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Swedish Environmental Emissions Data

Verification of activity data within the energy sector for the reporting to the UNFCCC, EU Monitoring Mechanism, CLRTAP and the EU NEC Directive using data from the EU Emission Trading Scheme

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SMED is short for Swedish Environmental Emissions Data, which is a collaboration between IVL Swedish Environmental Research Institute, SCB Statistics Sweden, SLU Swedish University of Agricultural Sciences, and SMHI Swedish Meteorological and Hydrological Institute. The work co-operation within SMED commenced during 2001 with the long-term aim of acquiring and developing expertise within emission statistics. Through a long-term contract for the Swedish Environmental Protection Agency extending until 2014, SMED is heavily involved in all work related to Sweden's international reporting obligations on emissions to air and water, waste and hazardous substances. A central objective of the SMED collaboration is to develop and operate national emission databases and offer related services to clients such as national, regional and local governmental authorities, air and water quality management districts, as well as industry. For more information visit SMED's website www.smed.se.

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Sammanfattning

EU's utsläppshandel för koldioxid (CO_2) inleddes 1 januari 2005 och omfattar drygt 700 anläggningar i Sverige. Naturvårdsverket ansvarar för att samla in och granska rapporterade data.

Aktivitetsdata inom energisektorn för internationell rapportering av utsläpp till UNFCCC, EU Monitoring Mechanism, CLRTAP och EU's Takdirektiv 1990-2004 har i huvudsak baserats på energistatistik från Statistiska Centralbyråns undersökningar. I vissa fall har kompletterande datakällor använts, som till exempel företagens miljörapporter eller uppgifter inkomna genom direktkontakt med företaget.

I förteliggande studie analyseras aktivitetsdata, värmevärden samt emissionsfaktorer för CO_2 för de 63 största anläggningarna inom handelssystemet (vilka bidrar med 75% av de totala CO_2-emissionerna inom handelssystemet) jämfört med data från energistatistiken. Vidare presenterar studien rekommendationer när det gäller val av datakällor för internationell rapportering för de aktuella anläggningarna.

Resultatet visar att för 21 anläggningar, tillsammans svarande för ca 49% av CO_2-utsläppen från de 63 undersökta anläggningarna, baserat på den svenska energistatistiken, kan ingen signifikant skillnad mellan de två datakällorna (data från handelssystemet vs. data från energistatistiken) identifieras.

Under projektets gång visade det sig att det saknades anläggningar inom energisektorn (CRF 1A1a) i handelsdata levererat från Naturvårdsverket. Därför kan resultaten för vissa anläggningar kräva vidare undersökning för korrekta jämförelser. Den här rapporten föreslår vidare att särskild uppmärksamhet bör ges till ett fåtal större industrianläggningar vid framtida studier.

Summary

In Sweden, about 700 plants are included in the European Union Emission Trading Scheme (ETS) for carbon dioxide (CO_2), which was launched on the 1st of January 2005. The Swedish Environmental Protection Agency (EPA) is responsible for collecting and reviewing the data.

For international reporting of emissions to the UNFCCC, EU Monitoring Mechanism, CLRTAP and the EU NEC Directive 1990-2004, activity data is mainly based on energy statistics from Statistics Sweden's surveys. In some cases, additional data sources, such as companies' environmental reports or direct information from the company, are used as a compliment.

In this study, activity data, thermal values and CO_2 emission factors from the largest 63 plants in the ETS (which account for 75% of the CO_2 emissions from all plants within the ETS) in 2005 are compared with the energy statistics and analysed. Furthermore, this study presents different choices and recommendations of data sources for the international reporting for these plants.

The results show that for 21 plants, accounting for about 49% of the CO_2 emissions of the 63 plants investigated, based on the Swedish energy statistics, no significant difference between the two data sources are identified.

It was discovered during the project that not all plants in the energy production sector (CRF 1A1a) were included in the ETS data delivered by the Swedish EPA, and therefore many of the results on plants need further investigation to make correct comparisons. This report also gives suggestion on a few large industrial plants for which additional attention should be paid in future studies.

1 Background and objective

The European Union Emission Trading Scheme (ETS) for carbon dioxide (CO_2) was launched on the 1st of January 2005. In Sweden about 700 plants are included, of which energy production plants make up for the majority, but industrial production plants are also included. The Swedish Environmental Protection Agency (EPA) is responsible for collecting and reviewing the data to the ETS.

In Sweden, energy statistics from Statistics Sweden are used as a base for most emission calculations within the energy sector to the annual international reporting to the UNFCCC, EU Monitoring Mechanism, CLRTAP and NEC. In some cases, additional data sources, such as companies' environmental reports or direct information from the company, are used as a complement. The compilation of these annual emission data (hereinafter referred to as SMED-data) is performed by SMED on the behalf of the Swedish EPA.

Previous studies indicate significant discrepancies in several cases when comparing data from the ETS and SMED-data (Cooper and Nyström, 2005; Gustafsson, Lidén and Nyström, 2005; Ivarsson, Kumlin, Lidén and Olsson, 2004).

1.1 Objective

This study aims at verifying the quality of all fuel combustion-related CO_2-emissions from the largest plants in Sweden (in terms of CO_2-emissions) by comparing SMED-data with the data from the ETS. In addition, the study aims at enabling recommendations on which activity data source to use for Sweden's international reporting to the UNFCCC, EU Monitoring Mechanism, CLRTAP and the EU NEC Directive for 2005.

1.2 Scope of the work

This study encompasses the 63 largest plants (in terms of CO_2 emissions) in the Swedish ETS, which account for 75% of the CO_2 emissions from all plants (about 700). For energy production, all plants from the same company and within the same municipality as the identified plant are included. This is due to the difficulty in identifying plant-specific data from the energy statistics.

To the ETS, companies are obligated to report emissions of CO_2 from fossil and biomass fuels, but this study focuses on comparing and analysing only the activity data related to fossil fuels due to its better reliability.

2 International emission reporting requirements and guidelines

On a yearly basis Sweden is obliged to report national air emissions of a number of pollutants to several international bodies: The European Union's Mechanism for Monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol, the UNFCCC (United Nations Framework Convention on Climate Change), the CLRTAP (Convention on Long-Range Transboundary Air Pollution) and the EU NEC (National Emissions Ceiling) Directive. The reporting follows revised 1996 IPCC (Intergovernmental Panel on Climate Change) Guidelines for National Greenhouse gas Inventories (IPCC Guidelines), IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse gas inventories (IPCC Good Practice Guidance), UNFCCC Reporting Guidelines on annual inventories (FCCC/CP/2002/8) and EMEP/CORINAIR Guidebook.

3 Description of data

3.1 Emission Trading Scheme

Emissions of CO_2 by plant and fuel type are given in the ETS data. Generally, the consumed amount of fuel together with thermal value and emission factor are also included.

SSAB (the largest steel producer in Sweden) has used carbon mass balances to calculate their CO_2 emissions, and therefore do not report specific thermal values and CO_2 emission factors.

The ETS data is separated into four categories: Combustion of fossil fuels, Combustion of mixed fossil and biomass fuels, Processes with fossil fuels, and Processes with mixed fossil and biomass fuels. The mixed fossil and biomass fuels are separated into fossil and biomass respectively in order to extract the fossil CO_2 content.

3.2 SMED-data

Activity data for emission calculations 1990-2004 for the energy sector is mainly based on results from the Quarterly Statistics (QS) and the Industrial Statistics (IS) surveys. Since reference year 2003, the majority of the activity data comes from the QS and for only a few plants from the IS. In addition, information from the companies via e-mail, telephone and environmental reports is also used.

For energy production plants (CRF 1A1a), the basis for the survey is not by plant, but by company and municipality. Identifying energy consumption for specific plants in that sector is therefore in some cases not possible, e.g. for several Fortum AB plants.

According to the international guidelines, attention should be paid to plants where emissions derive from both Energy (CRF 1) and Industrial Processes (CRF 2) in order to make the correct separation between the two sectors. Activity data for SSAB is therefore based on results from the QS through a special inquiry on combusted fuels divided on each plant.

Thermal values and CO_2 emission factors are in many cases general and yield good estimates on national level. Hence, they are to some extent not representative on plant level. The thermal values and CO_2 emission factors are presented in Appendix 16 in the Swedish National Inventory Report, submission 2006.

4 Methods

This project had two clear aims; one was to enable verification of the quality of the fuel combustion-related CO_2-emissions, and the other was to decide which data source that should be used for international reporting of emissions for Sweden. This was done by matching plant data from the ETS with QS for 2005 as well as analysing the two data sources for 2005 with the present time series used for Sweden's international reporting 1990-2004. In addition, thermal values and CO_2 emission factors were studied.

For some plants thermal values are not included in the ETS. If thermal values from the same plant were available via the energy statistics, these were applied. In other case, national thermal values used in the international reporting were applied.

4.1 Plant-specific comparison of activity data 2005

Comparison of data was generally carried out on plant level and by energy consumption (TJ). Matching of plants was done based on the SCB in-house identification number.

The distinction between emissions derived from fuel combustion and industrial processes differs for the ETS and the international reporting. Some activity data classified as process emissions in the ETS are therefore reclassified as fuel combustion to enable correct comparison of plant data.

For energy production plants, e.g. for Fortum AB, the sum of all plants by municipality or in total for each company is compared because of the difficulties in identifying single plants in the energy statistics.

For SSAB, comparison of energy consumption is not possible due to different methods for deriving CO_2 emissions; SMED-data is based on combusted fuels (mostly coke oven gas and blast furnace gas), whereas CO_2 emissions in the ETS are based on mass balances. Therefore, comparison of plant data is done for CO_2 emissions.

The activity data for each plant is considered to be verified when the difference in energy consumption by plant for 2005 between ETS data and QS does not exceed the given uncertainty limits[1] in Table 1. In these cases QS is recommended as data source in the international reporting for 2005.

[1] These uncertainty limits are derived from the uncertainty estimations presented in the Swedish inventory to the UNFCCC, submission 2006 and relates to the emission year 2004.

Table 1. Uncertainty limits (by CRF sector) used in this study.

	Uncertainty limits		
	≤2%	≤5%	≤10%
CRF	1A1a	1A1c	1A1b
	1A2d	1A2a	1A2c
		1A2b	1A2f
		1A2e	

For the plants where the activity data exceeds the uncertainty limits given in Table 1, further investigations through time series analysis are carried out to determine which data source best complies with the time series consistency.

4.2 Time series analysis

Time series based on SMED-data 1990-2004 are used to analyse the consistency over time for ETS-data and QS for 2005 in order to assess which data source is the most appropriate to use in the international reporting. For some plants it is difficult to establish a complete time series 1990-2004 due to differences in SMED data-bases and structural changes in companies. In order to maintain the data sources as consistent as possible over time, it is recommended that the same data source is used 2005 as the 2-3 previous years, unless data for 2005 from the same source significantly differs from the previous years' data. In those cases, further analysis is carried out in order to determine the most appropriate data source for 2005.

The time series analysis is divided into **four steps** where different methods are applied to assess and recommend which data source is most applicable for 2005.

The **first step** is to look at the time series on total fossil fuel consumption (in TJ) 1990-2004 for each plant and compare it with data for 2005 from the ETS and the QS, respectively.

Figure 1 shows an example of a plant which fossil fuel consumption for the QS 2005 is in line with the time series 1990-2004 (i.e. ≤10% difference between 2004 and 2005), at the same time as the ETS data for 2005 shows a large discrepancy. In such cases, the QS is recommended as data source for the international reporting for 2005. For the remaining plants in the QS, showing a difference in fuel consumption between 2004 and 2005 exceeding 10%, a further analysis is carried out (see the third step below).

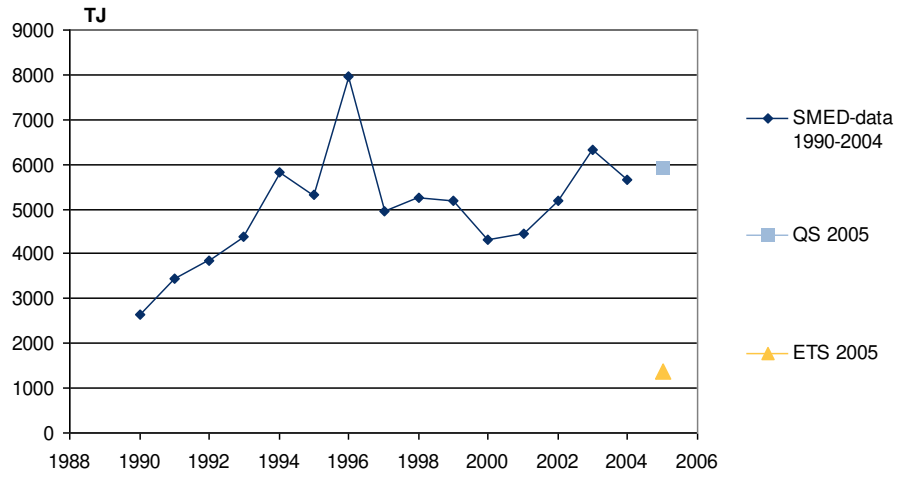

Figure 1. Example of a plant where the fossil fuel consumption (TJ) from Quarterly Statistics (QS) for 2005 harmonizes with the time series 1990-2004 in contrast to the ETS data for 2005.

In the **second step**, it is assessed whether a large change in SMED-data in fossil fuel consumption between 2004- and 2005 can be explained by an opposite trend in biomass fuel consumption. At the same time, ETS fossil fuel consumption is compared with the fossil fuel time series 1990-2004. Figure 2 gives an example of a plant for which a large decrease in SMED-data in fossil fuel consumption 2004-2005 can be explained by a similar increase in biomass consumption. In such cases, QS for 2005 is recommended as data source for the international reporting.

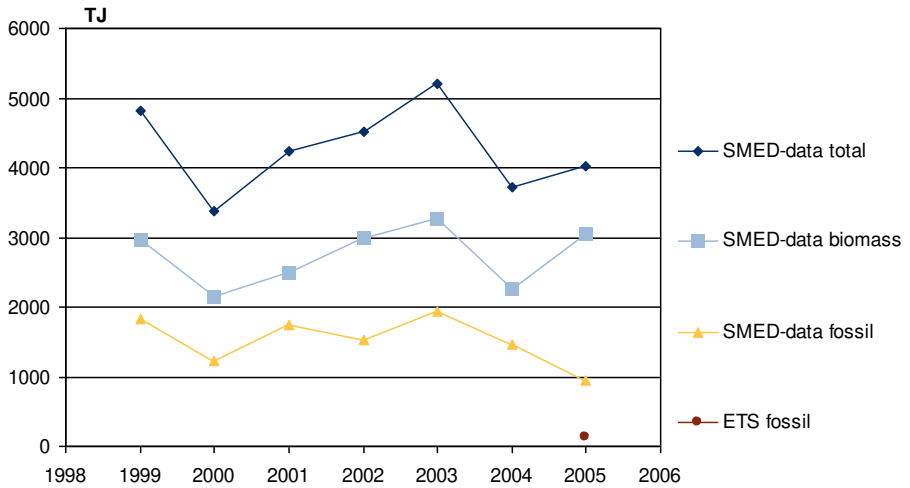

Figure 2. Example of a plant where a strong decrease in SMED-data in fossil fuel consumption 2004-2005 can be explained by a similar increase in biomass consumption.

The **third step** is to analyse the remaining plants for which SMED-data shows a large change (>10%) in fossil fuel consumption between 2004 and 2005. QS for 2005 is considered to be consistent with the time series when a large change in fossil fuel consumption between 2004 and 2005 is relatively small compared to the change in total (fossil and biomass) fuel consumption between 2004 and 2005 (cf Figure 3). Consideration is also taken to the time series consistency of QS 2005 as well as of ETS data on fossil fuel consumption 2005.

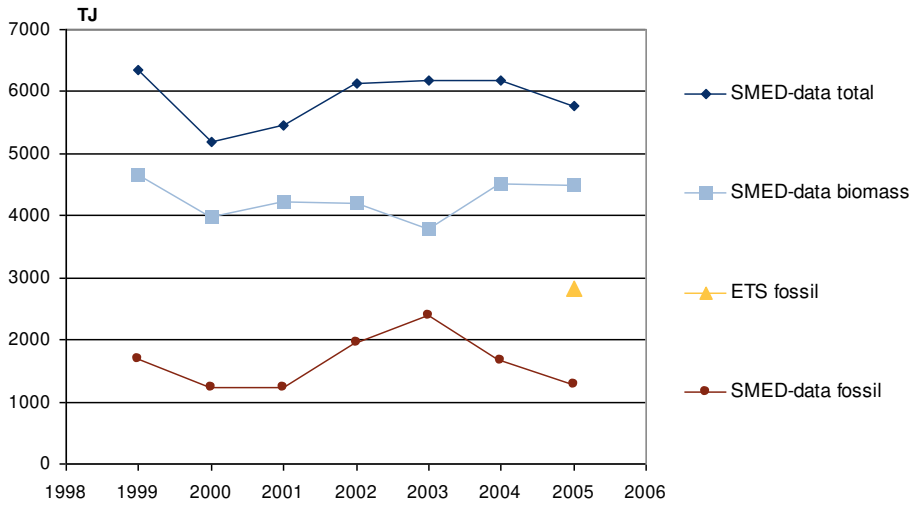

Figure 3. Example of a plant where a strong change in fossil fuel consumption 2004-2005 is relatively small compared to the change in total (fossil and biomass) fuel consumption 2004-2005.

The plants remaining after the three first steps are analysed in more detail in a **fourth step**. Here, an in-depth analysis of the different fuel amounts and fuel types are carried out for the ETS data 2005, QS data 2005 and SMED-data 1990-2004. Furthermore, additional information from the Industrial Statistics (IS) 2005 and environmental reports for 2005 is used to verify QS or ETS data. In some cases IS data and/or information direct from the company are used as complementing data sources.

5 Results and analysis

This chapter describes the results of the plant-specific comparisons as well as the time series analysis. For each plant, the recommended data source is presented. These recommendations were outlined in co-operation with the Swedish EPA. Due to confidentiality of energy statistics on plant level reported to Statistics Sweden, the results do not display any actual figures that may enable identification of single plant data.

Table 2 shows the total energy consumption and CO_2 emissions from fossil fuels from the plants included in the study. It is evident that the QS contains significantly (47%) more consumed energy than the ETS for 2005.

Table 2. Total energy consumption (TJ) and CO_2 emissions (1000 ton) from fossil fuels from the plants included in the study according to the QS and ETS, respectively.

All plants (63)	Quarterly Statistics (QS) 2005	Emission Trading Scheme (ETS) 2005	Difference between QS and ETS 2005
Fossil energy consumption (TJ)	165 877	112 697	47%
Fossil CO2 emissions (1000 ton)	11 223	7 950	41%

5.1 Plants with no significant difference between QS and ETS 2005

Based on the comparison of plant-specific data from the ETS and the QS 2005, 21 plants for which no significant difference between ETS and QS could be observed were identified (Table 3). For these plants, QS is recommended as data source in 2005. Since SSAB reports emission of CO_2 to the ETS by carbon mass balances, whereas SMED-data is based on consumed amounts of fuels according to the QS, a comparison of SSAB's energy consumption has not been made. Instead, emissions of CO_2 were compared.

Table 3. Plants with no significant difference between QS and ETS 2005.

CRF	Company	Plant	Uncertainty limit
1A1a – Public Electricity and Heat Production	E.ON Värme Sverige AB	Heleneholmsverket. fjärrvärmecentralen	≤2%
1A1a – Public Electricity and Heat Production	Mölndal Energi AB	Riskullaverket	≤2%
1A1b - Petroleum Refining	Preem Petroleum AB	Preemraff Göteborg	≤10%
1A2b – Non-Ferrous Metals	Boliden Bergsöe AB	1282-107	≤5%
1A2d – Pulp, Paper and Print	M-real Sverige AB	Husums fabrik	≤2%
1A2d – Pulp, Paper and Print	Iggesund Paperboard AB	Iggesunds Bruk	≤2%
1A2d – Pulp, Paper and Print	Kappa Kraftliner AB	Smurfit Kappa. Kraftliner Piteå	≤2%
1A2d – Pulp, Paper and Print	StoraEnso Kvarnsveden AB	Kvarnsvedens Bruk	≤2%
1A2d – Pulp, Paper and Print	Billerud Skärblacka AB		≤2%
1A2d – Pulp, Paper and Print	Södra Cell Mönsterås		≤2%
1A2d – Pulp, Paper and Print	Södra Cell Mörrum		≤2%
1A2d – Pulp, Paper and Print	SCA Packaging Munksund AB		≤2%
1A2d – Pulp, Paper and Print	Holmen Paper AB.	Wargöns Bruk	≤2%
1A2d – Pulp, Paper and Print	AssiDomän Cartonboard AB	AssiDomän Frövi	≤2%
1A2e – Food Processing, Beverages and Tobacco	Danisco Sugar AB	Jordberga Sockerbruk	≤5%
1A2f – Other Industries	Pilkington Floatglas AB	Pilkington Halmstad	≤10%
1A2f – Other Industries	Cementa AB	Skövdefabriken	≤10%
1A2f – Other Industries	Rexam Glass Limmared AB		≤10%
1A2f – Other Industries	Perstorp Specialty Chemicals AB	Perstorp Specialty Chemicals - Perstorp	≤10%
1A1a, 1A1c, 1A2a, 1B1c, 2C1	SSAB Oxelösund*		≤5%
1A1c, 1A2a, 1B1c, 2C1	SSAB Tunnplåt AB*	Metallurgi Luleå	≤5%

* In QS, all energy consumption and CO_2 emissions from Energy (CRF 1) and Industrial Processes (CRF 2) are included. ETS data is based on SSAB's carbon mass balances.

Table 3 shows that the Pulp, Paper and Print sector (CRF 1A2d) has the largest frequency of verified plants. Another observation was that the majority of the verified energy consumption (and thus the CO_2 emissions) derive from SSAB's plants.

Table 4 shows the sum of the above 21 plants' energy consumption (TJ) and CO_2 emissions (1000 ton) from fossil fuels in 2005 based on the QS and the ETS. These 21 plants account for about 50% of the energy consumption and about 49% of the CO_2 emissions for all the 63 plants included in this study.

Table 4. The sum of energy consumption (TJ) and CO_2 emissions (1000 ton) from fossil fuels from the plants with no significant difference between QS and ETS data in 2005.

Verified plants (21)	Quarterly Statistics (QS)	Emission Trading Scheme (ETS)	Difference between QS and ETS
Energy consumption of fossil fuels (TJ)	83 662	84 316[1]	-0.8%
CO_2 emissions from fossil fuels (1000 ton)	5 471	5 597	-2.3%

[1] Energy consumption for SSAB in these figures is based on the results from the QS.

5.2 Recommendations on activity data sources when QS and ETS data show significant differences

5.2.1 Recommendations through time series analysis step 1-3

Table 5 and 6 present companies and plants for which QS is recommended as data source in 2005, according to the step 1-3 procedures, as described above (chapter 4.2).

Table 5. Plants for which fossil fuel activity data in QS 2005 is consistent with the time series, while the data from the ETS 2005 show large discrepancies (step 1).

CRF	Company	Plant
1A1a – Public Electricity and Heat Production	Vattenfall AB	Boländerna
1A1a – Public Electricity and Heat Production	Tekniska Verken i Linköping AB	Kraftvärmeverket
1A1a – Public Electricity and Heat Production	Karlskoga Kraftvärmeverk AB	Karlskoga Kraftvärmeverk
1A1a – Public Electricity and Heat Production	Tekniska Verken i Kiruna AB	Kiruna kraftvärmeverk
1A1a – Public Electricity and Heat Production	Sundsvall Energi AB	Korstaverket
1A2a – Iron and Steel	Höganäs AB	
1A2c - Chemicals	Nordisk Carbon Black AB	
1A2d – Pulp, Paper and Print	Billerud AB Gruvöns Bruk	Gruvöns Bruk
1A2d – Pulp, Paper and Print	Klippan Mölndal AB	Klippan Mölndal Gaskombistationen
1A2d – Pulp, Paper and Print	HOLMEN PAPER AB	Bravikens Pappersbruk
1A2d – Pulp, Paper and Print	SCA Östrands massafabrik	Östrands massafabrik
1A2f – Other Industries	Cementa AB	Degerhamnsfabriken

Table 6. Plants where large changes (>10%) in fossil energy consumption in QS 2004-2005 can be explained by a change in biomass energy consumption (step 2), or the relative change in the total energy consumption is small (<10%) 2004-2005 (step 3).

CRF	Company	Plant (s)
1A1a – Public Electricity and Heat Production	E.ON Värme Sverige AB	Åbyverket and Händelöverket
1A1a – Public Electricity and Heat Production	Söderenergi AB	Igelsta värmeverk
1A2d – Pulp, Paper and Print	HOLMEN PAPER AB	Hallsta Pappersbruk
1A2d – Pulp, Paper and Print	SCA Graphic Sundsvall AB	Ortvikens Pappersbruk
1A2d – Pulp, Paper and Print	Stora Enso Pulp AB	Norrsundets bruk
1A2d – Pulp, Paper and Print	Billerud Karlsborg AB	Karlsborgs bruk

5.2.2 Recommendations through time series analysis step 4

Table 7 presents the remaining plants for which in-depth studies of the fuel types between the ETA and QS data is needed. It also shows which activity data source was used in previous submissions, and which data source is recommended for 2005. Brief explanations to the choice of recommendation are given for each company and plant(s) in sections 5.2.2.1-5.2.2.16.

Table 7. Previous data sources and recommended data sources for 2005 after in-depth studies of fuel types for the remaining companies (step 4)

CRF	Company	Plant(s)	Activity data source(s) recent years	Recommended data source for 2005
1A1a	Fortum AB	All	QS	QS
1A1a	Mälarenergi AB	Kraftvärmeverket and Panna 5	QS	QS
1A1a	Öresundskraft Produktion AB	Västhamnsverket	QS	QS
1A1a	Karskär Energi AB		QS	QS
1A1b	Nynäs Refining AB	Raffinaderiet i Nynäshamn	IS + company data	ETS
1A1b	Shell Raffinaderi AB	Shell Raffinaderi Göteborg	Environmental reports	ETS
1A1b	Preem Petroleum AB (publ)	Preemraff Lysekil	Environmental reports and company data	ETS
1A2c	Borealis AB	Krackeranläggningen	IS + company data for data on flaring	IS + direct contact for data on flaring
1A2c	Akzo Nobel Functional Chemicals AB		QS + company data	IS
1A2c	Perstorp Oxo AB		QS	QS
1A2d	Stora Enso Skoghall AB	Skoghalls Bruk	QS	IS
1A2d	Stora Enso Hylte AB	Hylte Bruk	QS	QS
1A2e	Danisco Sugar	Örtofta Sockerbruk	QS	QS
1A2e	Danisco Sugar	Köpingebro Sockerb.	QS	QS
1A2f	Cementa AB	Slitefabriken	QS	QS
1A2f	Nordkalk AB Köping		QS	QS

5.2.2.1 Fortum AB, all plants

Fortum AB has many plants in several municipalities. The comparison of activity data frequently shows (especially for the larger plants) significant differences between QS and ETS data 2005. A likely explanation to the differences between the two data sources is the absence of waste fuel in ETS data. According to the ETS a plant which main activity is to combust waste (hazardous waste and municipality waste) should not be included. The QS is recommended as data source for 2005.

5.2.2.2 Mälarenergi AB, Kraftvärmeverket and Panna 5

Data from the QS is used 2000-2004. Data from QS shows a strong decline 2004-2005 which is coherent with Mälarenergi AB statistics on electricity production. ETS is several times lower than QS data in 2005. An in-depth study based on information on all plants included in the ETS show that only two out of four plants for the municipality of Västerås are included in the ETS data sent to SMED. A brief overview of the two missing plants indicates that a complete data set for Mälarenergi AB from ETS show good agreement with QS data for 2005. The QS is recommended as data source for 2005.

5.2.2.3 Öresundskraft Produktion AB, Västhamnsverket

Data from ETS is lower than data from QS for 2005, mainly due to less consumption of heavy fuel oil and peat reported to ETS. The QS is recommended as data source for 2005.

5.2.2.4 Karskär Energi AB

Activity data consists of domestic heating oil and heavy fuel oil in ETS and QS 2005. ETS show larger amounts than QS. It is likely that the ETS data consists of two plants reported as one. This assumption is based on the fact that Karskär Energi AB's two plants identified in the QS together show very good agreement with the ETS data. The QS is recommended as data source for 2005.

5.2.2.5 Nynäs Refining AB, Raffinaderiet i Nynäsham,

The Nynäshamn plant is not included in the QS 2005. In ETS, activity data on domestic heating oil, heavy fuel oil , refinery gas and flaring of gas are consistent with the previous years' data. However, there are also large amounts of gasoline reported as fuel consumption, which is used for non-energy purposes and should not be regarded as fuel combustion. With the amounts of gasoline deducted, ETS data is recommended as data source for 2005.

5.2.2.6 Shell Raffinaderi AB, Shell Raffinaderi Göteborg

Activity data from Shell Raffinaderi AB in the QS is not suitable for the purpose of international reporting of emissions. Therefore, data 1990-2004 are obtained through direct contact with the company. Comparison of data from the IS and the ETS for 2005 shows that IS is lacking some data, especially on oils, whereas ETS

data shows good consistency over time. ETS data is considered to be the most accurate and is recommended as data source for 2005.

5.2.2.7 Preem Petroleum AB, Preemraff Lysekil

Preem Petroleum AB in Lysekil plant is formerly known as Scandinaviska Raffinaderi AB. It is not included in the QS survey and data for 1990-2004 are obtained through environmental reports and direct contact with the company. IS data 2005 does not include all fuel types. The activity data in the ETS 2005 is complete (i.e. also includes data on flaring of gases) and show good consistency taking into consideration the expanding of production during 2005. Therefore the ETS is recommended as data source for 2005.

5.2.2.8 Borealis AB, Krackeranläggningen

Since 2000, activity data has been taken from the IS complemented with data on flaring of gases through direct contact with the company. Neither QS nor ETS data 2005 show good consistency with the time series and are disregarded as data sources for 2005. Data from the IS 2005 on the other hand shows good consistency over time with the exception of flaring of gases. Data from the company's environmental report shows good agreement with the IS data for 2005. IS is recommended as data source for 2005, with the complement of data on flaring gases directly from the company.

5.2.2.9 Akzo Nobel Functional Chemicals AB

Activity data 1990-2004 are based on QS complemented by information directly from the company. Data from the QS and IS 2005 show similar results but IS data is more detailed. ETS data is detailed but shows significantly lower amounts of fuels than the QS and the IS. The IS is recommended as data source for 2005.

5.2.2.10 Perstorp Oxo AB

QS data and data directly from the company are used 1990-2004. QS data 2003-2005 show a strong increasing trend that is due to large amounts of natural gas, included as fuel combustion in the international reporting. This natural gas is actually used for non-energy purposes. ETS data only includes emissions of CO_2 and no clear classification of fuel types, which makes it difficult to estimate accurate activity data. The company's environmental report shows that LPG (Liquefied Petroleum Gas) is used in rather large amounts (124405 MWh) in 2005. This is not recorded in the SMED-data 1990-2004, QS 2005 or ETS data.

A brief overview of data from QS and ETS 2005 shows lower energy consumption for QS than ETS. The QS is recommended as data source for 2005, with the amounts of natural gas 2004 and 2005 deducted. Furthermore, future studies on the purpose of the LPG reported in the environmental report are recommended.

5.2.2.11 Stora Enso Skoghall AB, Skoghalls Bruk

QS data is used throughout the time series. QS data for 2005 show a large increase in heavy fuel oil compared to 2004. Data from the IS and ETS are similar and include less amounts of heavy fuel oil than QS. The IS is recommended as data source for 2005.

5.2.2.12 Stora Enso Hylte AB, Hylte Bruk

QS 2005 includes less natural gas but more coal compared to ETS 2005. Overall there is a relatively small difference (just above the uncertainty limit) between the two data sources. The QS is used for previous years as data source and is recommended as data source also for 2005.

5.2.2.13 Danisco Sugar AB, Örtofta Sockerbruk

The ETS and QS data 2005 show good agreement on natural gas which is the predominant fuel. ETS data only includes natural gas, whereas QS also includes other fuels. The QS is recommended as data source for 2005.

5.2.2.14 Danisco Sugar AB, Köpingebro Sockerbruk

Most of the fuel consumption is based on heavy fuel oil. The data from the ETS and QS are relatively comparable – slightly above the uncertainty limit. However, contrary to the QS, there are no amounts of coal and peat registered in the ETS. It has been brought to our attention that not all combustion processes are included in the ETS 2005 due to exemptions in the regulations, but supposedly in a future ETS (Elmlund, 2006). At this point, there are no clear indications to what extent this will affect the comparison. The QS is recommended as data source for 2005.

5.2.2.15 Cementa AB på Gotland, Slitefabriken

Data from QS 2005 are much higher than ETS. Data from IS 2005 shows good agreement with QS. In ETS data, rubber is used as fuel (classified as tires in QS), but is classified as both fossil and biomass fuel in ETS data and only as fossil fuel in QS. The QS is recommended as data source for 2005, with the awareness of that the amount of fossil fuel may be overestimated in the QS.

5.2.2.16 Nordkalk AB Köping

QS is used as data source the last few years. In QS 2005 data on heavy fuel oil is included. IS and ETS for 2005 includes domestic heating oil, heavy fuel oil and coal. Based on information from the company, coal is combusted for several years and should be included in the total energy consumption. The QS is recommended as data source for 2005 due to its consistency over time, however, the time series should be revised in future submissions to include also consumption of domestic heating oil and coal.

5.3 Thermal values and CO_2 emission factors

The ETS thermal values and CO_2 emission factors show no evident faults and very few significant discrepancies compared to those applied by SMED. In some cases (e.g. Fortum AB) though, old thermal values (35.82 GJ/m3) from SMED for heavy fuel oils are applied in the ETS, whereas SMED applies revised figures (35.16 GJ/m3). Furthermore, Fortum AB have reported the use of gas, but not further explained what kind of gas they refer to. They apply the SMED thermal value for gas works gas (16.75 GJ/1000 m3), but the CO_2 emission factor applied is very low (51.2 kg CO_2/GJ) compared to the value applied in the SMED-data (77.5 kg CO_2/GJ).

There are some fuels in the ETS for which the activity data name or figures on thermal values and emission factors are not specified. In these cases it is difficult to make a thorough comparison against the national figures. However, based on the scarce information and expert judgements, no obvious errors in any of the thermal values and emission factors in the ETS have been found.

6 Results summary and discussion

In this study the activity data, thermal values and CO_2 emission factors for the plants with the largest emissions of CO_2 in Sweden were compared on basis of two data sources (QS and ETS). The results show that for 21 plants accounting for about 50% of the fossil energy consumption (about 49% of the CO_2 emissions) of all the 63 plants included in the study, QS data can be verified with the ETS data. This means that 50% of the fossil energy consumption for these 63 plants has a difference between ETS and QS energy consumption for 2005 lower than given uncertainty limits.

For only six of the plants included in this study a different data source than QS for 2005 was recommended, and three of these were refineries. Only for one refinery was QS recommended as data source for 2005. The Pulp, Paper and Print sector (CRF 1A2d) has the largest frequency of verified plants, whereas the majority of the verified energy consumption (and thus the CO_2 emissions) derive from SSAB's plants.

At the end of the project, while performing an in-depth study of Mälarenergi AB, it was evident that not all energy production plants were included in the ETS data set sent to SMED as agreed in the project specification. Due to the lack of time left in the project, it has not been possible to do the necessary adjustments to include the lacking ETS plants. SMED therefore suggests that further in-depth studies of these plants are performed to enable adequate comparisons of the two data sources.

Furthermore, some of the larger industrial plants for which discrepancies between ETS and QS in 2005 are large (5.2.2.1-5.2.2.16) and it is questionable which data source to recommend, should be given additional attention in future studies. This is especially the case for Cementa AB (Slitefabriken), Borealis AB, Danisco AB (Örtofta Sockerbruk and Köpingebro Sockerbruk), Nordkalk AB Köping, and Perstorp Oxo AB.

7 References

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