waste treatment data (use of wood waste as fuel) have not been adjusted upwards for these local units. It is likely that a number of facilities have energy production facilities where wood waste is used as an energy source.

- 4) Households produce a relatively large quantity of hazardous waste. Of this quantity, 75% consists of end-of-life vehicles and more than 15% of electrical and electronic waste. Households are the reporting sector that generates the largest quantity of hazardous waste.

- 5) The quantity of incinerated waste includes the usage of wood waste in heating facilities and the use of bark and wood waste as fuel in the paper and pulp industry.

- 6) The quantity of landfilled waste is large because the depositing of mining waste is included. 58 million tonnes, corresponding to 87% of reported waste, is landfilled waste within the sector Mining and quarrying (NACE C), which is in turn completely dominated by mining.

- 7) The reported quantity of recovered and disposed waste is less than the quantity of waste generated. This could be for several reasons:
- Uncertainty in the estimations.
 - Generated waste may include types of waste that have been counted twice. For example, a type of waste can occur within the mining and manufacturing industries (NACE C and NACE D) and then further processed in NACE 37, NACE 51.57 or NACE 90, giving rise to secondary waste, which is also counted as generated waste. The secondary waste is treated by recovery or disposal. Pre-treatment in NACE 37, NACE 51.57 and NACE 90 is not included as waste treatment but can give rise to the generation of secondary waste.
 - The reporting of recovery and disposal of waste covers facilities which require a permit or registration according to articles 9, 10 or 11 in Directive 75/442/EEC. In practice, not all recovery comes under this rule:
 - Secondary raw materials are classified as waste according to the Mayer-Parry ruling from the European Court of Justice (C 444/00) but, before this ruling, were often considered as a commodity instead of waste. This means that it has been difficult to make an inventory of all recycling, as industrial facilities that used secondary raw materials do not normally have a permit nor are registered according to Directive 75/44/EEC. Furthermore, respondents at these facilities do not consider that they are managing waste and have often not noted that they recycle waste in the questionnaire surveys. This applies to waste such as wood waste, metallic waste, mineral waste, etc.
 - Mineral waste, some combustion waste, treated contaminated soil, etc. is used to a large extent as construction materials in construction projects. Much of this usage has been hard to identify.
 - The use of sludge in agriculture has not been reported as a treatment method.
 - Other types of waste treatment not included in the surveys. For example, we have identified the following cases where the inventories are not complete:
 - Waste released into municipal sewers is often not reported. Examples of such waste are purified water from the treatment of oil waste, leachate water from landfills, sludge from the production of drinking water, and such like. Respondents consider this waste to be sewage water rather than actual waste.
 - Leachate water from landfill sites that has been treated biologically or using physico-chemical methods has not always been reported by respondents (disposal D8 and D9). These should actually be reported as release to water but respondents have, in some cases, misunderstood how the treatment of leachate water should be filled in.
 - Dismantling of end-of-life-vehicles has not been included as a treatment method. We have considered the dismantling to be pre-treatment.

- Capacities are in general “in balance” with the treated quantities. In NACE 90, the reported capacity for recovery is considerably higher than the recovered quantities within the sector. This is principally due to some capacity for pretreatment (sorting) being included in the reported capacities (but not in the reported treated quantities). Several facilities have not been able to separate the capacity for processes that are to be reported as recovery from the various sorting and pretreatment processes that should not be reported.

The accuracy of the data on the generation of waste and recovery and disposal of waste is described in detail in the appendices for each sub-survey. The text is structured on the basis of the headings dictated by Eurostat. This has occasionally led to difficulties as the headings are adapted for simple questionnaire surveys and are difficult to apply when several survey methods have been used. All the relevant information has however been included.

2.1 Sampling errors

Sampling errors occur when only a selection of the local units/facilities/enterprises that are included in the group in question is surveyed. Errors depend on how representative the selected population is for the group as a whole.

Different methods for sampling have been used in different sectors. Surveys for several sectors have also been based on total population surveys. Sampling errors occur primarily when extrapolations are carried out of inhomogeneous groups. If the sample group is small, it is easy for extreme values from one responding local unit to result in a considerable adjustment error. This is reflected at the same time in the coefficients of variation. Sample surveys have been carried out for the questionnaire surveys within NACE C, NACE D and NACE 51.57. Sampling errors for generated and treated waste and treatment capacity are described in detail for each NACE group in the appendices.

2.2 Non-sampling errors

2.2.1 COVERAGE ERRORS

2.2.1.1 Coverage errors regarding the population

Coverage errors regarding the population occur when the survey method results in that waste quantities from some local units/facilities are missed in the survey or that these quantities are surveyed in several different sub-surveys. Coverage errors can lead to waste quantities being missed or counted twice.

Coverage errors are described in more detail in Appendices 1 - 13 for generated waste, the recovery and disposal of waste and the capacities for recovery and disposal for each sub-survey.

Different frames have been used in different surveys, i.e.:

- NACE C, NACE D, NACE 37 and NACE 51.57 were based on local units from Statistics Sweden's Business Register.
- NACE E (sector Energy production from incineration) is based on the register of energy enterprises used for the official energy statistics.
- NACE 90 (sector NACE 90.02 Collection and treatment of other waste) is based on the emissions database (EMIR) from the county administrative boards and the Swedish Environmental Protection Agency, which covers facilities with permits for environmentally harmful operations according to the Environmental Code. Facilities with permits for the treatment of waste were selected from this database.

Within many sub-sectors, supplementary sources, such as industry organisations, have also been used.

The use of different frames can, in theory, have resulted in both overcoverage (an object being counted twice in several surveys) and undercoverage (an object being missed by several frames). The different surveys have been checked against each other with the aim of detecting any objects that have appeared in several of the frames. Any cases identified where data have appeared twice have been corrected. We therefore assume that no data have been counted twice.

None of the questionnaire surveys cover the entire reporting sector in question. The questionnaire surveys are instead designed to capture data on the most important waste flows in the sector and then supplementary work has been done to achieve 100% coverage. An example of such supplementary work is as follows:

- Within NACE C and D, a model adjustment has been done for enterprises with less than 10 employees that have not been included in the frame. A supplementary study has also been done in these sectors to collect data on recycling facilities as defined by the Mayer-Parry ruling.
- Within NACE D, some sub-sectors with small quantities of waste have been excluded from the questionnaire survey. For these, waste quantities from a waste survey from 2002 have been used as a basis for expert assessments.
- Within NACE E, separate studies (based on data from enterprises, industry organisations, environmental reports, etc.) have been carried out for the most significant operations that have not been covered by the questionnaire survey.
- Within NACE 90, a special telephone survey to a limited number of municipalities was carried out for Sanitation (NACE 90.03). In addition, data were used from previous international reporting (according to the sludge directive) for the Collection and treatment of sewage (NACE 90.01).

2.2.1.2 Coverage errors regarding waste quantities

In the surveys, we have studied the generation of waste from households and all sectors apart from Agriculture, hunting and forestry (NACE A), Fishing (NACE B) and NACE G-Q (excl. 90 and 5157) Services.

We have attempted to apply a broad interpretation of the definition of waste. Some difficulties affecting data collection have been due to the fact that respondents have in practice not fully applied the official definition. This concerns for example:

- a. By-products. The line between a by-product and waste is sometimes hard to define. The ruling in the Saetti & Frediani case (C-235/02) states that a by-product does not need to be classified as waste if it occurs after a concrete process choice, see the discussion above in Part I, Scope and limitations. For example, the following "by-products" (occurring in large quantities) have been classified as waste:
 - Wood waste from sawmills. This is sold to heating plants or the pulp industry.
 - Metal waste (scrap) from the metal industry. This is sold to the scrap industry (normally in NACE 37 or 51.57) which then sells it on to metal-works (NACE 28).
 - Excavated material. The majority of excavated material dug-up during construction or foundation projects is reused in other construction projects. Data on these types of waste are marred by uncertainty as many respondents have not noted these as waste. We have estimated these waste quantities using an extrapolation process, see Appendix 2 (for wood and metal waste) and Appendix 4 (excavated material).
- b. Liquid water-containing waste that is released into sewers. In practice, some liquid waste that is released into sewers is considered to be sewage water, not waste. Examples of such waste are:
 - Leachate water from landfill sites
 - Water-containing liquid waste from wet flue gas cleaning and other water-containing liquid combustion wastes
 - Water-containing liquid waste from oil regeneration.All these waste types are classified as 03.2 Industrial effluent sludges according to EWC-Stat. For leachate water, we have recontacted respondents to obtain supplementary data – however, not all responded despite several reminders. The two other waste types have been included when we have received data but incomplete data have been received from many respondents.

2.2.1.3 Coverage of recovery and disposal

We have applied the following interpretations and limitations regarding recovery and disposal:

1. Incineration: use principally as a fuel (R1)

The incineration of waste in Sweden is, in general, classified as a recovery operation: R1 Use as fuel. Facilities carrying out waste incineration are integrated in the district heating system and, to a certain extent, also the electricity production system. Facilities are designed to produce district heating and electricity. In most cases, the facilities are also run by private or municipal energy companies and not by waste management companies. This applies also to facilities that incinerate household and similar wastes. In Sweden, these constitute base production units in the district heating network to which they provide heating.

Wood by-products and waste from the wood products industry (NACE 20) is a significant energy source of district heating production in Sweden. Wood by-products and waste from the wood products industry (NACE DD) and the pulp and paper industry (NACE DE) are also used for the production of energy for industrial use (i.e. steam and electricity). We have interpreted wood by-products as waste, and the usage of this for energy production constitutes waste incineration (classified as R1). This has the consequence that Sweden reports a relatively large quantity of wood waste for incineration and a very high total incineration capacity.

2. Incineration: incineration on land (D10)

One facility in NACE 90 that incinerates hazardous waste has been classified as D10 Incineration on land. Even if this facility produces electricity and district heating, we have assumed that it was designed and is operated primarily with a view to disposing of waste and, only in second place, for producing energy (with the interpretation of R1 given in the new proposal for a framework directive, the facility will likely be classified in the future as R1 Use as fuel).

3. Recovery, excluding energy recovery (R2 – R11)

The Mayer-Parry ruling (European Court of Justice C-444/00) has led to some difficulties when carrying out the surveys. When the surveys were planned, we began with the assumption that the court's interpretation of "when waste ceases to be waste" and of "recycling" would not apply. We made this assumption partly due to the fact that these issues were being discussed in the Commission's work with a thematic strategy for the prevention and recycling of waste. The thematic strategy resulted, among other things, in a proposal for a new framework directive (COM (2005) 667 final), which deviates from the interpretation in the Mayer-Parry ruling. However, after a proposal for guidelines were produced by Eurostat, it was stated that the Mayer-Parry interpretation would apply to reporting according to the waste statistics regulation and we have adapted to this. This has meant that

- Material recycling occurs mainly in the manufacturing industry (NACE D).
- For waste treatment facilities within NACE 90 and industrial landfill sites within NACE C and D, the use of by-products for covering waste landfills and/or as construction material has been classified as recovery, because the waste in these cases replaces other material.

- Anaerobic digestion and composting primarily within NACE 90 and NACE D has been classified as recovery.
- Within other industries, different processes occur (sorting, grinding, other processing) that can lead to recycling, but these have been classified as pre-treatment that is not covered by the reporting.

4. Landfilling (D1, D3, D4, D6, D12)

All landfill sites with permits are included in the survey. Landfilling also applies to intermediate storage before disposal for a period of more than one year or intermediate storage before recovery for a period of more than three years. Waste from mining is covered in the survey on NACE C. Some of the waste from mining is used in various ways to restore the mining pits (terracing, landscaping and such like). We have classified this as Depositing D1.

5. Other disposal (D2, D6, D7)

Other disposal refers to Release to water (D6 and D7) and Land treatment (D2). According to the waste statistics regulation, disposal operations D8 (Biological treatments) and D9 (Physico-chemical treatments) are not reported as these are considered to be pre-treatment and, in the majority of cases, lead to disposal via Release to water (D6 or D7) or Land treatment (D2). In the questionnaire surveys, we have not asked about biological or physico-chemical treatments. Consequently, some respondents may have omitted to fill in data from release or land treatments. This applies to leachate water from landfill sites, for example, or water from the treatment of oil waste, sludge from purification of tap water, flue gas condensate from combustion and incineration, etc. In a few cases, we have detected that landfill sites have reported generated leachate water but have not noted any treatment or release. We do not know therefore whether this leachate water has been released after purification or released into the municipal sewers. There is therefore a shortfall for leachate water in the reporting on release or treatment. Energy facilities have often not noted flue gas condensate either as generated waste or as disposed via release to water.

2.2.1.4 Household waste

Household and similar wastes (i.e. EWC-Stat code 10.1) can arise within all operations. Household waste is included in the questionnaire surveys as a surveyed type of waste. In some of the surveys, the quantity of household waste has been estimated to 100 kg /employee and year, using measurements taken in other sectors. In practice, sorted household waste (from business operations) can also have been classified as EWC-Stat 10.2 Mixed and undifferentiated materials (such as pre-sorted combustible waste or pre-sorted landfill residue). In the sub-project covering waste from households (see Appendix 12), it has been estimated how much of the household waste originates from business operations and how much from households. The results have shown that, in total, close to 2.4 million tonnes of household and similar wastes (EWC-Stat 10.1) are generated, of which 95% is generated by households. In practice, household waste is also generated by business opera-

tions mixed in with other industrial waste, often called sorted combustible waste. This is included in the item EWC-Stat 10.2 Mixed and undifferentiated materials.

2.2.1.5 Problems encountered by respondents when filling in data - definitions, questionnaire design, etc.

All the questionnaire surveys have requested the EWC-Stat classification of the generated waste. These codes (number and description) were pre-printed in different rows in the tables in the survey questionnaires. Two conversion keys are available on our website in pdf format to convert the usual codes according to Annex 2 of the Swedish waste ordinance to EWC-Stat and vice versa. Respondents were also able to contact us directly with questions on classification.

We have come across the following common problems when collecting data:

- 1) Coding of certain hazardous waste has been unclear and confused, e.g. the difference between Spent solvents (EWC-Stat 01.1), Chemical preparation wastes (EWC-Stat 02) and Chemical deposits and residues (EWC-Stat 03.1);
- 2) Waste containing oil can be classified under different codes according to EWC-Stat. There is for example oil-containing waste within 01.3 Used oils, 03.1 Chemical deposits and residues, 03.2 Industrial effluent sludges and 08 Discarded equipment.
- 3) There has often been confusion between the three EWC-Stat codes Household and similar waste (EWC-Stat 10.1), Mixed and undifferentiated materials (EWC-Stat 10.2) and, occasionally and Sorting residues (EWC-Stat 10.3).
- 4) The different types of sludges can also sometimes be difficult to define. Industrial effluent sludges (EWC-Stat 03.2) can have been coded as Common sludges (EWC-Stat 11) or vice versa.
- 5) Several respondents have noted that they have generated Hazardous metallic wastes (EWC-Stat 06). The majority of these have actually produced other types of waste, such as non-hazardous metallic wastes (EWC-Stat 06) or hazardous chemical preparation wastes (EWC-Stat 02), such as metal packaging contaminated with oil.
- 6) Some have wrongly interpreted the waste type Combustion wastes (EWC-Stat 12.4) as waste for incineration, when it should be reported as Mixed and undifferentiated materials (EWC-Stat 10.2).
- 7) Many have reported in the questionnaires that they treat waste when they actually send their waste away. This is because it is also required in the environmental reports (to the county council or municipality) to include the treatment of waste which is sent away. We have corrected this but it is possible that interpretation errors have been made in some cases.

These problems have been corrected when they have been detected.

2.2.2 MEASUREMENT ERRORS

Measurement errors can occur when incorrect data are received from respondents and are not corrected during checking. Furthermore, estimated values have been permitted in the surveys. This can affect the precision of the quantities given.

Quantities have been requested in the unit ton in the questionnaires. It is however relatively common that respondents have submitted other quantity units. If a different quantity measure (kg or 1000 tonnes) has been given, we have simply recalculated to tonnes. If other units have been reported, we have used conversion tables where these are available. The Swedish Association of Waste Management has designed such a table. In some cases, conversion factors have been taken from data provided by respondents and other subject experts. Some of the conversion factors are not particularly controversial, such as ton per m³ of oil, while problems have occurred when the waste has been mixed, for example, or when we do not know whether the waste has been compressed. The same conversion factors have been used in all sub-surveys for similar wastes.

The questionnaires in the questionnaire surveys have been tested in three ways:

- A survey regarding industrial waste was carried out for the reference year 2002. This survey provided valuable experience for the development of the current survey.
- For waste treatment facilities, a pilot study was carried out during 2004.
- All questionnaires and covering letters have been approved by the Board of Swedish Industry and Commerce for Better Regulation and the Swedish Association of Local Authorities and Regions after a consultation process.

The questionnaires were given a uniform design, with only slight variations to match the different types of operations. This was primarily because the surveys were to be carried out for the first time for WStatR reporting and so that the respondents would learn to recognise the questionnaire if they received several for different local units in different sectors. The pilot survey on treatment was considered to have worked well and was therefore used as a basis for the questionnaire design. Identical questionnaires were used for the surveys on NACE C+D, regardless of which sub-sector they referred to.

This standardisation of the questionnaire design can have led to the respondents finding it difficult to understand what should be filled in and where in the questionnaire their data should be reported. For example, a table was included for the mining and manufacturing industries (NACE C + D) for data on treated waste if the treatment took place at the local unit in question. In practice, few local units treat waste themselves but, because the table was provided, many filled in data on the treatment of waste - but on how it is treated externally rather than internally.

In cases where material recycling is carried out at the facility where the waste was generated, neither the generation nor the recycling of these quantities should be reported. This has led to great problems for respondents and those checking, with the result that undetected errors can have occurred.

So that the respondents understand what should be filled in, a reference is made in the table section of the questionnaire to the back of the questionnaire where information and definitions are provided. Some of this information is also in the covering letter. Unfortunately there is not room to provide these definitions directly in the tables where the data are to be written. Experiences from other surveys show that there is consequently a great risk that many of the respondents do not read this information, which can lead to incorrect or doubtful data that can be hard to detect when checking.

Another important source of error can be mistakes in the responses we have received. Incorrect responses can be due to carelessness or misunderstanding of the respondents. When checking and editing the questionnaires, we have carried out a rationality test: is the type of waste reasonable for the industry, is the size order reasonable, is there some other type of waste not given that should arise in the industry, etc. In several cases, we have detected and edited relatively large errors in the submitted responses. There can however still be incorrect responses that we have not detected. It is hard to quantify these errors as we have made a lot of effort to eliminate them.

2.2.3 PROCESSING ERRORS

Processing errors occur when the raw data are processed in various ways during the data production. The following processing errors can occur:

Checking errors. In questionnaire surveys, all the submitted questionnaires are checked and corrected. When larger possible errors are detected in the questionnaires, contact is made with the data provider. Lesser errors are corrected and some imputations (of household waste, for example) are carried out. A processing error can occur when the person checking the questionnaire misunderstands the responses and makes an incorrect amendment. Checking errors can result in incorrectly coded waste or an incorrect quantity for a specific type of waste.

Input errors. The questionnaires are checked in paper format and are then input into a database manually. When inputting, the "right figure" can be input in the "wrong place", or a mistake can be made with the input (e.g. one digit too few or too many). Input errors can also occur when the results from other survey methods are input into the database.

Adjustment errors. A significant processing error can occur when carrying out extrapolation, in particular with questionnaire surveys. Extrapolation is carried out principally for the adjustment of inhomogeneous groups. If the sample group is small, it is easy for extreme values from one responding local unit to result in a considerable adjustment error. This is reflected at the same time in the coefficients of variation. Sampling errors for waste generation and recovery and disposal of waste and treatment capacities are described in the appendices for each sector in detail.

We have attempted to avoid the above-mentioned processing errors by regularly checking the results. The project group has checked the results several times (indi-

vidual types of waste in every reporting sector or sub-survey) in order to identify extraordinary values. Industry experts, both within SMED and within the Swedish Environmental Protection Agency, have also carried out checking, assessing the rationality of the produced data. The results for some sectors (NACE DE and NACE DJ) have also been reviewed by some industry organisations.

2.2.4 NON-RESPONSE ERROR

Non-response adjustments are normally carried out in questionnaire surveys. This applies for both generated waste and recovered and disposed waste. Non-response adjustments are different in the different sectors, depending on whether the non-response can be assumed to be representative of the whole population. Non-response errors for waste generation and recovery and disposal of waste and for treatment capacities are described for each of the surveyed sectors in detail in the appendices.

3 Timeliness

A general time schedule for the reporting according to the EU waste statistics regulation is shown in Table II3.1.

Table II3.1. Time schedule for reporting waste statistics

Activity	Beginning	Completed
Methodology development	15-09-2003	30-11-2004
Survey planning	01-11-2004	28-02-2005
Surveys and compilation of data for reporting	01-03-2005	31-03-2006
Questionnaire surveys		
Sending of questionnaires	01-03-2005	15-05-2005
Registration and checking, imputation	01-03-2005	31-12-2005
Reminders	01-05-2005	30-09-2005
Adjustments	01-08-2005	31-12-2005
Other surveys	01-08-2005	31-01-2006
Compilation of statistics	31-01-2006	15-03-2006
Drafting of Quality Report	01-12-2005	15-03-2006
Final checking of statistics and documentation	01-02-2006	31-03-2006
Follow-up of statistical production, report	01-04-2006	01-05-2006
National independent controls	01-04-2006	20-06-2006
Drafting of national statistical report	01-04-2006	30-08-2006
Supplementary work, follow-up, archiving	01-04-2006	30-09-2006
Delivery of statistics and quality report to Eurostat		30-06-2006
National publication of statistical report		30-09-2006

4 Accessibility and clarity

Statistics on waste generation and recovery and disposal of waste are planned to be published on the website of the Swedish Environmental Protection Agency³³ at the end of June 2006. It is planned that a statistical report will also be published in September 2006. The design of the Internet reporting and statistical report is to be developed during spring/summer 2006.

It is thought that this quality report will be a resource for more advanced statistical users in order to increase clarity regarding methods and checking procedures, for example. With the aim of increasing the clarity for other users of statistics, a brief analysis and comments are planned to be published together with the statistics in a statistical report and Internet publication.

The statistics are covered by statistical confidentiality, according to the Official Statistics Act and the Secrecy Act. Because the format for the statistics on generated and treated waste quantities is new for this year, the routines for disclosure have been reviewed before publication and reporting to Eurostat. The disclosure control has shown that not all the results can be published, such as certain types of waste for certain industry sectors, because in several cases, the waste quantities or treatment within one particular company can be identified from the results. Such results cannot be published according to the confidentiality regulations. This can be changed for the 2008 reporting, when a new exception will be added regarding statistical confidentiality.

5 Comparability

5.1 Comparability with other member states and between sectors

The regulatory framework and guidelines from Eurostat have been followed as far as possible. When there have been difficulties regarding interpretation, contact has been made with Eurostat to ensure that the guidelines have been interpreted correctly. All surveys have been carried out to achieve 100% coverage of waste quantities. This should guarantee that the statistics are comparable with corresponding statistics from other member states. However, the following areas should be high-lighted as somewhat problematic concerning comparability:

- Different frames have been used for different sectors (see section 2.2.1 and appendices for the different surveys):
- The concept household waste contains, apart from waste from households, both in practice and legally, similar waste from shops, offices and other operations. The majority of waste flows, such as bag and dustbin waste, packaging waste, electronic scrap, etc. contain both waste from households and waste from different operations. For every waste flow included in household waste (according to EWC-Stat), an assessment has

³³ www.naturvardsverket.se

been made by industry experts of how much originates from households and how much from other operations. See Appendix 12.

Resources and efforts have consciously been evenly distributed to ensure that, as far as possible, the same care has been taken with all the sub-surveys. Some industries have, for natural reasons, been harder to survey than others, resulting in some differences in the precision of the final results.

For details of the level of coverage for individual industries, see Chapter 2 in the relevant appendix.

5.2 Regional comparability of waste treatment

VALIDATION OF DATA REGARDING WASTE TREATMENT

Data on waste treatment facilities have as far as possible been checked against other administrative data (i.e. EMIR which is a register of facilities with permits for environmentally harmful activities according to the Environmental Code). Compiled results have also been quality controlled by independent experts.

STATISTICAL UNITS

The objects have been different in different sub-surveys. Those used include local unit, facility, enterprise and industry. See also the earlier section on Comparability and Appendices 1-13.

MOBILE WASTE TREATMENT

For the generation of waste and the recovery and disposal of waste, mobile equipment has been reported where it has been used. Capacity data have however been reported in the equipment's home town. We have only found very few mobile operations in the survey, so the location of the facility is not considered to have any determining significance on the total reported quantities of waste or treatment capacities.

5.3 Comparability over time

Several waste surveys have been carried out previously in Sweden. The current survey (WStatR 2006) is, as a rule, not comparable with these earlier surveys. We have however used earlier surveys for validation when relevant.

Sweden has previously carried out a survey on generated and treated waste within the mining and manufacturing industries (NACE C and D) regarding 2002 (similar surveys have also been done in 1998 and 1993). The aim with these surveys was to provide a basis for reporting according to OECD/Eurostat Joint Questionnaire. Some data, such as the total quantities of waste and of hazardous waste, for different sub-sectors are expected to be comparable with the current survey.

Results from the next survey (which will be reported in 2008 and refers to generation of waste and waste treatment during 2006) will be able to be compared with

this year's survey. The results so far have shown that there are relatively large uncertainties associated with the results produced. This means that even if the results are comparable, it can be difficult to interpret the differences. The differences can, in some cases, reflect statistical uncertainties and, in other cases, be due to actual changes.

Changes in the interpretation of the definitions of waste and the concept of recovery (which have been discussed within the EU's thematic strategy on the prevention and recycling of waste, and also brought up in the Commission's proposal for a new framework directive) can mean that this year's results will not be comparable with the next survey to be reported in 2008.

6 Coherence

The Swedish official statistics on generated and treated waste quantities are planned to be based on the same statistical information (same surveys, scope and limitations of statistics) as the statistics that are to be reported to Eurostat.

7 Burden on respondents

The work to develop and produce these statistics has been underway since 2003. As mentioned previously, several different parties have been involved. This has resulted in costs in terms of time and/or money for respondents, the Swedish authorities and Eurostat. The total costs for the work carried out in Sweden are estimated to be around 24.5 million SEK or 2.7 million Euro. Table II7.1 shows the costs for the various parties involved.

Table II7.1. Total costs 2003-2006 for reporting according to the waste statistics regulation 2006 (WStatR 2006)

	Hours	SEK	Euro
Total costs to society	Ca 27 500	24 502 000	2 722 000
Eurostat, costs for pilot studies	Ca 1 300	1 253 000	139 000
<i>Of which work to contractors in Sweden</i>	Ca 1300	1 253 000	139 000
Costs to Swedish government	Ca 22 300	20 542 000	2 282 000
<i>Of which work to contractors</i>	Ca 16 500	16 516 000	1 835 000
<i>Of which work carried out at the Swedish Environmental Protection Agency</i>	5 800	4 026 000	447 000
Other costs to society in Sweden	3 900	2 707 000	301 000
<i>Of which efforts by respondents with questionnaires</i>	3 300	2 293 000	255 000
<i>Of which other efforts by respondents</i>	600	414 000	46 000

Efforts by respondents for responding to the questionnaires are based on results from a pilot study of treatment facilities carried out during 2004. This study tested

a questionnaire form for generated and treated waste similar to that which has now been used in the survey on NACE 90.02 (Treatment facilities). Respondents were requested to respond on how they experienced the questionnaire, the time it took them to fill in the questionnaire, etc. A weighted mean value gave a time of about 1.6 hours for every completed questionnaire. The questionnaires sent out in the current survey were simpler and we judge that 1.6 hours would be a slight overestimation of the burden on respondents. We have therefore chosen to estimate the burden on respondents to be 1.5 hours per completed questionnaire. Around 2 200 completed questionnaires then give a burden of 3 300 hours for submitted questionnaires.

The workload for Swedish Environmental Protection Agency and other work efforts by respondents have been estimated using expert assessments.

Work to contractors cannot be estimated in hours. The value reported is equal to the amounts paid by the Swedish Environmental Protection Agency and Eurostat for project work for reporting according to the waste statistics regulation during the period 2003-2006. It is reasonable to assume that these costs will fall for the 2008 reporting when the workload relating to pilot studies etc. will not be necessary to the same extent in the future.

We have used the currency exchange rate of 9 SEK/Euro. Furthermore, a charge of 700 SEK (ca. 80 Euro) per hour has been assumed for the work carried out by respondents and the Swedish Environmental Protection Agency.

Definitions, units and abbreviations

Accessibility and clarity	<p>A <i>quality attribute</i> used to describe the quality of the statistics produced. Accessibility and clarity refer to how the results are published in the country, various planned improvements and how confidentiality issues are managed.</p>
Accuracy	<p>A <i>quality attribute</i> used to describe the quality of the statistics produced. When describing accuracy, descriptions are included of sampling procedures, coverage errors, measurement errors, processing errors, non-response errors, model assumption errors, etc.</p>
Burden on respondents	<p>A <i>quality attribute</i> used to describe the quality of the statistics produced.</p>
Coherence	<p>A <i>quality attribute</i> used to describe the quality of the statistics produced. Coherence refers to how statistics can be used in a Swedish context.</p>
Comparability	<p>A <i>quality attribute</i> used to describe the quality of the statistics produced. A description of comparability consists primarily of how the produced statistics can be compared with other statistics.</p>
D-code	<p>Code for <i>disposal</i> operations as outlined in Annex IIA in Directive 75/442/EEC or in Annex 5 of the Swedish Waste Ordinance 2001:1063. See also <i>Disposal</i>.</p>
Disclosure control	<p>A disclosure control is carried out for a produced dataset to analyse whether it is possible from the dataset to directly or indirectly disclose the situation for an individual enterprise. If it is possible from the results to identify the information on an individual enterprise or facility, the data in question must be made confidential. Data are made confidential for the following reasons:</p> <ul style="list-style-type: none">- when there are only a few enterprises in the population (only 1 or 2)- when one enterprise is dominant (not too few enterprises but with one enterprise having more than X% of the value of the sector)- two enterprises dominating (not too few enterprises but with two enterprises together having more than Y% of the value of the sector)- confidentiality is not required in itself but the value must be confidential to prevent another confidential value being indirectly disclosed <p>Data which are confidential are marked (flagged) as confidential when reporting to the EU. Confidential data are not published by themselves but are combined with other data (i.e. different types of waste are combined).</p>
Disposal (of waste)	<p><i>Waste treatment</i> which includes the processes given in the list of disposal operations in Annex IIA in Directive 75/442/EEC or in Annex 5 of the Swedish Waste Ordinance 2001:1063</p>
EMIR	<p>Register and emissions database of facilities with a permit for environmentally harmful operations according to the Environmental Code.</p>
Eurostat	<p>The authority within the EU responsible for EU's waste statistics. Data are delivered to Eurostat according to the waste statistics regulation.</p>

EWC-Stat	A specific waste classification used when reporting according to the EU's waste statistics regulation. EWC-Stat consists of 48 types of waste that are primarily materials-based. EWC-Stat is based on combinations of different types of waste from the usual list of waste (Appendix 2 of the Swedish Waste Ordinance 2001:1063)
FDB	Statistics Sweden's Business Register
Generation of waste	Waste produced
IVL	Swedish Environmental Research Institute, see further under <i>SMED</i>
List of waste	In Annex 2 of the Waste Ordinance (2001:1063), there is a list of the different types of waste. This is usually used to classify different waste in various circumstances. This list has previously been called EWC (European Waste Catalogue)
LoW	See <i>List of Waste</i> . The same as the list of waste in Annex 2 of the Swedish Waste Ordinance 2001:1063 and the European Commission's decision 2000/532/EC
MR	Environmental reports (<i>Miljörapporter</i>)
NACE	NACE stands for the "Nomenclature Générale des Activités Economiques dans les Communautés Européennes" and is a classification of activities used within the EU, which corresponds to the Swedish SNI classification (SNI stands for <i>Svensk Näringslivsindelning</i>). The version of NACE referred to in the waste statistics regulation is NACE Rev 1. The most recent version of the SNI is SNI 2002.
Quality attributes	According to a European Commission regulation (No 1445/2005), a quality report for the reporting according to the waste statistics regulation should contain a description of the quality of the produced statistics. According to the regulation, there are seven different quality attributes to be described: <i>Relevance, Accuracy, Timeliness, Accessibility and clarity, Comparability, Coherence</i> and <i>Burden on respondents</i> (see these definitions)
R-code	Code for <i>recovery</i> operations in Annex IIB in Directive 75/442/EEC or in Appendix 4 of the Swedish Waste Ordinance 2001:1063. See also <i>Recovery</i>
Recovery (of waste)	Waste treatment covering the processes given in Appendix IIB in Directive 75/442/EEC or in Appendix 4 of the Swedish Waste Ordinance 2001:1063
Relevance	A <i>quality attribute</i> used to describe the quality of the statistics produced. Relevance relates to a description of how the statistics are used on a national level and the completeness of the data produced.
Sample survey	Statistical method based on studying a selection of the different subsets instead of the entire population. In a sample survey, the population (in this case, an entire sector) is first divided up into different sub-populations (strata). We have divided up into sub-populations based on number of employees. Within every stratum, a random sample of local units is then selected. When compiling the results, a proportional extrapolation is then carried out within each stratum.

SBR	Swedish Car Recyclers Association
SCB	Statistics Sweden, see further under SMED
SMED	<i>Swedish Methodology for Environmental Data (Svenska Miljöemissionsdata)</i> , a consortium consisting of IVL Swedish Environmental Research Institute, Statistics Sweden, the Swedish University of Agricultural Sciences (SLU) and the Swedish Meteorological and Hydrological Institute (SMHI).
Strata / stratum	A sub-population when using sample surveys. See further under <i>Sample survey</i>
Swedish Association of Waste Management	See http://www.rvf.se
Timeliness	A <i>quality attribute</i> used to describe the quality of the statistics produced. Timeliness comprises primarily of a description of the important moments for data production and reporting.
Treatment (of waste)	<i>Recovery and disposal</i> (see these definitions)
Waste treatment	<i>Recovery and disposal</i> (see these definitions)
WStatR	Waste Statistics Regulation - EU Regulation 2150/2002 on waste statistics

Appendix 1

Agriculture, hunting and forestry (NACE A) and Fishing (NACE B)

The regulation on waste statistics offered the possibility to apply for derogation of the reporting of NACE A and B for the first report. Sweden has applied for and been granted a derogation for these sectors with regards to the generation of waste. For the recovery and disposal of waste, a derogation has not been applied for and the recovery and disposal that has occurred should therefore be reported. When reporting data on the recovery and disposal of waste, it is not necessary to outline the recovery and disposal within the individual NACE sectors. However, the work in Sweden has been organised in such a way that we have compiled data on the generation and recovery and disposal of waste sector by sector (apart from sectors for which Sweden has a derogation).

The objective of the sub-survey was to map out to what extent waste management within Agriculture, hunting and forestry (NACE A) and Fishing (NACE B) was to be reported.

A number of pilot studies on waste and waste management within Agriculture, hunting and forestry (NACE A) and Fishing (NACE B) have been carried out by several member states with financing from Eurostat, including a study in Sweden. The pilot studies³⁴ identified different types of waste management within the two sectors. The type of waste managed in the agricultural sector includes primarily all fertiliser from agriculture and sludge from sewage facilities and, to an increasing extent, compost from the composting of household waste and biofertiliser (residues from anaerobic digestion) from biogas facilities. Within forestry, ash is recycled as revitalising fertiliser.

One fundamental question has been which types of waste treatments within the two sectors should be reported according to the waste statistics regulation. According to regulation, the following applies:

- Article 2(f) of the regulation on waste statistics defines the following: "recovery or disposal facility shall mean a facility that requires a permit or registration pursuant to articles 9, 10 or 11 of Directive 75/442/EC "
- Annex II, section 1, in the regulation states: "The statistics are to be compiled for all recovery and disposal facilities which run any of the operations referred to in Section 8(2) in Annex II³⁵ and which belong to or are part of the economic activities according to the groupings of NACE Rev. 1, mentioned in Annex I, Section 8 (1.1)³⁶".

³⁴ REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the progress of the pilot studies referred to in Article 4(3) and Article 5(1) of Regulation (EC) No 2150/2002 of the European Parliament and of the Council of 25 November 2002 on waste statistics

³⁵ Section 8(2) specifies a list of recovery and disposal operations; the codes refer to the codes in Annexes II.A and II.B to Directive 75/442/EC. This list includes 20 of the 28 recovery and disposal operations that are named in the annex

³⁶ Annex I, Section 8. (1 and 1.1) states that "the results for the characteristics listed in section 3(1) are to be compiled for the following sections, divisions, groups and classes of NACE Rev. 1"

We have interpreted Article 2(f) so that "a facility that requires a permit or registration" in Sweden refers to facilities requiring a permit according to the Environmental Code and therefore have an activity code (primary, secondary, tertiary, etc.) that relates to some form of waste treatment. The Swedish ordinance on environmentally harmful activities and environmental protection (1998:899) lists the different activities that require a permit. When studying the ordinance more closely, it can be seen that:

- Facilities that require a permit according to the Environmental Code from an environmental tribunal or the county administrative board comprise primarily of different types of recycling, incineration, landfilling, composting, anaerobic fermentation, etc.
- Certain facilities have an obligation to report regularly to the municipality, primarily intermediate storage facilities, sorting facilities, dismantling facilities (in principal, treatment prior to recovery or disposal). These facilities comprise mainly of R and D codes (recovery and disposal procedures according to Annex II.A and II.B in the framework directive 75/442/EC) that do not need to be reported according to the waste statistics regulation.

Our interpretation of this is that the waste treatment within NACE A and B (agriculture, forestry and fishing) to be discussed concerns facilities that are economically classified in these sectors. However, our opinion is that such facilities do not exist within NACE A and B. Furthermore, in the survey of NACE 90 (treatment facilities etc.), we have included all facilities with permits, regardless of in which economic sector they are classified (we have checked that they have not been included in any of the sub-surveys).

We have also used the interpretation that the agricultural sector's usage (i.e. spreading on fields) of sludge, compost and biofertiliser should not be reported as treatment, as this is not carried out at a facility for which "a permit or registration" is required.

The Commission's report to the Parliament on the pilot studies³⁷ expresses doubts as to what treatment within the agricultural sector should be given:

- *"...Another essential aspect is the treatment of waste within the agricultural sector and the extent to which this is included in the waste statistics."*

³⁷ See the first footnote in this Appendix.

Appendix 2

Mining and quarrying (NACE C) and Manufacturing (NACE D)

The numbering of the sub-headings in this appendix refers to the corresponding sub-headings in Part II Quality attributes. We have here included those sections/sub-headings from Part II that are significant for the sub-survey in question. Otherwise, the information already described in Part II is applicable.

1 Sources

The survey on waste in the sectors Mining and quarrying (NACE C) and Manufacturing (NACE D) covers 11 different reporting items on the generation of waste according to the waste statistics regulation, see the table below:

Reporting item	NACE/SNI letter code	NACE/SNI digit code	Description
3	C	10-14	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, man-made fibres + 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 + Manufacture of electrical and optical equipment + Manufacture of transport equipment
13	DN excl. 37	36	Manufacturing n.e.c.

The survey also covered the recovery and disposal of waste within these sectors.

The data source for NACE C+D was an optional sample survey with paper questionnaires. The frame consists of Statistics Sweden's Business Register and the object is local unit primarily coded under NACE 10-36.

Different models have been applied for adjusting the total waste quantities both for the sample and non-response, and for calculations of waste quantities from the smallest local units that were not included in the survey population. This is to achieve 100% coverage of waste quantities.

The administrative sources used to compensate for the missing data have in the first place consisted of environmental reports, sent in by local units instead of or together with the questionnaire.

In order to be able to report more complete statistics, contacts have been made with several industry organisations. The aim is to obtain data on how much secondary raw materials of different important materials are used in connection with the production of new products, i.e. when waste has ceased to be waste and has instead been converted into a new product.

2 Accuracy of data

The source of error affecting the results to the greatest extent can probably be linked to non-response and sampling. Many large important local units have not submitted data despite being repeatedly reminded. Sample surveys can give a skewed sample, with too great adjustments of extreme values.

2.1 Sampling errors

The population of all 11 sectors consists of nearly 60 000 local units. The frame for the questionnaire survey covers, with a few exceptions, all local units with at least 10 employees and consists of a total of around 7 300 local units. A stratified sample of 2 000 local units was drawn from this frame in December 2004.

2.2 Non-sampling errors

2.2.1 COVERAGE ERRORS

The method used to achieve 100% coverage of waste generation consists of three parts:

- a total population survey of one of the industries: Extraction of metal ores (NACE 13);
- a sample survey for some of the industries: Mining of coal and extraction of peat (NACE 10), Other mining and quarrying (NACE 14) and Manufacture of coke, refined petroleum products and nuclear fuel (NACE 23) without cut-off limits, i.e. all local units down to 0 employees are included in the population. Adjustments are then carried out to obtain total waste quantities for each industry;
- sample surveys for the remaining industries with different cut-off limits, such as 10 and 20 employees. Calculation methods were then used for populations under the cut-off limits using the factor “waste quantity generated per employee” taken from the local units over the various

limits that were surveyed. This factor has been calculated for the total waste quantity generated for each NACE industry on a 2-digit level and has thereafter been used to calculate all waste types according to EWC-Stat within the different NACE sectors. The different NACE industries have then been divided into the various reporting groups, e.g. Manufacture of basic metals and fabricated metal products (NACE DJ or 27 + 28). The additional values from the smaller industries have generally been very small, with the exception of Manufacture of wood and wood products (NACE 20) and Manufacture of fabricated metal products, except machinery and equipment (NACE 28), in which there are many local units with 0-9 employees. Manufacture of wood and wood products (NACE 20), which is in reporting group (DD), has large quantities of wood waste per employee so the additional values from smaller industries will be very large. The values for Manufacture of fabricated metal products, except machinery and equipment (NACE 28) can however be combined with Manufacture of basic metals (NACE 27), which completely dominates the waste quantities, both hazardous and non-hazardous.

The questionnaire survey has not been adapted for the interpretation of the concepts of waste and recycling, according to the Mayer-Parry ruling (European Court of Justice C-444/00), i.e. that waste does not cease to be waste until it has been incorporated into a new product. When the survey was planned, it was assumed that recycling would be defined as the production of secondary raw materials that can be used as raw materials in a manufacturing process. The manual from Eurostat stated later that the Mayer-Parry ruling would be applicable for the reporting to the EU according to the waste statistics regulation. To meet these requirements, we would need to ask for data in the questionnaire on the quantity of secondary raw materials used by the local unit for the production of goods of different materials. Our experience from earlier surveys shows that the manufacturing facilities do not consider themselves to be recycling when they use secondary raw materials. It would therefore almost certainly have been confusing and problematic for many of the respondents that the local unit should be counted as a recycling facility in the reporting. In order to collect data on recycling, we have instead chosen to make contact with a number of industry organisations to obtain data on how much secondary raw materials have been used for production of goods of different materials, i.e. to obtain data on the recovery of various materials in different manufacturing industries. The materials for which we received recycling data in this way were waste paper, wood shavings and chippings, recyclable glass, scrap steel and scrap plastic. These often very high values can contain considerable errors, when the industry organisation in question has only reported data from its members and some “recyclers” are not members.

A description of how household waste is confused with general waste from shops/offices is given in Appendix 12 Households.

2.2.1.1 Coverage errors regarding the population

Under- and overcoverage problems that have been detected in connection with the collection of data include local units with incorrect NACE codes in the Business Register and out-of-date information in the Business Register on local units that are no longer active or new enterprises starting during 2004 or earlier (undercoverage).

It has been discovered in the questionnaires submitted that several of the local units have incorrect NACE codes in the Business Register. Respondents have been asked in the questionnaire to describe in words the type of work carried out at the local unit and this can differ greatly from the industry code they have been given in the Business Register. When they have no operations that belong to the mining or manufacturing industries (NACE C+D) according to their own description, they represent overcoverage.

Some local units with the primary code NACE D have stated in their questionnaire responses that some of the waste has been disposed of at their own landfill site. On further questioning about this, it has been clarified that the landfill site is situated in the nearby area but is not actually a part of the local unit. In these cases, we have decided that the landfill site should come under the framework of NACE 90 and therefore be included in the survey directed to landfill sites within NACE 90.

There are also cases where the incineration of waste is carried out at a facility close to the local unit within a manufacturing industry (NACE D) but which is managed by an enterprise classified under Electricity supply (NACE E). In these cases, we have checked with the survey on NACE E to see if the facility is reported there. If not, it can remain in the present questionnaire.

This questionnaire survey has not included:

- Manufacture of textiles, Manufacture of wearing apparel and Manufacture of leather and leather products (NACE 17-19)
- Manufacture of office machinery and computers (NACE 30)
- Manufacture of radio, television and communication equipment and Manufacture of medical, precision and optical instruments (NACE 32-33)
- Manufacture of furniture and other manufacturing n.e.c. (NACE 36)

The equivalent survey for 2002 has shown that these sub-sectors produce so small waste quantities that it would not be worth including them in the survey when considering the burden and cost of data provision. Data for total quantities of hazardous and non-hazardous waste from 2002 have instead been used. The total quantities have been broken down into different types of waste for NACE 17-19 and NACE 36 by experts. NACE 30 and 32-33 are included in the reporting sector NACE DK-DM and are of marginal significance for this sector. We have therefore not added the 2002 values.

2.2.1.2 Coverage errors regarding waste quantities

The methods used are intended to give 100% coverage of waste generated and treated, including capacity data. There is no reason to suspect that over- and under-coverage occurs to a greater extent than that which is described under the errors noted below.

Data can be included twice in several ways. Some of the main examples of these are:

- Construction and demolition waste does not only arise in the construction industry but also in the manufacturing industry.
- Household waste from other sectors than households can be included in the waste quantities from the household sector.
- A type of waste can be treated several times, within or outside an industry. Sometimes the waste classification changes after treatment and sometimes it does not.

How waste is defined can result in a considerable underestimation of waste generated. Examples of this are scrap steel, shavings, chippings and bark, vegetal waste from bakeries and confectioners (sold as animal feed), which few respondents consider as waste.

The treatment of waste may also have been underestimated for the same reason, i.e. when considering the incineration of wood waste, it is likely that this value has been underestimated as many respondents do not consider this to be treatment of waste.

2.2.2 MEASUREMENT ERRORS

We have come across the following common problems when collecting data:

- 1) Coding of certain hazardous waste has been unclear and confused, e.g. the difference between Spent solvents (EWC-Stat 01.1), Chemical preparation wastes (02) and Chemical deposits and residues (03.1). Additionally, waste that contains oil can be classified under different codes according to EWC-Stat;
- 2) There has often been confusion between the three EWC-Stat codes Household and similar wastes (10.1), Mixed and undifferentiated materials (10.2) and, once or twice, Sorting residues (10.3);
- 3) Sludge has occasionally been incorrectly classified. Industrial effluent sludge (03.2) should be coded as Common sludge (11) or vice versa;
- 4) A large number recorded the existence of Hazardous metallic wastes (06). The majority of these have actually been other types of waste, such as Non-hazardous metallic wastes (06) or Hazardous chemical preparation wastes (02), such as metal packaging contaminated with oil;
- 5) Some have wrongly interpreted the waste type Combustion wastes (12.4) as waste for incineration, which should be reported as Mixed and undifferentiated materials (10.2).

Statistics Sweden's Business Register has been used, which means that local unit and not activity unit is the applicable statistical object in the survey. There is therefore some risk that several types of activities occur at the same local unit. This is only a problem if the combination of activities leads to a classification under NACE codes outside the reporting sectors. We do not know how great this problem is and we do not have a method or the possibility of solving this particular problem.

Estimated values have been permitted in the survey. This can affect the accuracy of the quantities given.

It has been requested in the questionnaire that quantities are given in tonnes. It is however relatively common that respondents have given another quantity measure. If a different quantity measure (kg or 1 000 tonnes) has been given, we have simply recalculated to tonnes. If other units have been used, e.g. items, barrels or m³, we have used conversion tables where these are available. The Swedish Association of Waste Management has designed such a table³⁸. In certain cases, conversion factors have been acquired from experts. Some of the conversion factors are not particularly controversial, such as ton per m³ of oil, while problems have occurred when the waste has been mixed, for example, or when we do not know whether the waste has been compressed or not.

The questionnaire for the sample survey has been tested in three ways:

- An equivalent survey was carried out for 2002. This survey provided valuable experience for the development of the 2004 survey;
- The questionnaire and covering letter were examined and approved by the Board of Swedish Industry and Commerce for Better Regulation and the Swedish Association of Local Authorities and Regions;
- Before beginning with the various questionnaire surveys, a pilot survey of treatment facilities was carried out, which also proved valuable when developing the survey.

Possible errors can also occur when respondents write incorrect responses in the questionnaire. Incorrect responses can be due to carelessness or misunderstanding of the respondents. When checking the questionnaires, we have carried out a rationality test: is the type of waste reasonable for the industry, is the size given reasonable, is there some other type of waste that should occur in the industry, etc. In several cases, we have detected relatively large errors in the submitted responses. There can however still be incorrect responses that we have not detected. It is hard to quantify these errors as we have made a lot of effort to eliminate them.

All questionnaires in NACE C + D were given a uniform design, with only slight variations from the other surveys. This was primarily because the surveys were to be carried out for the first time for the reporting according to the waste statistics regulation and so that the respondents would learn to recognise the questionnaire if they received several for different local units in different sectors.

³⁸ Waste facilities with landfilling, Statistics 2003. Report from the Association of Waste Management 2004:13

The pilot survey on treatment was considered to have worked well and was therefore used as a basis for the questionnaire design. Identical questionnaires were used for the surveys on NACE C+D, regardless of which sub-sector they referred to.

This standardisation of the questionnaire design can have led to the respondents finding it difficult to understand what should be filled in and where in the questionnaire their data should be reported. For example, a table was included for data on treated waste if the treatment took place at the local unit in question. In practice, few local units treat waste themselves but, because the table was provided, many filled in data on the treatment of waste - but on how it is treated externally rather than internally.

Material recycling at the same facility where the waste is generated has caused several problems of interpretation leading to possible errors in the responses. According to the waste statistics regulation, neither the existence nor the recovery of these quantities should be reported but respondents can have included this in their responses without it being detected.

So that respondents should understand what should be filled in, a reference was made in the table section of the questionnaire to the back of the questionnaire where information and definitions were provided. Some of this information was also in the covering letter. Unfortunately there was not room to provide these definitions directly in the tables where the data were to be written. Experiences from other surveys show that there is consequently a large risk that a great deal of respondents do not read this information, which can lead to incorrect or doubtful data that can be hard to detect when checking.

2.2.3 PROCESSING ERRORS

When registering submitted questionnaire responses in the processing database, there has also been a risk that the data are input incorrectly. In many cases, small errors of this kind have not been detected. Larger errors, such as errors in the number of zeros, have probably been detected in most cases when a thorough analysis of the survey results is carried out, with aggregations of various kinds, such as by industry, size category and type of waste. The comprehensive checking procedure consisted of several stages: estimates of rationality of different experts, comparisons with previous surveys (only for NACE C+D this year with the survey on Industries' waste 2002), comparisons with other data sources where possible, such as environmental reports from facilities with permits. These methods have also occasionally led to the amendment of certain variables or imputation when there is partial non-response.

It is not easy to detect coding errors related to waste types. Many of the suspected errors have been dealt with via telephone or e-mail contact directly with respondents. A number of obvious errors have been detected by the checking experts, for example that some processes within a NACE code should result in a certain type of waste, such as metallic wastes from the manufacturing of metallic goods and plastic wastes from the manufacture of plastic goods (when the waste is not recycled into the own processes as this should not be counted as waste generated nor re-reported as internal treatment). Respondents are directed in the covering

letter to a website where a list is provided to help convert codes from those included in the list of waste to EWC-Stat, which can be used when coding waste. We suspect that the majority of respondents have not used this conversion table. This means that, although they have classified their waste according to the list of waste, this waste has not always ended up in the correct EWC Stat-code. Finally, processing errors that have not been detected when checking remain as well as those that we have ourselves incorrectly amended when we have suspected an error and not received any response from the respondent on the issue.

In some cases, the methods for recovery and disposal may have been incorrectly reported by respondents. For example, sorting, pre-treatment or internal material recycling can have been reported as a recovery operation. When larger recycling values have been reported, contact has in most cases been made with the respondent to check that the data are correct. When respondents have reported incorrect values on a smaller scale, these have often been left uncorrected as, for budgetary reasons, it has not been possible to contact respondents regarding every suspected error.

Our checks have shown that many respondents have misunderstood the section in the questionnaire on the treatment of waste. It was unclear for many that only internal treatment should be included and they have therefore reported treatment for all waste, including that treated externally. When editing, we have often deleted all the submitted data on treatment when these values are too small and/or the corresponding data from 2002 show that this related only to external treatment. In a few cases, we may have edited values incorrectly. Some smaller local units may actually carry out the treatment of waste internally, the situation could have changed since 2002 or have been incorrectly reported in 2002.

In the mining sector, all mining facilities that submitted data on the internal treatment of waste noted the internal landfilling of mineral waste, regardless of what the local unit does with this waste. One larger local unit in the mining industry (NACE C) stated that some of the mineral waste is recovered. We have not corrected the reporting for mining.

Some local units have had large quantities of pre-treated water-containing oil waste. This treatment consists of the separation of oil and water using various physicochemical methods. The water phase is often released via the sewers into a watercourse or a municipal sewage facility after purification, and the oil phase is sent on to an oil waste facility. We have considered that, for this process, the treatment (separation) should not be reported according to the regulation on waste statistics (D9). The waste generated is made up of oil waste and separated water. The treated waste is only the water that is released into a watercourse (D6, D7). If the water is released to a municipal sewage facility, this is not reported as treatment. This process has been reported in different ways by different respondents and it can sometimes be difficult to judge if this is correct.

Some respondents have noted a waste quantity generated, often small, under the questionnaire's extra row "Other waste". Where the respondents have noted the type of waste in words, we have moved this value to the appropriate EWC-Stat

code. In the remaining cases, we have very often moved this value to Mixed and undifferentiated materials (10.2).

When respondents have noted a lesser value under Sorting residues (10.3), we have very often moved this value to 10.2. One exception is for the pulp and paper industry, where Mechanical and rejects from the manufacture of pulp from secondary fibres (List of Waste 03 03 07) should be classified as Sorting residues (10.3).

The existence of hazardous metallic wastes (06) for which some have filled in values, have in some cases been moved to non-hazardous metallic wastes, i.e. when the same local unit has also noted treatment of non-hazardous metallic wastes. In other cases, the value has been moved to hazardous chemical preparation wastes (02), where oil-contaminated metallic barrels belong.

In cases where respondents have filled in data on Combustion wastes (12.4) and we have no reason to believe that the local unit has their own incineration or thermal processes, we have assumed that the respondent actually meant Waste for incineration and have therefore moved the value to Mixed and undifferentiated materials (10.2).

Many have written "fluorescent tube" beside the waste type Hazardous discarded equipment (08) and noted "items" instead of a weight measure. We have converted to a weight measure using 0.2kg/item. In the majority of cases where the number given is relatively large, we have additionally assumed that submitted data in "items" for waste type 08 (hazardous) without any description in words refers to fluorescent tubes and converted as above.

Coding errors related to regions are not relevant for this survey as the sample has been drawn from the Business Register, where the object is local unit with county and municipality codes.

In the sub-project Waste from households (see Appendix 12), it has been estimated how much of the household waste originated from business activities and how much from households. According to the questionnaire survey, around 70 000 tonnes of household waste has been generated within Mining and quarrying (NACE C) and Manufacturing (NACE D). In practice, sorted household waste can also have been classified as mixed and undifferentiated materials (such as sorted combustible waste or sorted residues).

2.2.4 NON-RESPONSE ERRORS

The response rate for the whole survey on NACE 10-36 was 65% on average. This response rate includes overcoverage that was detected when checking the submitted questionnaires and questionnaires sent in without any data, e.g. when the respondent refused to respond, or when local units have recently ceased to exist or are inactive.

Object non-response problems have been addressed using written reminders sent on two separate occasions to respondents that have not responded and, thereafter, telephone reminders to larger local units within the 2-digit NACE codes that have a particularly low share of responses. These efforts have given mixed results. Many pointed out that the survey is optional and that we should instead contact the supervising authority to obtain an environmental report in which the waste data

should be reported. As the Swedish Environmental Protection Agency did not wish us to contact the county administrative boards, no action has been taken.

In order to reduce partial non-response and to check uncertain data, direct contact has been made with respondents by e-mail or telephone. Checks and imputations to reduce non-response have also been carried out using various calculations and other sources, such as environmental reports and the 2002 industrial waste survey. For the pulp and paper industry, waste data compiled by the industry organisation, the Swedish Forest Industries Federation, have also been used.

Methods used on partial non-response, when we have not succeeded in persuading respondents to report themselves, have primarily concerned:

- Dry weight for sludge (both common sludges and industrial effluent sludges) has been assumed by deriving a factor dry weight/wet weight from all local units that have submitted data on both. Every wet weight for which a dry weight is missing has then been multiplied by this factor.
- Where values for both Household waste (10.1) and Mixed and undifferentiated materials (10.2) are missing, the former has been calculated partly from the results of the 2002 survey and partly from those who have submitted data in the current survey on the quantity of household waste. The factor used was 100kg/employee. Calculations were based firstly on the submitted information on employees and secondly on the number of employees registered in the source register, the Business Register.
- Publishing enterprises (NACE 22) without own printing works have often commented that they are only an office and not industrial, and therefore do not need to submit data. When we have not received responses from respondents after requesting that they still submit data on the small amounts of waste they do produce, we have calculated household waste according to the above. For paper waste, we have calculated a factor for “paper waste per employee” using data from the publishing local units that have submitted data on paper waste. This factor has then been multiplied by the number of employees at the local units that have not submitted data on waste.
- It has been very difficult to obtain data on wood waste from sawmills and, to some extent, planning facilities (NACE 20). Few local units are willing to call chippings, shavings and bark “wood waste” and the imputation of large quantities of wood waste has been necessary. Various calculation methods have been used for this. In most cases, we have used those local units that have submitted data on wood waste, often after repeated contacts with the respondents. Waste quantities per employee have then been calculated using the least squares method. In cases where we have received data on sawed quantities from the respondent or the local unit's website, we have added data on wood waste for the local unit, calculated using the factor “wood waste per sawed quantity”. This has then been used to calculate waste for the local units for which sawed quantities can be obtained. In a few cases, data on how much waste has

been generated from own incineration of wood waste have been used to calculate the quantity of wood waste generated on the basis of an expert assessment on the weight of ashes per ton incinerated wood waste.

- Some local units within bakeries and confectioners have not given data on the production of Animal and vegetal waste (09). Some smaller local units have included this waste as household waste whereas others have not included this waste at all, as they do not consider this to be waste, partly because it is often sold as animal feed. We have therefore calculated vegetal waste per employee from the local units that have submitted data on this and used this factor to calculate waste for those who have not given data.
- Data on capacity for the various treatments have often not been given by respondents. When reminders have not succeeded, we have in some cases been able to use environmental reports to obtain these data. In most cases, calculations have been done instead. For landfill sites, it has been assumed that there are 5 years left for landfilling waste and there will be the same treatment quantities as given in 2004. A recalculation from ton to m³ has been done for types of waste for which it is considered that the weight will differ considerably from 1 ton/m³. For other treatment methods, it has been assumed that the capacity is the same as the treatment quantity rounded up. For supplementing according to Mayer-Parry (see section 2.2.1), it has been assumed that capacity data for certain types of material are equal to the recycled quantities, rounded up, when data have not been obtained directly from the industry organisations contacted.

Non-response has led to problematic quality issues, despite great efforts in many different ways to reduce it. No investigation has been carried out into whether there is any significant difference between waste quantities in the non-response group and the response group, i.e. if the survey's results are distorted.

2.2.5 MODEL ASSUMPTION ERRORS

In order to reduce the costs to society and the burden on respondents, the survey has been carried out using a stratified sample. All local units with 100 employees or more were included. For local units with less than 100 employees, a sample has been drawn using a variety of methods for the different NACE industries. Cut-off limits used include local units with 10, 20 or even 0 employees. Over these limits, the number of employees at a local unit determined the probability of being included in the sample. Extrapolations were then carried out for every industry to obtain a total waste quantity over the cut-off limits. The number of employees has then been used as a factor for calculating waste quantities generated for local units under the cut-off limits to achieve 100% coverage of waste quantities. It was considered that these small local units would not have any treatments of significance to the final results so no calculation of these regarding recovery and disposal was done. Errors can have occurred in different ways. Two examples of these:

- 1) There can be a poor correlation between the number of employees and waste quantities. This risk becomes less and less with every survey carried out so that better models can be developed to simulate the connection between waste quantities and number of employees in the different NACE groups and size classes.
- 2) Some of the objects in the sample could be extreme in some way. As the values for these objects are then multiplied by a factor of 10 or more, when the sample has been sparse and there may also have been large non-response, the result can be a large over-evaluation of a particular type of waste. This risk for error is not easy to detect if the error is not so large that experienced waste and industry experts can detect it when checking various compilations. Even if this type of error is detected, it has not been clear how it should be handled so it of-ten remains as it is. One example where a larger extrapolation has been carried out is regarding metal waste within Manufacture of basic metals and fabricated metal products (NACE DJ), for which the total value can have been considerably overvalued.

2.2.6 NON-SAMPLING ERRORS AFFECTING ACCURACY

The questionnaire has been sent to the person responsible for environmental issues at the local units. It is possible that another person could be able to fill in the questionnaire more accurately or that non-response would be less if another person was addressed. In some specific examples, we have received two questionnaires from the same local unit with different data (regular and reminder), either from the same data provider or two different respondents.

5 Comparability

5.2 Regional comparability of waste treatment

VALIDATION OF DATA REGARDING TREATMENT OF WASTE

Data on waste treatment facilities within NACE C+D has been double-checked against other administrative data (environmental reports etc.). The compiled results have also been quality controlled and validated by independent experts.

STATISTICAL UNITS

The objects have been local units that, because the Business Register has been used, are a local unit with a county and municipality code.

MOBILE WASTE TREATMENT

For the generation of waste and the recovery and disposal of waste, mobile equipment has been reported in the place it was used. Capacity data have however been reported in the home town. We have only come across a few mobile units in the survey on NACE C+D so the facility's location does not have a determining significance for the total reported quantities of waste or treatment capacities.

Appendix 3

Electricity, gas, steam, hot water and water supply (NACE E)

The numbering of the sub-headings in this appendix refers to the corresponding sub-headings in Part II Quality attributes. We have here included those sections/sub-headings from Part II that are significant for the sub-survey in question. Otherwise, the information already described in Part II is applicable.

1 Sources

The sector NACE E consists of two main sections; electricity, gas, steam and hot water supply (NACE 40, hereafter called energy sector) and the collection, purification and distribution of water (NACE 41, hereafter called water supply sector).

The survey covers one reporting item on waste generated. The survey also provides data on the recovery and disposal of waste in the industry.

Most waste treatment in the industry is carried out at facilities producing energy from the combustion of different types of waste fuels and secondary fuels. Energy production from the combustion of all kinds of fuels also gives rise to a large part of the waste that is generated in the industry. For these enterprises within the energy sector (NACE 40), a questionnaire survey has been carried out.

For other types of activities within the energy sector (NACE 40), waste data have been obtained using other methods, see below.

For the water supply sector (NACE 41), the basis for production-based waste factors has been obtained from a limited questionnaire survey.

The statistics produced for the industry are consequently based on data collected using different methods depending on what type of activity the enterprise has.

1.1 Enterprises with energy production from combustion

These enterprises come under NACE 40.1 (the production and distribution of electricity) and 40.3 (steam and hot water supply). Also included are all enterprises with some form of heating plant or combined heat and power plant that use municipal solid waste as fuel. The population includes only those enterprises with combustion facilities. The frame is made up of the energy statistics' register for the survey on annual energy statistics (electricity, gas, heating)³⁹.

In order to guarantee data collection from the 30 municipal waste incineration plants, these were identified using details from the Swedish Association of Waste Management⁴⁰. A few of these plants were missing in the population above. Mu-

³⁹ Annual energy statistics (electricity, gas, heating). Official Statistics of Sweden, Statistical Report EN11 SM0502 and direct information from Statistics Sweden, Energy Unit.

⁴⁰ "Swedish Waste Management 2005", publication from the Swedish Association of Waste Management

municipal waste incineration plants included in larger energy enterprises were also identified. Questionnaires were then sent to these facilities as well. For checking, supplementary information and corrections of the data received from the questionnaire responses, the following sources have been used:

- Data from the energy statistics survey “Annual energy statistics (electricity, gas, heating)” regarding 2004
- “Swedish Waste Management 2005” from the Swedish Association of Waste Management (refers to waste quantities from 2004)
- District heating and combined heat and power statistics 2004 from the Swedish District Heating Association⁴¹ (refers to 2004 production)
- Environmental reports
- Websites of relevant enterprises and municipalities
- Statistics Sweden's Business Register

1.2 Nuclear power plants

There were four nuclear power plants in Sweden in 2004. Data on generated non-radioactive waste from these facilities have been obtained from environmental reports taken from the enterprise's website.

1.3 Manufacture of gas

There are 10 local units with the main activity Manufacture of gas (NACE 40.2). The majority of these distributes or carries out trade in gaseous substances. Data have been obtained from telephone contacts, websites and environmental reports. Waste treatment is not relevant for this type of activity.

1.4 Hydroelectric power stations

The statistics are based on interviews with the responsible persons at the largest producers of hydroelectric power. Data have been obtained via e-mail or telephone.

1.5 Wind power stations

After contacting the Swedish Wind Energy Association, it was ascertained that the quantity of generated waste is insignificant at the current time. The treatment of waste is not relevant for this type of activity.

1.6 Electricity network enterprises

Waste is generated by electricity network enterprises primarily when building new networks or renovating the electricity supply mains with its distribution apparatus.

Contact has been made with several of the larger electricity network enterprises that have submitted data on waste quantities generated. These data, together with data from the Swedish Energy Agency on the combined length of different types of electricity network, have been used when calculating the waste quantities of these operations. Waste treatment is not relevant for this type of activity.

⁴¹ "District heating and combined heat and power statistics 2004". The Swedish District Heating Association's website www.svenskfjarrvarme.se.

1.7 Electricity trade enterprises

For enterprises whose main activities involve trade in electricity, small quantities of normal office waste are generated. Generated household waste has been estimated as mentioned below. Other waste quantities have not been investigated further. Waste treatment is not relevant for these enterprises.

1.8 Water supply

In cooperation with the Swedish Water & Wastewater Association⁴², data on waste have been obtained from a limited questionnaire survey to the larger waterworks. These data have been used to determine production-based waste factors.

1.9 Household waste generated by the whole industry

The quantities of household and similar wastes generated by the industry as a whole have been estimated using the waste factor “quantity per employee”, established during the surveys on the mining and manufacturing industries (NACE C and D). Data on the number of employees were taken from Statistics Sweden's Business Register.

2 Accuracy of data

2.1 Sampling errors

The questionnaire survey to enterprises producing energy by fuel combustion is a total population survey. Sampling errors therefore do not occur.

2.2 Non-sampling errors

Sections 2.2.1 - 2.2.5 deal primarily with the various sources of error in the questionnaire survey to combustion enterprises. Sources of error in the other sub-surveys are dealt with in section 2.2.6.

2.2.1 COVERAGE ERRORS

The method used is designed to ensure 100% coverage of waste generated as well as recovered and disposed waste.

2.2.1.1 Coverage errors regarding population

The frame for the questionnaire survey is taken from the energy statistics' register. The statistical unit in the register is enterprise. The survey is an optional total population survey. The register contains additional information on the energy production units that is included in each enterprise. Under and overcoverage errors can occur when enterprises or production units are missing or have incorrect NACE codes.

⁴² The Swedish Water & Wastewater Association, direct contacts and the publication VA-verk 1995, statistics VAV 1995.

The surveys for other industries are carried out in a variety of different ways. To a large extent, the frames for these surveys are taken from the Business Register. The statistical unit is thus local units whose main activity lies within the relevant industry. This can cause different types of coverage error:

- 1) Some enterprises with a NACE code other than 40 can have local units within NACE 40. This can imply undercoverage.
- 2) Some enterprises within NACE 40 can have local units with a different NACE affiliation. This would imply overcoverage.
- 3) Some enterprises, municipal enterprises in particular, have different types of technical operations within the same enterprise. The enterprise can therefore carry out district heating operations as well as the collection and treatment of refuse, sewage management and the supply of drinking water. Trade in electricity and electricity network operations may also be included.
- 4) The larger energy enterprises have or operate plants producing, for example, steam for other industrial enterprises.

The large energy enterprises in the population are included as subsidiaries whose activities often correspond fairly well with the activities that the survey is designed to include. The scope of the coverage errors is therefore limited.

The following measures have been taken to minimise the risk for coverage errors:

- The covering letter highlights the fact that data should refer to the combustion plants within the enterprise. The wording can however lead to respondents not reporting waste originating from the distribution of district heating.
- Enterprises which have submitted data on own landfilling or recycling have been contacted to clarify that this comes within the framework of the enterprise's energy activities.
- Enterprises with own landfilling have been checked against the survey on the sector Collection and treatment of other wastes (NACE 90.02) to avoid reporting data twice.
- Facilities within the survey on the sector Collection and treatment of other wastes (NACE 90.02), which have noted waste incineration, have been checked to avoid reporting twice.
- If it is suspected for some reason that an enterprise has or operates plants producing, for example, steam for other industrial enterprises, this has been checked against the survey on the sector Manufacturing (NACE C and D).
- For enterprises with municipal waste incineration plants, the NACE code of the local unit including the incineration plant has been checked in the Business Register. All facilities, apart from one, were coded as NACE 40. One facility was coded as NACE 90; this was considered incorrectly coded in the Business Register as other facilities within similar enterprise structures were coded NACE 40.

The remaining errors caused by overlapping frames or poor coverage in relation to other industries are estimated to be small.

Coverage errors between the questionnaire survey and the sub-surveys on electricity enterprises and electricity trade enterprises do occur. However it is estimated that this type of error is on a lesser scale.

Coverage errors between the questionnaire survey and other sub-surveys should not occur.

2.2.1.2 Coverage errors regarding waste quantities

The method used is designed to ensure 100% coverage of waste generated as well as waste quantities treated and capacity data:

- In the questionnaire survey, data are requested on all types of waste covered by the statistics according to the waste statistics regulation.
- The other sub-surveys cover the actual waste for all activities of this type in Sweden.
- The quantity of household waste generated is estimated for the industry as a whole.

It is possible for data to be reported twice for several reasons, as described in the main report. For the energy and water supply industry (NACE E), these errors are estimated to be particularly significant:

- Construction and demolition waste not only appears within the construction industry but also in the energy and water supply industry (NACE E). There is particular risk for reporting data twice for new construction and renovations as these activities are partly carried out by contractors.

The definition of waste has resulted in a considerable underestimation of the incineration of certain types of waste. The delimitation between by-products and waste and the definition of recovery do not correspond to respondents' understanding. This is particularly the case for the incineration of wood wastes (EWC-Stat 07.5), which is very extensive in Sweden. Wood waste from the manufacture of wood and wood products (NACE DD) such as sawdust, chips and shavings and bark, are not normally considered as waste by the respondents. In 2003, the quantity of pre-sold wood fuel made up of wood waste and by-products amounted to around 10 TWh, or around 3.3 million tonnes. Around 5.7 million tonnes of unprocessed wood fuel were used in total in the energy sector (NACE E) during 2004. A considerable amount of this constituted wood waste as per the definition applicable for waste statistics. The result of the waste survey however showed that only around 1.4 million tonnes of wood waste were incinerated in the energy sector. The results indicate that a further some 2 million tonnes of wood waste were incinerated in the sector. A similar problem also occurs for tall pitch oil (classified as EWC-Stat 03.1 Chemical deposits and residues). It is likely that there are similar problems for other waste fuels as well, such as Animal and vegetal waste (EWC-Stat 09).

2.2.1.3 Interpretation and definition of incineration capacity

Defining capacity for the incineration of waste in an unambiguous and relevant way is a problem for this industry. Many qualities of wood waste are, when used as fuel, equivalent to virgin wood fuel. Because incineration is almost exclusively carried out to produce district heating and, to a certain extent, electricity, the maximum fuel consumption of a facility is not a relevant measurement of annual incineration capacity. Annual fuel consumption is instead determined by the need for heat production. The corresponding problem also exists for tall pitch oil.

The following method has been used to calculate the number of facilities that can incinerate waste and the capacity of these:

- Facilities that during 2004 combusted unprocessed wood fuel (wood fuel excluding briquettes, pellets and wood dust according to the annual energy statistics) are considered to be able to incinerate wood waste. The capacity has been set as equal to the consumption of unprocessed wood fuel in 2004.
- For facilities that are designed for municipal waste incineration the environmental permit usually states the maximum annual waste incineration allowed. This quantity is used as the capacity.
- For facilities which incinerated other types of waste fuels in 2004, capacity has been set as equal to the quantity of waste incinerated.

As the survey was carried out at enterprise level, there is some risk that the number of facilities that can incinerate waste has been somewhat underestimated.

2.2.2 MEASUREMENT ERRORS

This is the first time that waste statistics have been produced for the industry. Previous experiences of the survey are therefore not available.

The questionnaires used have been designed on the basis of results from pilot studies carried out⁴³ earlier and experiences of questionnaire design from other industries, primarily previous surveys on Industrial waste 2002⁴⁴. Before the data collection for waste statistics, a pilot survey was carried out on treatment facilities⁴⁵ with the aim of testing the questionnaire design. The results of this survey have been used when designing the questionnaire to enterprises carrying out energy production from combustion. The questionnaire design used was not tested before the survey was carried out.

The questionnaire's table section refers to the back of the questionnaire where information and definitions are provided. Unfortunately there is not space for these definitions etc. directly beside the tables in which the data are to be input. Experience from other surveys shows that there is therefore a great risk that many respondents do not read this information. This can lead to incorrect or doubtful data that can be hard to detect when checking.

⁴³ "Methods for compiling waste statistics on NACE 40-41", Pilot study, Statistics Sweden on behalf of Eurostat, 2002

⁴⁴ "Industrial waste 2002", Swedish Environmental Protection Agency report 5371

⁴⁵ "WStatR 2006: Pilot study on treatment facilities". SMED report September 2004

To make it easier for respondents to judge which fuel is to be considered as waste in the questionnaire survey, special instructions were drafted. Despite these instructions, many respondents have not submitted data on the incineration of certain types of waste. This relates primarily to fuels that respondents often consider by-products or secondary fuels.

In addition, the instructions included a list of the common types of waste that could be generated by the facility. The types of waste were given with a code from the list of waste (Appendix 2 in the Swedish Waste Ordinance 2001:1063) as well as the corresponding EWC-Stat code. On our website, respondents had access to a complete list of codes. Despite this, respondents still had problems when interpreting waste codes. General errors in coding, relating to all surveys, are described in the main report. The following were particularly significant for the energy sector (NACE E):

- Coding of waste types Household waste (10.1), Mixed and undifferentiated materials (10.2) and Sorting residues (10.3). A number of respondents stated that they only incinerate household waste. When coding errors are obvious, we have corrected these so that the quantity of incinerated household waste corresponds with data from the Swedish Association of Waste Management. The remaining quantities are assumed to consist of Mixed and undifferentiated materials (10.2).
- Many respondents stated in the questionnaire that they landfill and/or recover waste. In some cases, this is carried out by waste management and treatment facilities (NACE 90). In other cases, the waste is in practice sent on for landfilling or recovery. After further contact with respondents, or collection of information from other sources, corrections have been made.

Some respondents stated that Common sludges (EWC-Stat 11) are generated. Common sludge should not be generated from energy production. Where the enterprise in question has some form of sewage facility, the data have been deleted as sewage treatment coming under NACE 90.

Condensate from flue gas condensation and wet flue gas cleaning is often released into water after purification. Water quantities should therefore be reported as re-lease into water. The questionnaire design has been unclear regarding releases. Many respondents have not understood that a questionnaire on waste statistics also includes release into water. It is likely that this is underreported.

Precision in the given values in the questionnaire responses is difficult to specify as estimated values have been permitted in the survey. Quantities are requested in tonnes. Some data have been submitted in other units and we have converted these. As far as possible, we have used the same conversion factors as used in all surveys.

Incorrect responses can be due to carelessness or misunderstanding of the respondents. When checking the questionnaires, we have carried out a rationality test but this has not been easy for the types of waste for which there is no data to compare with. It is likely that there are errors that we have not detected.

For Combustion wastes (EWC-Stat 12.4), a rationality test has been carried out by comparing to an estimated ash quantity. The quantity of ash has been estimated from the quantity of consumed fuel taken from the energy statistics.

The quantity of incinerated waste has been checked against other sources (the Swedish Association of Waste Management, the Swedish District Heating Association and energy statistics). When contacting the respondents, it has become apparent that wood waste (such as bark, sawdust, chips and shavings) has not been considered waste. There is a considerable risk that other facilities also incinerate such waste.

Despite all checks, there is a risk that incorrect data can have been included as a basis for the presented statistics. Respondents have had certain problems when filling in data in the questionnaires. There are several reasons for this, such as instructions that were not precise enough and difficulties in getting hold of the data required to respond to the questionnaire.

2.2.3 PROCESSING ERRORS

When registering the submitted questionnaire responses in the working database, there has been some risk that data have been coded incorrectly. The inputs have been checked but some occasional errors can have been missed.

When converting waste codes from the codes in the list of waste to EWC-Stat codes, or coding uncoded waste, coding errors can have occurred.

The survey has been directed to enterprises. The questionnaire did not contain questions on the number of facilities that incinerate waste nor on capacity data per facility. This has meant extensive work has been necessary to identify which facilities incinerate waste. The basis for this work was the energy statistics register, which contains data on enterprises' different energy production facilities. Data from the Swedish District Heating Association and, in some cases, contacts with respondents, have supplemented this. The method used implies that there is some risk that the number of facilities has been underestimated. Capacity data can also have been placed in the incorrect region. The combined capacity should however correspond with actual capacity according to the definitions used.

2.2.4 NON-RESPONSE ERRORS

The questionnaire survey consisted of 169 enterprises and 12 supplementary questionnaires to facilities that incinerate municipal solid waste (of which some unfortunately doubled up with the enterprise surveys). Responses were received (in some cases after telephone reminders) from 75% of enterprises. The response rate includes the enterprises/facilities that submitted questionnaires without any data. Together with the supplementary questionnaires, the responses covered 28 of Sweden's 30 facilities that incinerate solid municipal waste.

Ten enterprises were considered to have operations that should not have been included in the survey. These were deleted from the survey.

For enterprises that did not submit data, or that submitted incomplete data, the following supplementary work was carried out:

- 1) The quantities of Combustion wastes (12.4) generated have been estimated using data on fuel consumption.
- 2) The quantities of incinerated wood waste (07.5) have been supplemented with data on the quantity of recycled wood chippings used as fuel from the Swedish District Heating Association.
- 3) Supplementary data on the quantities of tall pitch oil (coded as 03.1) used as fuel taken from energy statistics.
- 4) Supplementary data from websites and environmental reports.
- 5) Identification of facilities carrying out incineration of waste using energy statistics.
- 6) Non-response extrapolation of waste generated (except waste types 10.4, 11, 12.4 and 13). Non-response extrapolation is based on produced energy and also covers partial non-response.

Supplementary data from the above points 1-5 provided the most important data for all non-response enterprises apart from five. One of these remaining enterprises has possibly been merged with one of the other enterprises included in the survey. There is no trace of the remaining four enterprises. No adjustments have been made for these as it is likely that they have been included as one of the other enterprises in the survey.

2.2.5 MODEL ASSUMPTION ERRORS

Not applicable for the survey method used.

2.2.6 NON-SAMPLING ERRORS AFFECTING ACCURACY

2.2.6.1 Energy production from combustion

The questionnaire was sent to the environmental officers in each enterprise. It is possible that the response rate and accuracy of the data would have been better if the questionnaire had been addressed to another appropriate named individual.

Under-reporting of waste from district heating distribution can be significant for the final statistics. To a large extent, however, the extrapolation made should compensate for this partial non-response.

2.2.6.2 Nuclear power plants

Data from all nuclear power stations were obtained from environmental reports. There is a good basis for reported data on nuclear power stations.

2.2.6.3 Manufacture of gas

The manufacture of gas produces relatively small quantities of waste. The data received via telephone contacts, websites and environmental reports should give a good picture of the quantities of waste generated.

2.2.6.4 Hydroelectric power enterprises

Data on the seven largest hydroelectric power enterprises were obtained by interviews or using environmental reports and environmental accounts. According to Swedenergy, these selected enterprises represent around 90% of the hydroelectric power production in Sweden. Extrapolations are carried out to produce estimates for the remaining hydroelectric power stations.

2.2.6.5 Wind power stations

The quantity of used oils (01.3) generated have been crudely estimated. Otherwise, only a negligible quantity of waste is generated from this type of activity.

2.2.6.6 Electricity network enterprises

The quantities of waste generated from this type of activity are based on interviews with the largest enterprises in the industry. Waste factors have been developed from data on the length and the type of the electricity supply mains (overhead lines or underground cables and voltage distributed). Using these factors, the quantity of waste generated by Sweden's entire electricity network is estimated. Both the stem network and regional and local networks are included. Uncertainty in the estimates is likely to be relatively high.

A considerable amount of new constructions and renovations are carried out by sub-contractors, who are often also responsible for waste. In these cases, the waste should be classified under the sub-contractor's industry, usually the construction industry (NACE F). The quantities of waste generated that should be classified in the construction industry are unclear. The entire waste quantities have been counted in the energy and water supply sector.

Hurricane Gudrun did not occur until January 2005 and can therefore not have affected the waste quantities.

2.2.6.7 Electricity trade enterprises

The quantity of household waste generated is included in the estimates for the sector (NACE E) as a whole. Other waste quantities are considered to be negligible.

2.2.6.8 Water supply

Data have been obtained from a special limited questionnaire survey to 12 larger waterworks. These data have been used to determine production-based waste factors. The Swedish Water & Wastewater Association, participated in the implementation and evaluation of the survey.

Large quantities of Common sludges (EWC-Stat 11) are generated by waterworks. The quantity varies greatly between different waterworks, depending on the water quality and production processes. Quantities of dry sludge differ greatly between facilities carrying out groundwater extraction or surface water extraction. Wet sludge has very low dry matter content and the quantity of wet sludge depends largely on which dry matter content is relevant for the facility in question. The quantity of wet sludge is normally not measured. Furthermore, the basis provided by the limited questionnaire survey is very inadequate regarding facilities with groundwater extraction. The quantity that forms the basis for the statistics is therefore affected by a high level of uncertainty. The quantity of dry sludge has a considerably lower level of uncertainty.

5 Comparability

5.2 Regional comparability of waste treatment

VALIDATION OF DATA REGARDING TREATMENT OF WASTE

All facilities in Sweden that incinerate municipal solid waste are included in the survey. Data are of good quality and have been checked against data from the Swedish Association of Waste Management and the Swedish District Heating Association.

There is significant under-reporting from respondents of different types of unprocessed waste fuels (such as wood waste and tall pitch oil). Supplementary data have been added to a great extent using other sources (primarily the Swedish District Heating Association and energy statistics) but there is likely to still be some under-reporting of the quantities of incinerated waste.

The larger facilities that use waste as fuel have an environmental permit for these operations. There is however no simple way to differentiate the facilities combusting waste fuel from those combusting forest chippings (with the exception of facilities incinerating municipal solid waste and similar waste).

Other waste treatments than incineration only occur occasionally within the sector (NACE E).

The compiled results for the treatment of waste within the sector (NACE E) have been quality controlled by independent experts.

STATISTICAL UNITS

The survey object is enterprises with the energy statistics register as a frame. The register contains information on the production units of the different enterprises including where they are located, i.e. municipality code.

MOBILE WASTE TREATMENT

It has not been clarified if any mobile equipment has been used in this industry. Such activities should not really occur within this sector other than a special business on the side.

Appendix 4

Construction(NACE F)

The numbering of the sub-headings in this appendix refers to the corresponding sub-headings in Part II Quality attributes. We have here included those sections/sub-headings from Part II that are significant for the sub-survey in question. Otherwise, the information already described in Part II is applicable.

1 Sources

A panel of experts has been used to compile data on waste from construction. The work has been divided into the following activities:

- 1) Compilation of literature and references. Several studies have been carried out to estimate the quantities of construction waste. Studies have also been done in other countries.
- 2) A panel of experts has assessed the waste quantities. This panel consisted of experts and representatives from
 - the waste industry (several municipal and private waste enterprises)
 - the construction industry (the industry organisation Ecocycle Council and representatives from the four largest construction companies)
 - authorities (the National Board of Housing, Building and Planning, the Swedish Environmental Protection Agency)
 - consultants who have worked in the construction industry on issues on waste and the environment.

2 Accuracy of data

The methods used are estimated to give roughly a 30% level of uncertainty, both regarding the generation of waste and the recovery and disposal of waste.

A comprehensive study of waste generated in the construction industry (NACE F) has not been carried out before. However several partial estimations have previously been done, covering several types of waste in some sub-sectors. The study carried out by the panel of experts used a combination of several different partial estimations that had been done using different methods. The different methodological approaches have given relatively similar results for the sub-sectors and types of waste studied. The methods used by the panel of experts include:

- Study of the waste flows within a particular region. The figures are based on analyses from waste flows in two regions: Skåne (region with 10 municipalities) and Halmstad (one municipality). These figures have been adjusted up-wards to a national level based on the number of inhabitants.
- Calculation of production waste etc. based on waste factors. Waste factors have partly been taken from subject literature and partly produced by the Eco-cycle Council (The Ecocycle Council is an association of around

30 organisations within the Swedish building and real estate sector). According to the Ecocycle Council, these factors have been validated in several construction projects.

The greatest uncertainty seems to depend on the uncertainty of the definition of waste. There is particular uncertainty about when dug-up soil (classified as mineral waste) constitutes waste and when it constitutes a product.

2.1 Sampling errors

Not applicable for this sector.

2.2 Non-sampling errors

2.2.1 COVERAGE ERRORS

Estimations cover the entire sector of NACE F and all existing types of waste.

2.2.2 MEASUREMENT ERRORS

Not applicable for this sector.

2.2.3 PROCESSING ERRORS

Not applicable for this sector.

2.2.4 NON-RESPONSE ERRORS

Not applicable for this sector.

2.2.5 MODEL ASSUMPTION ERRORS

The methods used are based on two different models:

- A study of waste flows within particular regions, which are then adjusted upwards to a national level on the basis of population. Figures are based on analyses of waste flows in two regions: Skåne (region with 10 municipalities) and Halmstad (one municipality).
- A calculation of production waste etc. based on waste factors. Waste factors have partly been taken from subject literature and partly produced by the Eco-cycle Council. According to the council, these factors have been confirmed in several construction projects.

Both these models involve simplifications of reality. Adjusting waste flows upwards can give the wrong results since construction can differ in intensity from region to region. The regions on which we based the extrapolation are considered to have a more intense construction market than several other regions in the country. The use of waste factors can give the wrong results if all material is not included in the calculations and if actual building methods are not consistent with the assumed model.

5 Comparability

5.2 Regional comparability of waste treatment

There is generally no recovery at construction sites except for excavated materials (classified as 12 Mineral wastes according to EWC-Stat). Other waste that is recycled is treated in facilities outside the construction site (usually in the survey Collection and treatment of other waste NACE 90.02 or Manufacturing NACE D). Assessment by experts indicated that most of the excavated material is recycled. Internal recycling occurs in a few cases.

There is no measurement of the quantities of excavated material generated or of its recovery. We assumed that both the generated and recovered quantities of excavated material correlate to the number of building permits (dwellings, offices, industries). It was assumed that one building permit consisted of one local unit. The official building statistics at Statistics Sweden include information on the volume of construction and the number of building permits broken down by municipality and by county. Recovery was distributed among the various NUTS regions based on this information.

Appendix 5

Services (NACE G-Q)

The numbering of the sub-headings in this appendix refers to the corresponding sub-headings in Part II Quality attributes. We have here included those sections/sub-headings from Part II that are significant for the sub-survey in question. Otherwise, the information already described in Part II is applicable.

1 Sources

Sweden has applied for and been granted a derogation for the reporting on the generation of waste in the Services sector, NACE G-Q (excluding 51.57 and 90). The following information therefore only includes data on recovery and disposal of waste within the sector.

The main data sources have been representatives from the various sub-sectors in which we assume waste treatment has occurred. To select the sample, a review of the NACE classification has been done together with a retrieval from EMIR⁴⁶ to identify which local units or facilities had waste treatment as a sub-classification. Sub-classification here means that a facility can be classified within the service sector but can have an underlying activity that is classified as waste treatment (NACE 90). The sub-sectors we have chosen to include, together with the method of contacting them, are illustrated in table B5.1 below:

Table B5.1 Overview of sub-sectors within NACE G- Q excluding 51.57 and 90, with potential recovery and disposal of waste

Sub-sector	Method of contact	Waste treatment
Treatment of carcasses	Only one enterprise in Sweden, contacts by telephone and website	Yes
Crematoria for animals	Telephone and e-mail contact	Yes
Hospitals	E-mail to environmental managers at county councils	To some extent
Military	Telephone contacts with responsible person	Capacity for some treatment but has not utilised it
Ports	Telephone contact	No
Garden centres etc.	-	Too small and of "private" character
Crematoria	-	No, humans are not considered as waste

⁴⁶ EMIR is the emissions register of the County Administrative Boards, i.e. a database where County Administrative Boards input information on emissions from environmental reports, etc

2 Accuracy of data

2.1 Sampling errors

Not applicable for NACE G-Q excluding 51.57 and 90.

2.2 Non-sampling errors

Errors which occur for each sub-sector are summarised in table B5.2.

Table B5.2. Errors occurring in sub-sectors within NACE G-Q excluding 51.57 and 90

Sub-sector	Error
Treatment of carcasses	Information on capacity has been taken from the enterprise's website since the enterprise did not want to submit an environmental report. The assumption that the amount treated is the same as the capacity can be seen as reliable since there is a shortage of capacity in Sweden. The error in estimated data is thus probably small. Another possible error in the data regarding how much waste is incinerated and how much is recycled. However, this was checked by an industry expert and there should therefore only be a small risk for error.
Crematoria for animals	14 facilities were found by searching the Business Register and the Internet. We have tried to contact all the facilities but were unable to reach three enterprises.
Hospitals	22 county councils received an e-mail. 12 of these replied. However, the replies we received were so similar that we can assume they apply to the whole sub-sector. The error in estimated data is thus probably small.
Military	Some facilities carrying out waste treatment activities can have been overlooked. This should however not result in any significant error.
Ports	Only a sample of ports has been contacted by telephone. Because these responded in the same way, the assumption that ports do not carry out waste treatment activities can be taken to apply to all ports. The error in estimated data is thus probably small.
Garden centres etc.	The assumption that garden centres only handle their own waste is with all likelihood correct. The error in estimated data is thus probably negligible.

2.2.1 COVERAGE ERRORS

2.2.1.1 Coverage errors regarding the population

The following steps have been taken to minimise coverage errors regarding the population:

- A thorough analysis of all sub-sectors within NACE G-Q has been carried out to locate any further businesses in which internal treatment of waste may occur, with the exception of the already noted treatment of hazardous waste in the healthcare and cremation sectors. An analysis of the Business Register and various Internet searches has been carried out.
- An analysis of the list of activities in the ordinance on environmentally harmful activities has also been carried out to identify conceivable waste treatment activities within the service sector.
- A control in EMIR in relation to the survey in the sector Collection and treatment of other waste (NACE 90.02) has been done. Two small animal crematoria are classified under NACE 90.02 and have received the questionnaire on this survey. Two facilities were also identified that have

been included in the survey on NACE 90.02 but that have not reported any cremation activities. A decision has been taken that facilities that only carry out cremation activities should be included in this sector. The two with cremation in combination with other activities have been included in the survey on NACE 90.02 and excluded from this sector.

- The Swedish Association of Local Authorities and Regions was contacted. The list of county councils' environmental managers is complete so there should not be any coverage errors regarding the population for the sub-sector hospitals.
- Contacts have been made with the relevant industry organisations with the aim of locating businesses in which waste treatment activities can occur and to investigate the existence of data on such facilities.
- Contact has been made by telephone with ports, the military, facilities with the treatment of carcasses and small animal crematoria.

We consider that all sub-sectors and local units that carry out waste treatment activities have been included, giving 100% coverage. Some sub-sectors with waste treatment activities may have been overlooked but this is not likely.

2.2.1.2 Coverage errors regarding waste quantities

The methods used should give 100% coverage. We have no reason to suspect that there has been over- or undercoverage.

2.2.2 MEASUREMENT ERRORS

The errors occurring in this survey are described in other sections.

2.2.3 PROCESSING ERRORS

The errors occurring in this survey are described in other sections.

2.2.4 NON-RESPONSE ERRORS

We have not managed to contact three small animal crematoria for data on waste treatment. However these can be considered to have only a minimal effect on the final result, as one of these crematoria is possibly inactive and the other two are believed to carry out minimal treatment activities.

2.2.5 MODEL ASSUMPTION ERRORS

The assumed average weight of animals at several small animal crematoria can differ from the actual average weight. This is considered to result in a small error in the total figures. Only data on the number of animals are available for many small animal crematoria and the average weight is set to 12.5 kg. If respondents have given both the number and the weight for these animals, the given weight is used. When data on capacity is missing, this has been estimated as the same as the number of cremated animals in 2004. This can result in a small error.

The number of carcasses treated is considered to be the same as capacity. This can result in a small error.

5 Comparability

5.2 Regional comparability of waste treatment

VALIDATION OF DATA REGARDING TREATMENT OF WASTE

The compiled results have been quality controlled by independent experts.

STATISTICAL UNITS

It has been possible to divide up capacity data for the sector on a NUTS 02 level because the location of all facilities is known.

MOBILE WASTE TREATMENT

This does not occur within the Services sector (NACE G-Q excluding 51.57 and 90).

Appendix 6

Recycling (NACE 37)

The numbering of the sub-headings in this appendix refers to the corresponding sub-headings in Part II Quality attributes. We have here included those sections/sub-headings from Part II that are significant for the sub-survey in question. Otherwise, the information already described in Part II is applicable.

This appendix deals with the generation of waste and recovery and disposal of waste within Recycling (NACE 37) excluding dismantling of end-of-life vehicles. The dismantling of end-of-life vehicles, which also comes under NACE 51.57, has been sorted from this questionnaire survey and is instead estimated using the same procedures as for dismantling of end-of-life vehicles under NACE 51.57. For more information on end-of-life vehicles, see Appendix 8.

1 Sources

The primary data source for Recycling (NACE 37) is an optional total population survey using paper questionnaires. The frame consists of Statistics Sweden's Business Register and the object is local units (workplace) primarily coded as NACE 37.

Environmental reports have been used for a few local units as data sources to compensate for non-response in the questionnaire. This concerns local units that chose to send an environmental report (via e-mail or mail) instead of responding to the questionnaire and a few cases when environmental reports were available on the website.

Local units that chose not to respond to the questionnaire were followed up, i.e. directly by telephone.

2 Accuracy of data

The sub-survey has had serious problems with non-response. Furthermore, it is likely that some waste quantities have been counted twice as the same waste can be treated at several local units and can thus appear in the statistics more than once. Unfortunately this results in large errors that reduce accuracy to some extent.

2.1 Sampling errors

The survey was carried out using a postal questionnaire to all local units registered in the sector Recycling (NACE 37) in the Business Register. Data were retrieved from the Business Register on 16-03-2005. The survey has been carried out on the total population in the sector, 284 local units. Of these, 55 are included in the group dismantling of end-of-life vehicles, which were dealt with using the methods described in Appendix 8. The questionnaire survey thus covered the remaining 229

local units. Because the survey is directed towards the total population, there is no sampling error.

2.2 Non-sampling errors

2.2.1 COVERAGE ERRORS

2.2.1.1 Coverage errors regarding the population

Under and overcoverage problems identified when collecting data involve a few local units with the incorrect NACE classification in the Business Register. The information in the Business Register was also not completely up-to-date. Some registered local units were not active (overcoverage) while local units that started during 2004 or earlier were not registered (undercoverage).

The few local units, relating to transportation enterprises, consultancy offices or solely office-based operations, that were incorrectly classified in the Business Register have not been included in the compilation of material for NACE 37.

The statistical object applicable in the survey is local unit. Statistics Sweden's Business Register has been used. There is a risk that several types of activities can occur at the same local unit. This is only a problem when the various activities lead to NACE codes outside this sector. We do not know how great this particular problem is and we do not have a method or the intention of solving it.

2.2.1.2 Coverage errors regarding waste quantities

In some cases, there has also been a problem with identifying which waste code is the most appropriate. For example, data may have been submitted under the alternative "other waste". Furthermore, some types of waste have been reclassified after direct contacts with the enterprises or on the basis of expert assessments.

After studying the draft version of Eurostat's manual, it was decided that only types of waste that change character, i.e. change code in the list of waste, should be registered as generated. For NACE 37, this means that if waste is received as paper or plastic and then sorted at the facility, it should not be reported as generated. However, if waste is received as mixed waste and is sorted into plastic and paper, it does constitute generated waste.

Several local units within the sector receive waste from other local units within the sector. As it is not possible to differentiate these wastes using primary or secondary categorisation, we are aware that waste quantities can unintentionally be counted twice. Several of the facilities treating metal wastes by fragmentation have not responded to the questionnaire (nor the reminders) or by telephone. This can mean however that we avoid counting data twice, as material at fragmentation facilities largely comes from other facilities within NACE 37.

A number of local units have stated that they have either landfill or incineration of waste (with or without energy recovery). It has become clear however, from telephone interviews, that this is only the case at very few facilities.

Where the disposal of used oils, sewage sludge, mineral waste, etc. have been stated in the questionnaire, we have assumed that this waste has been generated by the facility if it has not been included at the beginning as “received waste”.

2.2.2 MEASUREMENT ERRORS

Estimated values have been permitted in the survey. This can affect the precision of the quantities given.

Quantities were requested in the questionnaire survey in tonnes. If respondents have the figures available in other units, we have requested in the questionnaire that these figures should be converted into tonnes by the respondent. If this has not been possible, we have requested that the other quantity unit be reported. When checking, we have then used our own standardised conversion factors to convert the units into tonnes. Some of these conversion factors are not particularly controversial, such as ton per m³ of oil, while others are more problematic, such as when the waste is mixed or when we do not know how compressed the waste is.

The survey is based on a paper questionnaire. The questionnaire has been tested in two ways:

- Both the questionnaire and covering letter have been examined and approved by the Board of Swedish Industry and Commerce for Better Regulation (NNR) and the Swedish Association of Local Authorities and Regions.
- Before beginning the questionnaire surveys, a pilot survey was implemented for treatment facilities, which proved a valuable exercise also when developing the survey on NACE 37.

The standardisation of the questionnaire design can have led to the respondents finding it difficult to understand what should be filled in and where in the questionnaire their data should be reported. For example, a table was included for NACE 37 for data on treated waste if the treatment took place at the local unit in question. In practice, few local units treat waste themselves but, because the table was provided, many filled in data on the treatment of waste - but on how it is treated externally rather than internally.

So that respondents should understand what should be filled in, a reference was made in the table section of the questionnaire to the back of the questionnaire where information and definitions were provided. Some of this information was also in the covering letter. Unfortunately there was not room to provide these definitions directly in the tables where the data were to be written. Experiences from other surveys show that there is consequently a great risk that many respondents do not read this information. This can lead to incorrect or doubtful data that can be hard to detect when checking.

2.2.3 PROCESSING ERRORS

All questionnaires received are processed in a systematic and consistent manner in order to minimise any processing errors. Completed data have undergone a rationality test and been corrected where necessary, on the basis of expert assessments or contacts with the responsible persons at the enterprises. This results of course in some uncertainty in data which are largely based on second-hand information and knowledge. Checked questionnaires are input manually in a database, which can lead to coding errors. There has not been any systematic analysis of whether this is a problem within the sector. Random comparisons of data on local units in the database and the corresponding questionnaires have been carried out to minimise processing errors as much as possible.

2.2.4 NON-RESPONSE ERRORS

The response rate for the whole sub-survey, including the groups dismantling end-of-life vehicles and other recycling was 61% on average. However, this figure is not relevant for the presented results as an alternative method was used to improve the estimations for end-of-life vehicles, see Appendix 8. Within the group "other recycling", responses were received from 127 of 229 local units which give a response rate of 55%. This response rate includes overcoverage that was detected when checking the submitted questionnaires and questionnaires sent in without any data, e.g. where the respondent refused to respond or local units have recently ceased to exist or are inactive.

Non-response problems have been addressed in a variety of ways: written reminders on one occasion to those not responding and then telephone reminders to larger local units within the group "other recycling" (>10 employees). These methods reduced non-response to some extent but several local units were not able to be reached or were not willing to respond to enquiries. The methods for reducing partial non-response and checking uncertain data included direct contacts with respondents by e-mail or telephone. Environmental reports have also been used for the imputation of non-response. Despite the measures that were taken in the first place to reduce non-response, a great deal of uncertainty remains.

When extrapolating waste quantities upwards to the total population for NACE 37 excluding dismantling of cars, local units that are thought to be involved in the dismantling of cars were excluded.

A problem that can be expected with non-response is greater uncertainty in the results from the survey after extrapolations to the total population for non-response. It has not been investigated if there was any significant difference between waste quantities in the non-response group compared to the responding group, i.e. if the survey showed a distorted result.

2.2.5 MODEL ASSUMPTION ERRORS

We have used model assumptions in the form of waste factors (0.1 ton/employee) for household waste generated and sorting/paper residues. Because the number of employees at local units within the sector NACE 37 is generally relatively low and because the waste factors can be assumed to be normally distributed, it can be assumed that this is a good approximation for estimating quantities on a total level.

When checking the questionnaire, it was noticed that many facilities stated a waste fraction remaining when sorting waste. The questionnaires which included sorting residues were therefore studied and a model was produced for every waste fraction. These models were then used for all the questionnaires and can be assumed to give a good approximation of waste quantities.

For information on the model used for end-of-life vehicles, see Appendix 8.

2.2.6 OTHER ERRORS AFFECTING ACCURACY

The questionnaire has been sent to the person responsible for environmental issues at the local units. It is possible that another person could be able to fill in the questionnaire more accurately or that non-response would be less if another person is addressed. In some specific examples, we have received two questionnaires from the same local unit with different data (normal and reminder), either from the same data provider or two different respondents.

5 Comparability

5.2 Regional comparability of waste treatment

Landfilling and waste incineration occurs to a minimal extent within Recycling (NACE 37). On the basis of the Mayer-Parry ruling, no recycling occurs within the sector. The activities carried out include sorting, grinding, baling, etc. that are preparations for recovery.

VALIDATION OF DATA REGARDING WASTE TREATMENT

The compiled results have been quality controlled by independent experts.

STATISTICAL UNITS

The objects are local units that, because the Business Register has been used, correspond to a local unit with a county and municipality code.

MOBILE WASTE TREATMENT

Because waste treatment occurs to such a minimal extent within NACE 37, data on mobile waste treatment have not been specifically requested in the questionnaire.

Appendix 7

Wholesale of waste and scrap (NACE 51.57)

The numbering of the sub-headings in this appendix refers to the corresponding sub-headings in Part II Quality attributes. We have here included those sections/sub-headings from Part II that are significant for the sub-survey in question. Otherwise, the information already described in Part II is applicable.

1 Sources

The data source for the Wholesale of waste and scrap sector (NACE 51.57) is an optional sample survey using paper questionnaires. The frame consists of Statistics Sweden's Business Register and the objects are local units primary coded as NACE 51.57. The total population NACE 51.57 consists of 873 local units. A stratified sample of 487 local units was drawn from this population in March 2005. Questionnaires were sent to respondents at the end of March 2005, giving them four weeks to respond. A reminder letter together with a new questionnaire was sent thereafter to local units that did not respond. Telephone enquiries to a sample of the larger local units were carried out in September.

As the response rate and quality of responses for the sub-sector Dismantling of end-of-life vehicles (NACE 51.571) were particularly unsatisfactory, it was decided at an early stage in the survey to use a different method for this sector, see Appendix 8.

2 Accuracy of data

2.1 Sampling errors

In order to reduce the costs to society and the burden on respondents, the survey has been carried out using a stratified sample. This results naturally in a sampling error. As established statistical methods have been used, statistical extrapolations to the sample can compensate for a large part of this error.

2.2 Non-sampling errors

2.2.1 COVERAGE ERRORS

2.2.1.1 Coverage errors regarding the population

Under and overcoverage problems occur because some local units have an incorrect NACE code in the Business Register. Another problem is that the Business Register is not comprehensively updated. For example, local units that have ceased to exist or are inactive are reported as active (overcoverage) and some enterprises started during 2004 or earlier are not included (undercoverage). Several other local units that are registered as NACE 51.57 in the Business Register only work with administration and do not carry out any activities related to sorting or collecting waste.

Furthermore, the statistical object applicable in the survey is local units. It is possible that several types of activity, possibly in different industries, are carried out at one local unit. As the other questionnaire surveys are also based on local units (with the exception of incineration facilities within NACE E), this should not lead to any significant coverage error.

2.2.1.2 Coverage errors regarding waste quantities

The types of waste occurring from activities within the Wholesale of waste and scrap (NACE 51.57) are primarily sorting residues, household waste or office waste. Waste resulting from the usage of vehicles and machinery may also occur. The majority of local units in this industry are very small which means that the use of machinery is not so widespread.

We decided that only the types of waste that change character, i.e. change classification, should be registered as generated waste. For NACE 51.57, this means that if waste is received as paper or plastic and then sorted at the facility, it should not be reported as waste generated but will instead appear as sorting residue. However if waste is received as mixed waste and sorted at the facility into plastic and paper, it will appear as waste generated.

In occasional cases, local units within NACE 51.57 can receive waste quantities from other local units within the same sector. As it is not possible to differentiate between this waste using primary or secondary categorisation, waste quantities may be counted twice. Discarded vehicles may have been reported in other sectors, such as households, which may also lead to these being counted twice.

2.2.2 MEASUREMENT ERRORS

The questionnaires were given a uniform design, with only slight variations to match the different types of operations. This standardisation of the questionnaire design can have led to respondents finding it difficult to understand what should be filled in and where in the questionnaire their data should be reported. The majority of local units are small, often one-man businesses. The respondent (often the owner) may not be familiar with the terminology and language that is used in the

questionnaires. The questionnaire margin contains further information on waste. Similar information is also provided in the covering letter. There is unfortunately a risk that many respondents do not read this information, which can lead to incorrect or doubtful data that can be hard to detect when checking.

In some cases, it has been difficult to determine which EWC-Stat code is the most appropriate. For example, data may have been submitted under the alternative "other". Some types of waste have in some cases been categorised after contact with respondents or on the basis of expert opinion. However, more such cases can have been overlooked.

Respondents have, in many cases, given the same quantity for waste received and generated, which is interpreted as a misunderstanding when checking.

Estimated values have been permitted in the survey. This can affect the precision of the quantities given.

Quantities were requested in the questionnaire survey in tonnes. If respondents have used another unit, we have requested in the questionnaire that this quantity unit should be converted into tonnes. If this has not been possible, we have requested that the other quantity unit be reported.

2.2.3 PROCESSING ERRORS

All questionnaires received are processed in a systematic and consistent manner in order to minimise errors. Completed data have undergone a rationality test and been corrected where necessary on the basis of expert opinions or contacts with the responsible persons at the enterprises. This results, of course, in some uncertainty in data which are largely based on second-hand information and knowledge.

When waste quantities have been given in units other than tonnes (i.e. piece, m³, container, kg, barrel), we have used our own standardised conversion factors when checking. Some of the conversion factors are not particularly controversial, such as ton per m³ of oil, while others are more problematic, i.e. when the waste has been mixed or when we do not know how compressed the waste is.

When registering the submitted questionnaire responses in the working database, there has been some risk that data are coded incorrectly. Small errors of this kind have in many cases not been detected. Larger errors, such as errors in the number of zeros, have probably been detected in most cases when a thorough analysis of the survey results is carried out, with aggregations of various kinds, such as by industry, size category and type of waste.

The questionnaires have been checked in batches and figures have been changed. The checked questionnaires with the new figures have been input manually into the database which can lead to interpretation errors. To minimise these errors, all data in the database have been checked and corrected where necessary.

2.2.4 NON-RESPONSE ERRORS

The response rate for the whole survey on NACE 51.57 was 27% on average. This includes both end-of-life vehicles (NACE 51.571) and other wholesale waste products and scrap (NACE 51.572 and 51.573). When taking away the group dismantling of end-of-life vehicles for which a different method was used (see Appendix

8), the response rate amounts to 37% for the remaining sectors within NACE 51.57. Enterprises (particularly the small ones) were often unwilling to fill in the questionnaire due to lack of time and/or because participation was not obligatory. In a few cases, the local unit has not had its own address, which means that the questionnaire has been sent to the administrator. This increases non-response.

In order to reduce the non-response, the following measures were used:

- One written reminder was sent to those not responding to the questionnaire.
- Direct contact with respondents was made by e-mail and/or telephone to reduce partial non-response and to check ambiguous data.
- Environmental reports have been used for imputation in some cases.

One problem that can be expected due to non-response is greater uncertainty in the results from the survey, after extrapolation to the total population to compensate for sampling and non-response. It has not been investigated if there was any significant difference between waste quantities in the non-response group compared to the responding group, i.e. if the survey results were in any way distorted.

2.2.5 MODEL ASSUMPTION ERRORS

When checking the questionnaires, it was noticed that many facilities stated a waste fraction as remaining when sorting waste. The questionnaires giving sorting residues were therefore studied and a model was produced for every waste fraction. These models were then used for all questionnaires within both NACE 51.57 and NACE 37. Table B.71 shows the estimated factors for these types of waste, produced on the basis of discussions with waste experts and estimations based on the stated quantities.

Table B7.1. Estimated shares of sorting residues for metal, glass, paper and plastic

Sorted materials	Sorting residue
Metal	1%
Glass	13%
Paper	0.5%
Plastic	9%

We have also used waste factors (0.1 ton/employee) for household waste generated. Small enterprises rarely have own employees as it is usually only the owner who works within the enterprise, which can mean that some quantities of household waste have not been included in the calculations. In the cases where 0 employees are noted for a local unit that has still carried out some activity, we have assumed that it has been the owner who has carried out the work and have therefore added 0.1 tonnes of generated household waste.

All the models used constitute a simplification of reality and therefore introduce an error into the data. However this error is not considered to have any greater significance for the compiled final results. For errors in the model used for end-of-life vehicles within NACE 51.57, see Appendix 8.

2.2.6 OTHER ERRORS AFFECTING ACCURACY

The questionnaire has been sent to the person responsible for environmental issues at the local units. It is possible that another person could be able to fill in the questionnaire more accurately or that non-response would be less if another person was addressed. In some specific examples, we have received two questionnaires from the same local unit with different data (normal and reminder), either from the same respondent or two different respondents.

5 Comparability

5.2 Regional comparability of waste treatment

Waste treatment does not occur in this industry.

Appendix 8

Dismantling of end-of-life-vehicles within NACE 37 and 51.57

The numbering of the sub-headings in this appendix refers to the corresponding sub-headings in Part II Quality attributes. We have here included those sections/sub-headings from Part II that are significant for the sub-survey in question. Otherwise, the information already described in Part II is applicable.

1 Sources

Many facilities within NACE 37 and NACE 51.571 which carry out car dismantling are members of the Swedish Car Recyclers Association (SBR). Every year, the SBR carries out a questionnaire survey among its members, producing data on the number of scrapping certificates issued and on the quantity of waste generated for a number of selected waste types. Contact has been made with the SBR and we have been given access to the questionnaires regarding 2003 and 2004. These total quantities cannot be used as a measurement of the total quantity of waste because not all car dismantling facilities are members of the SBR. The figures can instead be used to calculate waste factors for each type of waste.

Data taken from the SBR's survey for 2003 and 2004 have been input into an Excel database and converted into EWC-Stat codes by combining some of the variables (types of waste). In some cases, the units given are converted to weight units. Weights for each type of waste are added together. The respective waste factors are obtained by dividing the total weights for each type of waste with the number of scrapping certificates issued.

The Swedish Road Administration compiles data on the total number of scrapping certificates issued in Sweden each year. Using simple multiplication of the waste factors and the number of issued scrapping certificates from the Road Administration, it is possible to obtain estimates of total waste quantities in tonnes for each type of waste.

2 Accuracy of data

2.1 Sampling errors

Not applicable for this sector.

2.2 Non-sampling errors

2.2.1 COVERAGE ERRORS

The SBR's questionnaire has been used as a basis for the waste factors. We consider the following as possible coverage errors for this questionnaire:

2.2.1.1 Coverage errors regarding the population

There is a risk that certain types of vehicle are not represented among the SBR's members, such as the dismantling of trucks and buses.

2.2.1.2 Coverage errors regarding waste quantities

The number of scrapped cars does not always correspond with the number of scrapping certificates because a car dismantling facility may deal with cars that have been stored from previous years. Coverage errors regarding waste quantities can also be caused when not all scrapped cars have received a scrapping certificate. This refers to crashed cars, for example.

As certain types of dismantling facility are not represented in the SBR, there can have been an underestimation of waste quantities.

2.2.2 MEASUREMENT ERRORS

The statistical unit for car dismantling is ton of waste per scrapping certificate. The measurement error is primarily caused when the information in the SBR questionnaire is not given in the correct unit. There is a risk that the quantities given in tonnes actually refer to kg and vice versa. As the method of developing waste factors per scrapping certificate is based on averages, some waste factors have serious errors. This is generally in cases where very few facilities state a particular type of waste.

2.2.3 PROCESSING ERRORS

Data from the SBR questionnaire have been input in an Excel database. In several cases, recalculations were required to convert the units given in the questionnaires (i.e. item, m³, container, kg, barrel) to tonnes. Standardised conversion factors are then used. There can be mistakes in the calculation of certain types of waste, particularly when data include problematic units, such as barrel, container, oil filters and tyres with or without rims.

Waste categories in the SBR questionnaire were reported according to the list of waste and not according to EWC-Stat codes. In order to obtain EWC-Stat codes, it was necessary to combine several types of waste category and convert to EWC-Stat codes. This results in a risk for errors in coding, which we consider to be relatively small.

In cases where the car dismantling facility has not given the number of scrapping certificates, this has been imputed from the number of car bodies sorted to metal fragmentation. This also contributes to processing errors.

2.2.4 NON-RESPONSE ERRORS

The response rate for the SBR questionnaire that has been used as the basis was fairly satisfactory for 2003 (63%) but worse for 2004 (39%). This non-response obviously has an effect on our results. It is however not possible to quantify this error.

2.2.5 MODEL ASSUMPTION ERRORS

Model errors can occur in the assumption that the number of scrapping certificates is proportional to the quantity of waste.

Some of the objects in the SBR sample may be extremes in some way. As the values for these objects are then multiplied by a factor of 10, the result can be a large over-evaluation of one type of waste. This error is not easy to detect unless it is so significant in various compilations that an experienced waste/industry expert can detect the "error". Even when this type of error is detected, it is not clear how it should be addressed.

Local units that are principally engaged in the dismantling of cars are partly classified as Recycling (NACE 37) and partly as Wholesale of waste and scrap (NACE 51.57). This means that car dismantling can occur under two items in the reporting according to the waste statistics regulation and thus the waste quantities generated should be divided up between these two in some way. The estimated quantities of waste generated have been divided proportionally to the number of employees in the respective NACE group. There can be a poor correlation between the number of employees and the quantities of waste, which can result in errors. This error will become smaller as more surveys are carried out, as better models can be developed to describe the connection between quantities of waste and number of employees in the different NACE groups and size classes.

5 Comparability

These statistics correspond well when compared with statistics from motor industry organisation BilSweden for 2004.

5.2 Regional comparability of waste treatment

Waste treatment does not occur in this industry.

Appendix 9

Collection and treatment of sewage (NACE 90.01)

The numbering of the sub-headings in this appendix refers to the corresponding sub-headings in Part II Quality attributes. We have here included those sections/sub-headings from Part II that are significant for the sub-survey in question. Otherwise, the information already described in Part II is applicable.

1 Sources

Sweden's reporting to the European Environment Information and Observation Network (EIONET) in accordance with Directive 86/278 for 2001, 2002, and 2003⁴⁷.

2 Accuracy of data

The primary reasons for uncertainty regarding the quantity of dry matter are considered to be the lack of clarity in definitions (rotten or not, in addition to other process stages), and the risks of confusing wet and dry weights when registering data from environmental reports. Overall uncertainty about the quantity of dry matter is judged to be from -20% to + 50%.

2.1 Sampling errors

Not applicable for this sector.

2.2 Non-sampling errors

2.2.1 COVERAGE ERRORS

2.2.1.1 Coverage errors regarding the population

There are slightly over 400 sewage treatment facilities that are known to produce sludge. It is considered that these also treat sludge generated in smaller sewage facilities and sludge from individual sewers. This assumption is partly supported in the results from a questionnaire survey carried out in 1999 on sewage treatment techniques for facilities designed for over 200 person equivalents. One of the ques-

⁴⁷ SMED report: International reporting of sludge statistics 2004, Appendix 2, November 2004.

tions on the treatment of sewage in the questionnaire referred specifically to how much sludge is sent to the sewage treatment facility.⁴⁸

2.2.1.2 Coverage errors regarding waste quantities

The method chosen should give 100% coverage of waste generated as well as recovery and disposal within the sector.

2.2.2 MEASUREMENT ERRORS

The quantity of dry matter in the annual production of sludge can be both defined and estimated in different ways and according to different procedures. The calculation of quantity is based on different measurements/estimates of wet weights and dry matter content in one stage of production, most likely after anaerobic fermentation. We are not clear on the details of this method.

2.2.3 PROCESSING ERRORS

Both wet weights and quantities of dry matter can be registered in EMIR. These parameters are sometimes confused. If an incorrect registration is not detected and corrected when the statistics are compiled, errors can occur to a factor of about 5, which together can lead to overestimations of the quantity of dry matter.

2.2.4 NON-RESPONSE ERRORS

Compensation for non-response data on sludge quantities generated is only carried out for a small number of facilities. In these cases, the quantity is assumed to be the same as the quantity from the previous compilation of statistics. The resulting error is considered to be small compared to other types of error.

2.2.5 MODEL ASSUMPTION ERRORS

The following assumptions have been made:

Production measured in dry matter in 2004 is assumed to be the same as that assumed in the reference report during the period 2001-2003.

The average dry matter content is assumed to be 22%.

It is believed that the slightly over 400 sewage treatment facilities that are known to produce sludge also treat sludge generated in smaller sewage facilities and sludge from individual sewers.

Assumption 2 is a pure model. We consider that the other two assumptions are reasonably well supported.

⁴⁸ The presentation of results is included in the SMED report Actual technical data for sewage treatment facilities, 2003

5 Comparability

5.2 Regional comparability of waste treatment

Not applicable for the sector as no treatment of waste is thought to occur.

Appendix 10

Collection and treatment of other waste (NACE 90.02)

The numbering of the sub-headings in this appendix refers to the corresponding sub-headings in Part II Quality attributes. We have here included those sections/sub-headings from Part II that are significant for the sub-survey in question. Otherwise, the information already described in Part II is applicable.

1. Sources

The data source for the sub-survey Treatment of waste (NACE 90.02) is an optional total population survey with paper questionnaires directed to waste treatment facilities such as landfill sites, composting facilities, anaerobic digestion facilities, incineration facilities for the disposal of waste (see exception in Appendix 5, NACE G-Q).

Facilities that only constitute intermediary storage facilities, recycling depots, sorting facilities and preparation facilities have not been included in the target population. Other facilities not covered include incineration facilities for energy production (see Appendix 3, Electricity, gas, steam and hot water supply NACE 40), treatment facilities linked to mining and manufacturing industries (see Appendix 2, Mining and Manufacturing industries NACE C and D), car dismantling (see Appendix 8, Recycling NACE 37 and Wholesale of waste and scrap NACE 51.57) etc.

The frame has been put together using data from three different registers. Firstly, the EMIR register from the Swedish Environmental Protection Agency is an important basic source, containing all A and B classified operations in Sweden⁴⁹. Waste treatment facilities that are assumed to be active have been taken from this register. Secondly, the Swedish Association of Waste Management also has a register of treatment facilities to enable them to carry out annual statistical surveys. This register contains facilities that receive and treat household waste in Sweden. Finally, the frame is supplemented with data from the SMED project "DIA", in which a register of facilities was compiled together with some facility and statistical data at the request of the Swedish Environmental Protection Agency for international reporting in 2003. The final register used as a frame for the survey on NACE 90.02 contained a total of 587 facilities that were thought to be active and relevant. After the sorting process described below, there were 437 facilities remaining.

⁴⁹ See Ordinance 1998:899 on environmentally harmful activities and health protection. "A"-classified operations require permission from the Environmental Court, while "B"-classified operations require permission from the county administration.

A questionnaire survey was carried out in three stages: a first mailing plus two reminder mailings (in May, June and August 2005 respectively). The final mailing requested that facilities should respond whether they were active or not. They were also given the possibility of sending in their environmental report instead if they did not have time to respond to the questionnaire.

Attempts to contact the treatment facilities that did not respond to the questionnaire were made by telephone. The aim was to check whether the facility was active or not, whether they should be included in the survey frame (correct non-response or frame overcoverage), as well as to try and obtain the questionnaire responses/ environmental reports for the most important facilities. It was possible to sort out a number of facilities from the survey on the basis of these efforts and of supplementary expert assessments on the objects in the survey frame and the questionnaire responses received. In order to compensate for "correct" non-response, the environmental reports sent in have been used. As a final resort, when such reports have not been available, facility data from the Swedish Association of Waste Management regarding 2003 have been used.

The sorting work meant that facilities and questionnaire responses could be removed or redirected to adjacent sub-surveys.

2 Accuracy of data

Measurement errors and partial non-response are the types of error that have had the greatest effect on the statistical result.

2.1 Sampling errors

Not applicable for this sub-survey which is a total population survey.

2.2 Non-sampling errors

2.2.1 COVERAGE ERRORS

2.2.1.1 Coverage errors regarding the population

The frame in the total population survey contains considerable overcoverage, something which has become apparent during the implementation of the questionnaire survey. This has been addressed by sorting out overcoverage objects or re-locating questionnaire responses to adjacent surveys. The remaining overcoverage is considered to be limited in the survey.

Undercoverage is, for obvious reasons, harder to identify. Despite the original frame containing overcoverage of 150 facilities, it is theoretically possible that some facilities can have been missed. The possibility of being able to balance the three different registers against one another has however eliminated the risk of omitting treatment facilities. All of the facilities within the Swedish Association of

Waste Management have been covered in this survey. We can therefore draw the conclusion that undercoverage (if it exists at all) is very limited.

2.2.1.2 Coverage errors regarding waste quantities

An overall assessment of the compiled statistics regarding "quantities treated" is that, on the whole, they cover waste quantities well. "Quantities generated" can be marred by underestimation, whereas treatment capacity data can contain overestimations, particularly with regards to landfill capacity. See further information in section 2.2.2.

2.2.2 MEASUREMENT ERRORS

The questionnaires used for data collection apply the concepts from EU waste legislation and the EU Regulation on Waste Statistics. It is expected that respondents should be able to recognise and understand these concepts. Supplementary information in the form of examples and conversion tables between the list of waste and EWC-Stat has been provided in the questionnaire's covering letter and on a special website on the Internet. Experiences from this and other surveys show that there is a great risk that many respondents do not read this information, which can lead to incorrect or doubtful questionnaire responses that can be hard to detect when checking. However when carrying out supplementary work in the form of further contacts with respondents, such errors can be detected and respondents have been able to clarify and correct their responses.

The questionnaire for the sample survey has been tested in two ways:

- Questionnaires were tested in a pilot project which preceded the questionnaire survey. The results of the pilot study were taken into consideration to some extent.
- The questionnaire and covering letter have been sent for comments to the Board of Swedish Industry and Commerce for Better Regulation (NNR) and the Swedish Association of Local Authorities and Regions.

Estimated values have been permitted in the survey. This can affect the precision regarding the quantities given.

A large number of telephone calls have been received from respondents with enquiries about the classification of waste types and concepts such as "generation of waste". The quality of responses regarding the classification of waste types is considered to be reasonably good. However, data on the "generation of waste" can be considerably more uncertain. This concept is not normally used by those working in the sector and these internal waste flows are rarely measured or weighed. "Preparation for recycling or recovery" (pre-treatment) is also often confused with "recycling" and "recovery", as interpreted according to the Mayer-Parry ruling. Those checking the questionnaires have scrutinised such data especially carefully.

Capacities for which permits are required are not formulated in a standardised way on the permits received by those working in the sector for carrying out their work. This means that these data are considerably more uncertain than treated

quantities, for example, even if these data have been checked and amended as carefully as possible.

In the majority of cases, quantities are requested in the unit tonnes. If respondents have used another unit, we requested in the questionnaire that this quantity unit should be converted into tonnes. If this has not been possible, we have requested that the other quantity unit be reported. When checking, we have then used our own standardised conversion factors to convert to tonnes. Some of the conversion factors are not particularly controversial, such as ton per m³ of oil, while others are more problematic, i.e. when the waste has been mixed or when we do not know how compressed the waste is. See also section 2.2.5 below.

2.2.3 PROCESSING ERRORS

The comprehensive checking procedures have consisted of several stages at *questionnaire* level:

- estimation of rationality of the questionnaire responses
- comparisons with other data sources, i.e. environmental reports from facilities with permits where this has been possible and considered necessary

The comprehensive checking procedures have consisted of several stages at *aggregated* level:

- estimation of rationality on an aggregated level
- comparisons with other data sources where such alternative statistical sources have existed, i.e. statistics from the Swedish Association of Waste Management

These methods have sometimes led to the correction of questionnaire data.

When registering the submitted questionnaire responses in the working database, there has been some risk that data has been coded incorrectly. In most cases, it has not been possible to detect small errors of this kind. Larger errors, such as errors in the magnitude have probably been detected in most cases when aggregations of various kinds have been carried out during a thorough analysis of the survey results. When studying aggregated data, a number of unreasonable data has appeared, which it has been possible to correct either in the questionnaires (checking misses) or in the database (input errors).

Coding errors relating to regions do not occur in this survey as the unique facility numbers used include a municipality code, which makes regional divisions of data possible and accurate.

2.2.4 NON-RESPONSE ERRORS

The final object non-response consists, after sorting, of around 8% of treatment facilities (33 facilities). No general statistical adjustment has been done of the final non-response. This is because these facilities/enterprises can very likely constitute “overcoverage” of various types instead of “true” non-response. Another reason is that they do not seem to be representative for the population as a whole as they are

generally small and divergent facilities. It is therefore assumed in the survey that this group does not produce or treat any waste, nor is there thought to be any treatment capacity at these facilities.

The effect of partial non-response is described in section 2.2.5 below.

2.2.5 MODEL ASSUMPTION ERRORS

The submitted questionnaire responses have been amended or supplemented after checking for various reasons such as partial non-response or conversion to requested weights/units. This has been normal for the generation of waste, e.g. for household waste and leachate water, treatment capacities, etc. A number of conversion factors for imputation/correction have been developed for this purpose. Some of these conversion factors are calculated, some are documented data from published sources and some are "expert assessments", i.e. documented data from subject experts. These conversion factors can correspond to a greater or lesser extent to the reality for the individual facilities. On the whole, such imputations make the statistics considerably more accurate than they would be without these measures.

2.2.6 OTHER ERRORS AFFECTING ACCURACY

The questionnaire has been sent to the person responsible for environmental issues at the local units. It is possible that another person could be able to fill in the questionnaire more accurately or that non-response would be less if another person was addressed. In some specific examples, we have received two questionnaires from the same local unit with different data (normal and reminder), either from the same respondent or two different respondents.

5 Comparability

5.2 Regional comparability of waste treatment

VALIDATION OF DATA REGARDING WASTE TREATMENT

The high response rate, including the imputation efforts, means that there should not be regional differences regarding coverage. The compiled results have also been quality controlled by independent experts.

STATISTICAL UNITS

The survey object has been treatment facilities. Every facility in the register EMIR has a unique facility number received when they are issued a permit. The four first digits in this number refer to a municipality code. Regional comparability is therefore good in this respect.

MOBILE WASTE TREATMENT

No mobile waste treatment facilities have been identified within the frame.

Appendix 11

Sanitation and related activities (NACE 90.03)

The numbering of the sub-headings in this appendix refers to the corresponding sub-headings in Part II Quality attributes. We have here included those sections/sub-headings from Part II that are significant for the sub-survey in question. Otherwise, the information already described in Part II is applicable.

1 Sources

The sources used are persons responsible for the sanitation of streets, parks and gardens within the different municipalities. We have collected data via a telephone survey to these persons (often at least two people in each municipality).

2 Accuracy of data

2.1 Sampling errors

When planning, an assessment was made that the sector Sanitation etc. (NACE 90.03) would contribute relatively small quantities of waste, compared to NACE 90 as a whole. It was therefore decided to carry out a limited survey of NACE 90.03, in order to determine whether this sub-sector was of importance or not. The Swedish Association of Local Authorities and Regions has divided Sweden's 290 municipalities into 9 different categories: city municipalities, suburban municipalities, larger towns, commuter municipalities, rural municipalities, goods-producing municipalities, other municipalities with more than 25 000 inhabitants, other municipalities with 12 500 – 25 000 inhabitants, other municipalities with less than 12 500 inhabitants. 32 municipalities representing all 9 categories were selected randomly. The sample in this survey consisted of at least 3 municipalities from each category and is representative for the entire population.

2.2 Non-sampling errors

2.2.1 COVERAGE ERRORS

2.2.1.1 Coverage errors regarding the population

The sample is limited. We randomly selected 32 municipalities (which represented all 9 municipality categories). We received usable responses from 15 municipalities covering roughly 14% of Sweden's population and representing 7 out of 9 municipality categories.

2.2.1.2 Coverage errors regarding waste quantities

Almost all data are estimated by the respondents. Very few municipalities keep records on data of this kind. The estimates are, as far as we can see, reasonable but there is nothing to check the data against.

Extrapolations have been made using population data as a basis. For municipalities that could respond to the questions, the quantity of waste per capita has been calculated for the different waste categories. The mean value of these in the responding municipalities was then extrapolated to national level (responses were received from municipalities with 1 261 918 inhabitants, whereas there were 8 975 670 inhabitants in the whole country). The quantity of waste per inhabitant varied relatively greatly between the responding municipalities. The standard deviation was of the size of 200 - 300% of the mean value. The standard deviation was least for the category "mineral waste" (grit swept after gritting treatments), where it was 119%.

2.2.2 MEASUREMENT ERRORS

Only a few of the municipalities we contacted had the amounts in written records. To a great extent, the data collected are estimates made by the persons responsible in each municipality. These estimates made by the respondents can therefore be incorrect. This can result in measurement errors that are not possible to quantify.

2.2.3 PROCESSING ERRORS

Not applicable for NACE 90.03.

2.2.4 NON-RESPONSE ERRORS

Of the 32 selected municipalities, we managed to reach 22 municipalities and received usable results from 15. Of these, 9 submitted all the data requested, 6 gave incomplete data, 4 did not contact us as promised and 3 did not have the possibility to produce the data requested.

2.2.5 MODEL ASSUMPTION ERRORS

Data have been extrapolated to correspond to the total number of inhabitants in Sweden. This is not a completely correct model as it can be assumed that the quantity of waste from sanitation services is not only directly related to the number of inhabitants but also relates to other factors, such as the road network, existence of parks and green areas, etc. We still consider that the error is relatively small.

5 Comparability

5.2 Regional comparability of waste treatment

Not applicable for NACE 90.03 as we assume that no such treatment occurs within sector.

Appendix 12

Households

The numbering of the sub-headings in this appendix refers to the corresponding sub-headings in Part II Quality attributes. We have here included those sections/sub-headings from Part II that are significant for the sub-survey in question. Otherwise, the information already described in Part II is applicable.

1 Sources

Data on waste quantities have been collected and an assessment has been made on how much comes from households, using contacts with the following organisations:

- AB Svenska Returpack (an organisation responsible for recycling of aluminium cans and PET bottles within the producer's responsibility)
- Apoteket AB (the national cooperation of Swedish pharmacies)
- BIL Sweden (representing manufacturers and importers of cars, trucks and buses)
- El-Kretsen AB (service company within electrical and electronic trade associations with the task to practically fulfil the producer's responsibility for WEEE)
- IVL Swedish Environmental Research Institute
- NSR (Nordvästra Skånes Renhållnings AB: a municipality-owned waste and recycling company in Northwest Skåne)
- Plastkretsen AB (an organisation responsible for recycling of plastic packaging within the producer's responsibility)
- Pressretur AB (an organisation responsible for recycling of paper within the producer's responsibility)
- Returkartong AB (an organisation responsible for recycling of cardboard within the producer's responsibility)
- SCB - Statistics Sweden, units for Environment and Tourism, Regional Planning and Natural Resource Statistics and Transport
- SDAB (Swedish Tyre Recycling Organisation: an organisation responsible for the producer's responsibility for tyres)
- Svensk GlasÅtervinning AB (an organisation responsible for recycling of glass within the producer's responsibility)
- Swedish Brewers' Association
- Svenska MetallKretsen AB (recycling of metal within the producer's responsibility)
- RVF – the Swedish Association of Waste Management
- Valla Däck AB (private tyre company, which has given information on consumption of tyres)

- Swedish Road Association Traffic Register (for information on end-of-life vehicles)

2 Accuracy of data

Producer responsibility entails that producers (via materials companies) are responsible for reporting waste quantities to the Swedish Environmental Protection Agency. This means that total figures for the types of waste affected by producer responsibility are very accurate. When statistics on the share of waste generated from households are not available, an assessment has been made by experts in the subject. These assessments are therefore the best possible. The same is applicable for types of waste not included under producer responsibility.

The source of error that affects results to the greatest extent is probably that waste from households is rarely collected/reported separately and is therefore mixed with other household waste, from offices or shops, for example.

2.1 Sampling errors

Not applicable for households.

2.2 Non-sampling errors

2.2.1 COVERAGE ERRORS

The majority of household waste is collected by the municipality's contractor directly at the property or is brought by the household to "recycling stations" (waste covered by producer's responsibility), recycling centres (bulky waste, garden waste, domestic building and construction waste and similar, environmental stations (hazardous waste) or other collection sites. The method used to give 100 % coverage is based on these waste flows. Exceptions include discarded vehicles and rubber waste, which is calculated from the number of scrapping certificates and the number of vehicles in traffic. For every waste type, an expert assessment has been given on how much of this comes from households and how much from shops, offices, etc.

2.2.1.1 Coverage errors regarding the population

Recycling stations and recycling centres are primarily for private individuals, i.e. households. In practice, however, some waste is included from small enterprises, for example. It is not possible to distinguish this quantity and it has therefore been assumed that all packaging waste brought to recycling stations comes from households. This also relates to pharmaceutical waste brought to pharmacies. There is thus a risk for overcoverage, i.e. that waste quantities generated in other sectors may be counted within the household sector. The industry experts consulted considered that counting all the above-mentioned waste in the household sector gives a better result than trying to estimate how large a share comes from shops, offices,

etc. The assessments made on households' share of the different waste types are in most cases estimates from industry experts, which naturally results in risks for both over and undercoverage.

2.2.1.2 Coverage errors regarding waste quantities

Existing data on waste from households refer in most cases to treated waste. In order to be able to calculate the quantity of waste generated from households, it has been assumed that this is the same as treated waste. This leads to some under-reporting but this is not considered to have a significant effect on the total result.

The methods used for calculating households' generated waste involve some simplifications. For example, mineral waste or waste containing PCBs are not considered to be generated by households despite the fact that, to some extent, they are. This is because it is difficult to obtain data on these types of waste and that it relates to small quantities of waste that are not considered to lead to any greater error in the final results.

Certain types of waste are generated by households but are not sorted into a specific fraction, such as textile waste and non-hazardous discarded equipment. These cannot be measured and are therefore included in the item household and similar wastes.

Hazardous waste is reported as a total figure from the Swedish Association of Waste Management, with the exception of discarded vehicles and discarded equipment. The total figure is, according to the Swedish Association of Waste Management, of good quality but the divisions into different types of waste that we had access to were based on relatively few observations and therefore lead to some uncertainty in the quantities of the waste types included.

2.2.2 MEASUREMENT ERRORS

Not applicable for households.

2.2.3 PROCESSING ERRORS

Not applicable for households.

2.2.4 NON-RESPONSE ERRORS

Not applicable for households.

2.2.5 MODEL ASSUMPTION ERRORS

Rubber waste has been calculated by multiplying the number of privately-owned vehicles in traffic by the number of tyre changes per year and the weight of the tyres. For passenger cars, light trucks and light buses, these figures have been obtained from industry experts that have a sound basis for their estimations. For motorcycles, very rough estimations have been made for average weight and number of tyre changes per year and the figures can therefore differ somewhat from reality. As passenger cars are the clear dominant factor when considering rubber waste,

errors in tyre weight and number of tyre changes for motorcycles only leads to a very small error in the total results.

The same applies for discarded vehicles, where the number of privately-owned scrapped vehicles has been multiplied by the vehicle's average weight. The average weight for motorcycles is uncertain but, because passenger cars are dominant for the total result, it is judged that motorcycle weight is of minor importance.

For the calculation of sludge quantities from individual sewers, it has been assumed in the model that one person gives rise to 175 g sludge (dry matter) per day. This is a model previously used by the Swedish Environmental Research Institute. There is a risk that the model value differs from reality but the model is still considered to be the best available. A change in the model value has a relatively large effect on the final result which is why the quantity of sludge generated has been given a coefficient of variation of 20 % for dry weight and 40 % for wet weight, where even the assessment of dry matter affects uncertainty.

2.2.6 OTHER ERRORS AFFECTING ACCURACY

One source of error for which it is difficult to estimate the significance is the quality of the data. The majority of data has been provided primarily by the materials companies and the Swedish Association of Waste Management. The figures are considered to be of good quality but, because they have partly been provided using questionnaire surveys, they naturally contain non-response, measurement and processing errors. In order to calculate uncertainty of the total results for waste from households, an error margin of 5 % has been added to all second-hand data.

5 Comparability

5.2 Regional comparability of waste treatment

Waste treatment is not applicable for households.

Appendix 13

Recovery and disposal of waste

The numbering of the sub-headings in this appendix refers to the corresponding sub-headings in Part II Quality attributes. We have here included those sections/sub-headings from Part II that are significant for the sub-survey in question. Otherwise, the information already described in Part II is applicable.

1 Sources

Data on recovery and disposal have been produced sector by sector within the surveys described in Appendices 1 – 12 (with the exception that waste treatment does not occur in all industries):

- Agriculture, hunting and forestry (NACE A) and Fishing (NACE B): No waste treatment is thought to occur. We have not considered the use of fertiliser, sludge, compost and biofertiliser as recycling that should be reported, see Appendix 1.
- Mining and quarrying (NACE C) and Manufacturing (NACE D): Recovery and disposal have been studied in questionnaire surveys together with generated waste, see Appendix 2. There are several different types of recovery and disposal operations occurring within NACE C and NACE D.
- Energy, gas and water supply (NACE E): Recovery and disposal have been studied in questionnaire surveys together with generated waste, see Appendix 3. Waste treatment occurs primarily in the form of incineration with energy recovery (R1), both of wood waste and of municipal waste. Other types of waste treatment occur only at occasional facilities.
- Construction industry (NACE F): The only recovery occurring is the recycling of excavation materials.
- Service sector (NACE G-Q excluding 37 and 51.57): Some treatment facilities exist within the service sector, such as cremation facilities for small animals, treatment of animal carcasses and hospitals. The military also have some facilities for the treatment of contaminated soil.
- Recycling (NACE 37): It is primarily pre-treatment that occurs. This should not be reported according to the waste statistics regulation.
- Wholesale trade in waste and scrap (NACE 51.57): Primarily intermediate storage and, occasionally, pre-treatment occur here. These should not be reported according to the waste statistics regulation.
- Sewage and refuse disposal, sanitation and similar activities (NACE 90): Recovery and disposal within Refuse disposal (NACE 90.02) have been studied in questionnaire surveys together with generated waste, see Appendix 10. No treatment occurs in the sub-sectors Collection and treatment of sewage (90.01) and Sanitation and related activities (90.03).

- Waste from households: No waste treatment is considered to occur. Home composting has been regarded as internal recycling which should not be re-reported.

2 Accuracy

The source of error that affects the results to the greatest extent can probably be linked to non-response and sampling, primarily in the sub-survey relating to the manufacturing industry (NACE D), where several large important local units have not submitted data despite great efforts with reminders. Within NACE D, waste treatment is also extrapolated from the sample surveys.

2.1 Sampling errors

For the manufacturing industry (within NACE D), waste treatment has been adjusted upwards with sampling and non-response extrapolations. In other sectors, total population surveys have been carried out.

2.2 Non-sampling errors

2.2.1 COVERAGE ERRORS – WASTE DEFINITION AND DEFINITIONS OF RECYCLING AND RECOVERY

2.2.1.1 Coverage errors due to misinterpretation of waste and of recycling

Coverage errors can be due to misinterpretation of the definitions of waste and of recycling. We have found in the questionnaire surveys that respondents do not always have the same definitions as the authorities.

The definition of waste used by the EU has been the subject of several discussions, and has also been involved in several cases at the European Court of Justice. In this survey, we have interpreted the definition of waste widely as it has been interpreted by the European Court of Justice in several cases. At the same time, we have learnt in the surveys that, in practice, respondents do not understand the definition in the same way as the authorities. Drawing a line between by-product and waste is difficult, particularly when the waste/by-product is recycled. This definition is not even completely clear legally in the European Court of Justice.

The concept of recycling

The European Court of Justice ruling in the Mayer-Parry case (C-444/00) states that waste ceases to be waste first when it becomes a new product. We have interpreted this as that recycling takes place when the waste becomes a new product. Previously the general interpretation has been that waste ceases to be waste when it can be used as a raw material in a manufacturing process. When looking at recyclable paper, for example, waste paper can be considered waste until it has become new pulp or new paper at a pulp/paper factory. This means that pre-treatments,

sorting, etc. do not constitute recycling. Sorting and such like occurs under NACE 37 Recycling. However, one consequence of the Mayer-Parry case is that recycling does in practice not occur in NACE 37 (which is called "Recycling") but, instead, most usually within the manufacturing industry (NACE D).

When reporting on recycling, we have not taken into account pre-treatment and sorting but only the "final" recycling process when the waste becomes a new product. The recycling concept also then includes the production of soil improvement solutions/fertiliser via composting or anaerobic fermentation.

This interpretation ensures that data are not reported twice, as one particular waste flow is only reported once during the reporting.

2.2.1.2 Coverage errors regarding the population

Coverage errors regarding the population have been discussed for each survey in Appendices 1 – 12.

2.2.1.3 Coverage errors regarding waste quantities

The methods used aim to give 100% coverage of the recovered and disposed waste, including capacity data. We have no reason to suspect that there is greater over or undercoverage than that described in the various errors in Appendices 1 - 12.

The reporting of recovery and disposal of waste covers facilities which require a permit or registration according to articles 9, 10 or 11 in the framework directive on waste (Directive 75/442/EEC). In practice, not all recycling comes under this rule:

- Secondary raw materials are classified as waste according to the Mayer-Parry ruling from the European Court of Justice (C 444/00) but, before this ruling, were often considered as a commodity instead of waste. This means that it has been difficult to make an inventory of all recovery and recycling, as industrial facilities that use secondary raw materials do not normally have a permit nor are registered according to Directive 75/44/EEC. Furthermore, they do not consider themselves that they are managing waste and, in the questionnaires, have often not stated that they recycle waste. This applies to waste such as wood wastes, metallic wastes, mineral wastes, etc.
- Mineral wastes, certain combustion wastes, treated contaminated soil, etc are widely used as construction materials in building projects in society. Much of this usage is difficult to inventory.
- Other types of waste treatment that have not been covered in the surveys. For example, we have identified the following cases where the inventories are in-complete:
 - Waste that is released into municipal sewers is not normally reported. For example, purified water from the treatment of oil waste, leachate water from landfills, sludge from the production of drinking water and such like.
 - Leachate water from landfill sites that is treated using biological or physico-chemical methods has not always been reported by respon-

dents (disposal procedures D8 and D9). This should really be reported as Re-lease to water but respondents have, in some cases, misunderstood how the treatment of leachate water should be filled in.

- Use of sludge within the agricultural sector has not been reported as a treatment method.
- Dismantling of cars has not been included as a treatment method. We have considered the dismantling of cars as a pre-treatment.
- Capacities are in general in "balance" with the treated quantities. In Sewage and refuse disposal (NACE 90), the reported capacity for recycling is considerably higher than the recycled quantity within the sector. This is principally due to the inclusion of some capacity for pre-treatment (sorting) in the reported capacities (but not in the reported treated quantities). Several facilities have not been able to differentiate between capacity data for the processes that are to be reported as recycling and the various sorting and pre-treatment processes that are not to be reported.

Difficulties with the implementation of the Mayer-Parry ruling have meant that it has not been possible to make an inventory of all recycling.

2.2.2 MEASUREMENT ERRORS

Common problems we have come across in the majority of surveys when collecting data have been the following:

- 1) Coding of certain hazardous waste has been unclear and confused, e.g. the difference between Spent solvents (EWC-Stat 01.1), Chemical preparation wastes (EWC-Stat 02) and Chemical deposits and residues (EWC-Stat 03.1);
- 2) Waste that contains oil can be classified with different codes according to EWC-Stat;
- 3) There has often been confusion between the three EWC-Stat codes Household and similar waste (EWC-Stat 10.1), Mixed and undifferentiated materials (EWC-Stat 10.2) and, occasionally, Sorting residues (EWC-Stat 10.3);
- 4) Sludge has occasionally been incorrectly classified - Industrial effluent sludges (EWC-Stat 03.2) should be coded as Common sludges (EWC-Stat 11) or vice versa;
- 5) A large number noted the existence of Hazardous metallic wastes (EWC-Stat 06). The majority of these have actually been other types of waste, i.e. non-hazardous metallic wastes (EWC-Stat 06) or hazardous chemical preparation wastes (EWC-Stat 02), such as metal packaging contaminated with oil;
- 6) Some have confused the waste type Combustion wastes (EWC-Stat 12.4) with waste for incineration, which should be reported as Mixed and undifferentiated material (EWC-Stat 10.2).

Quantities have been requested in the unit tonnes in the questionnaires. It is however relatively common that respondents have submitted other quantity units. If other weight units (i.e. kg or 1 000 tonnes) have been reported, we have converted

these to tonnes. If other units have been reported (such as item, m³ or barrel), we have used conversion tables where these are available. The Swedish Association of Waste Management has designed such a table⁵⁰. In certain cases, conversion factors have been acquired from experts. Some of the conversion factors are not particularly controversial, such as ton per m³ of oil, while problems have occurred when the waste has been mixed, for example, or when we do not know whether the waste has been compressed.

2.2.3 PROCESSING ERRORS

Processing errors have been described for the different sub-surveys in Appendices 1 – 12.

Common errors that can occur include:

- respondents misunderstand what data should be submitted (incorrect coding of waste treatments or types of waste)
- incorrect coding of data when checking
- input errors
- adjustment errors (because the adjustment models are not appropriate)

We have attempted to detect these errors using recurrent checking by both the project groups and by independent experts who have helped to assess rationality in the results.

2.2.4 NON-RESPONSE ERRORS

Non-response has been discussed for every sub-survey in Appendices 1 – 12. Non-response is considered to occur principally within sectors in the Manufacturing industry (NACE D). We estimate that waste treatment in the other surveys has had almost 100% coverage in the responses.

2.2.5 MODEL ASSUMPTION ERRORS

Errors in model assumptions are described for every sub-survey in Appendices 1 - 12. We estimate that errors for recovery and disposal are relatively small. The extrapolation model used within the Manufacturing industry (NACE D) can possibly lead to some uncertainty, see Appendix 2.

⁵⁰ Waste facilities with landfilling, Statistics 2003, Swedish Association of Waste Management Report 2004:13

5 Comparability

5.2 Regional comparability of waste treatment

VALIDATION OF DATA REGARDING WASTE TREATMENT

Data on waste treatment facilities have been double-checked against other administrative data (EMIR register of facilities with permits for environmentally harmful activities). The compiled results have also been quality controlled and validated by independent experts.

STATISTICAL UNITS

Different statistical units have been used for the different sub-surveys: local unit, facility, enterprise, industry. See further for every sub-survey in Appendices 1 – 12.

MOBILE WASTE TREATMENT

For the generation of waste and the recovery and disposal of waste, mobile equipment has been reported in the place where it has been used. Capacity data have, however, been reported in the home town. We have only found a few mobile operations in the survey, so the location of the facility is not of vital importance for the total reported quantities of waste or treatment capacities.

Appendix 14

Uncertainty estimates of key aggregates

1 Uncertainty in the questionnaire surveys

In cases where data on the generation of waste and on the recovery and disposal of waste have been produced from questionnaire surveys, statistical uncertainty (coefficients of variation) is created when extrapolations are carried out. The variance is calculated according to the formula:

$$\hat{V}(\hat{t}_z) = \sum_{h=1}^H \frac{N_h^2}{m_h} \left(1 - \frac{m_h}{N_h}\right) \frac{1}{m_h - 1} \left[\sum_{k=1}^{m_h} z_{hk}^2 - \frac{\left(\sum_{k=1}^{m_h} z_{hk}\right)^2}{m_h} \right]$$

where,

\hat{t} = point estimate

H = number of strata

N_h = population in stratum h

m_h = total responses in stratum h

r_h = number of elements in stratum h

y_k = k -te variable value in stratum h

The estimate's mean error is then calculated using $SE(\hat{t}) = \sqrt{\hat{V}(\hat{t})}$

after which the relative mean error or coefficient of variation are calculated using $SE(\hat{t}) = \sqrt{\hat{V}(\hat{t})}$

The variance coefficients have then been given in per cent.

2 Uncertainty in other sources

In cases where other sources than questionnaire surveys have provided the basis for the inventory, the uncertainty estimates are based on subjective assessments. The true value is assumed, with 95% probability, to lie at the most 2 standard deviations over or under the statistical value that has been estimated.

3 List of uncertainties in key aggregates

It has been assumed that the different sub-sectors are independent of one another when they are summed to the key aggregates (Table II.1). The standard formulae for propagation errors can thus be applied:

$$U_{total} = \frac{\sqrt{(U_1 * x_1)^2 + (U_2 * x_2)^2 + \dots + (U_n * x_n)^2}}{x_1 + x_2 + \dots + x_n}$$

Where:

U_{total} is the percentage uncertainty for the total waste quantity

x_i is the incoming waste quantity

U_i is the percentage uncertainty for waste quantity x_i

Quality Report

for statistics on generation and recovery
and disposal of waste in Sweden 2004
according to EU Regulation on Waste
Statistics 2150/2002

NATURVÅRDSVERKET

ISBN 91-620-5594-1

ISSN 0282-7298

This report contains the quality declaration for the data reported in June 2006, referring to the generation of waste and the recovery and disposal of waste during 2004.



Swedish Methology for Environmental Data