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Swedish Environmental Emissions Data

Study of differences in plant data between the Energy Statistics and 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.

Content

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.

För rapportering av utsläpp till UNFCCC, EU Monitoring Mechanism, CLRTAP och EU:s Takdirektiv 1990-2005, används i huvudsak SCB:s kvartalsvisa bränslestatistik som aktivitetsdata. I vissa fall används kompletterande källor som SCB:s industristatistik, miljörapporter och data från direktkontakter med företagen.

Under 2006 genomförde SMED ett projekt där anläggningsspecifika data från kvartalsstatistiken jämfördes med data från utsläppshandelssystemet. En av slutsatserna var att man i en kommande studie behöver fördjupa jämförelsen för ett antal anläggningar, vilket nu gjorts och resultaten från studien redovisas i denna rapport.

I projektet har den fossila energimängden från 19 anläggningar beräknats i utsläppshandelsdata och sedan jämförts med energimängderna i kvartalsstatistiken. I de fall energimängderna skiljde sig åt gjordes analyser genom att jämföra energi- och bränsleförbrukning på bränsleslagsnivå. Ett antal anläggningar har kontaktats för att bättre förstå skillnaderna mellan datakällorna. Avfallsförbränning ingår inte i utsläppshandelssystemet och resultaten visar relativt god överensstämmelse mellan datakällorna efter det att avfallsförbränning räknats bort från kvartalsstatistiken.

I kvartalsstatistiken och de beräkningar som görs baserat på dessa data finns en rad brister. För det första så skiljer sig de rapporterade bränslemängderna något för många av anläggningarna och med tanke på att handelsdata data är verifierade bör de anses som mer korrekta. På anläggningsnivå kommer dessutom de nationella värmevärden och emissionsfaktorer som användas inte att vara helt korrekta. En annan brist med kvartalsstatistiken är att ovanliga bränslen grupperas i bränslegrupper som ”övriga icke specificerade”. För dessa bränslegrupper används mycket osäkra emissionsfaktorer eftersom de inte är anpassade för ett specifikt bränsle eller anläggning. Ett ytterligare problem är att vissa av dessa ovanliga bränslen är felklassade. I utsläppshandelsdata är ofta dessa bränslen delvis biogena och borde således klassas som ”Övriga biobränslen”.

För att få bättre överensstämmelse mellan kvartalsstatistiken och utsläppshandelsdata bör dessa brister ses över.

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 reporting of emissions to the UNFCCC, EU Monitoring Mechanism, CLRTAP and the EU NEC Directive 1990-2005, activity data is mainly based on energy statistics from Statistics Sweden's quarterly fuel surveys (QS) and the industrial energy survey. In some cases, additional data sources, such as companies' environmental reports or direct information from the companies, are used as a complement.

In 2006, a study was performed by SMED to verify plant specific data from the quarterly fuels statistics with data from the ETS. One recommendation in the study was to carry out an in-depth study focussing on a few plants with large differences between their QS and ETS data , which has now been carried out and the results are presented in this report.

In this study the fossil energy amounts from 19 plants have been calculated in the ETS and compared with the energy amounts in the QS. Where differences were found the reasons were analysed comparing the levels of energy and fuel consumption by fuel type. Contacts have been made with a few plants to better understand the differences. Waste combustion is not included in the ETS and results show that the coherence is relatively good after waste combustion was excluded from the QS.

The QS and the emission estimations that are made based on those data have a number of deficiencies. First of all, the reported fuel amount differs slightly between the data sets and since ETS data are verified, they are likely to be more correct. Besides, on plant level, the national thermal values and emission factors that are used for the GHG inventory is not totally correct. An other deficiency in the QS is that unconventional fuels are grouped in the QS into for instance "Other not specified fuels". The emission factors of these fuels are associated with very large uncertainties, since they are not specific for the current fuel and plant. Finally, another problem is that some of those unconventional fuels are incorrectly classified. In the ETS some of these fuels are often partly biogenic and should hence be classified as "Other biomass".

The deficiencies identified should be considered to be revised if a better coherence between the QS and the ETS is desired.

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 reporting to the UNFCCC, EU Monitoring Mechanism, CLRTAP and the EU NEC Directive. In some cases, additional data sources, such as companies' environmental reports or direct information from the companies, are used as 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 (Backman and Gustafsson, 2006; Cooper and Nyström, 2005; Gustafsson, Lidén and Nyström, 2005; Ivarsson, Kumlin, Lidén and Olsson, 2004).

1.1 Objective

This study aims at comparing the fossil energy amount reported in 20 energy and industry plants in the ETS and in Statistics Sweden's quarterly fuel statistics (QS). The plants chosen are those with the largest discrepancies in energy amounts in the study carried out by SMED in 2006.[1] For plants where the difference in energy amounts are higher then the uncertainty limits presented in Table 1, more in-depth comparisons were made to understand the reasons for the differences. Finally, recommendations for further efforts were made where considered necessary.

1.2 Scope of the work

For energy, electricity and heat production, all plants from the same company and within the same municipality are generally included. This is due to that single plants within one municipality can not be separated in the QS. This is due to the difficulty in identifying plant-specific data from the energy statistics.

[1] Backman & Gustafsson, 2006.

2 Method

2.1 Plant-specific comparison of activity data 2006

Comparison of data was generally carried out on plant level and by fossil energy consumption (TJ). For some plants thermal values are not included in the ETS. In those cases national thermal values used in the international reporting were applied.[2] In other cases activity data was not reported either, and the national emissions factors had to be used to calculate the energy amount of the fuels.

The activity data for each plant is considered to be verified when the difference in energy consumption by plant for 2006 between ETS data and QS does not exceed the given uncertainty limits[3] in Table 1.

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 of the fuel consumption (energy, or energy and fuel amounts) were carried out to explain the differences. Contacts were also made with an expert in the QS at Statistics Sweden to receive more information about specific plants and fuels.[4] Contacts were also made with a representative at the Swedish EPA to get more information about definitions in the ETS for specific plants.[5] For some plants, direct contacts were made with staff responsible for the ETS reporting at the plants.

[2] Thermal values from The Swedish National inventory Report Submission 2007, Appendix 17.
[3] 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.
[4] Erik Marklund, contact person for the QS at Statistics Sweden. erik.marklund@scb.se
[5] Thea Ohlander, contact person for the ETS at the Swedish EPA thea.ohlander@naturvardsverket.se.

3 Results and analysis

This chapter describes the results of the plant-specific comparisons. For each plant an explanation to the observed differences in energy amounts are given. Due to the confidentiality of the 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 from fossil fuels from the plants included in the study. Note that Nordic Carbon Black, which was one of the plants that showed large differences for 2005, was not included in the study since ETS-data was lacking. The first rough comparison of the two data sets showed 28 % difference. However, after excluding combustion of waste, which is not included in the ETS, the difference was only 12 %.

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 (19)	Quarterly Statistics (QS) 2006	Emission Trading Scheme (ETS) 2006	Difference between QS and ETS 2006
Fossil energy consumption (TJ) Before correction	89 573	64 308	28 %
Fossil energy consumption (TJ) After excluding waste	71 976	64 308	12 %

3.1 Plants with no significant difference between QS and ETS 2006

Based on the comparison of plant-specific data from the ETS and the QS 2006, only three plants showed no significant difference between ETS and QS. Though since waste combustion is not included in the ETS, all waste data was excluded in the QS, which resulted in that another two plants fell below the uncertainty limits. All five plants are shown in Table 3, and they represent about 20% of the total energy consumption in the study.

Table 3. Plants with no significant difference between QS and ETS 2006.

CRF	Company	Plant	Plant-id in ETS	Uncertainty limit
1A1a – Public Electricity and Heat Production	Karskär Energi AB	Karskär	372	≤2%
1A1a – Public Electricity and Heat Production	Sundsvall Energi AB	Korstaverket[6]	232	≤2%
1A1b – Petroleum refining	Preem Petroleum AB	Göteborg	425	≤10%
1A2a – Iron and steel production	Höganäs AB	Höganäs	489	≤5%
1A2F – Other Industries	Nordkalk AB Köping	Nordkalk AB Köping	410	≤10%

3.2 Plants with significant difference between QS and ETS in 2006

For 14 plants, the difference in fossil energy amounts exceeded the uncertainty limits and was hence studied in more detail. As can be seen in Table 4, the difference is just slightly above the uncertainty limit for a number of plants. For other plants however, the differences are large and it is evident that QS data collection needs to be improved if a better coherence is desirable.

[6] When all plants in the community was included, the results was not comparable, probably due to that QS- data included more plants than what are included in the ETS.

Table 4. Plants with significant difference between QS and ETS 2005, after waste has been excluded.

CRF	Company	Plant	Plant-id in ETS	Uncer cer-tainty limit	Differ-ence QS/ETS	Further actions needed
1A1a	AB Fortum Värme samägt med Stock-holm stad	All plants in the munici-pality of Stockholm	4-5, 11, 13, 15-16, 19-20 25-26,42, 45-46,50, 346	≤2%	≤10%	Yes, improve correct data collection in QS
1A1a	E.ON Värme Sverige AB	All plants in the mun. of Norrköping	266, 267, 268, 619	≤2%	≤10%	No
1A1a	E.ON Värme Sverige AB	All plants in the mun. of Örebro	25, 243	≤2%	≤5%	No
1A1a	Karlskoga kraftvär-meverk AB	All plants in the mun. of Karlskoga	139, 140, (639)	≤2%	≤5%	No
1A1a	Mälarenergi AB	All parts of the plant in Västerås	194,195, 596	≤2%	≤5%	Yes, improve correct data collection in QS
1A1a	Vattenfall AB	All plants in the mun. of Uppsala	310, 311	≤2%	≤15%	No
1A1a	Söderenergi	All plants in the mun. of Södertälje	272, 274	≤2%	≤10%	Yes, improve classifi-cation of fuels in QS
1A1a	Tekniska Verken i Kiruna AB	Kiruna power station	278	≤2%	≤10%	No
1A1a	Tekniska Verken i Linköping AB	All plants in the mun. of Linköping	280-281,282-284, 581-582, 620, 631	≤2%	≤5%	Yes, improve correct data collection in QS
1A2c	Pertorp Oxo		378	<10%	>50%	Yes, identify energy consumption
1A2c	Borealis AB	The whole plant incl. the cracker	357	<10%	>80%	No, not until the whole plant is included in the ETS
1A2d	Stora Enso Fine Paper	Grycksbo bruk	468	≤2%	≤5%	No
1A2d	Stora Enso Skoghall AB	Skoghalls bruk	475	≤2%	≤5%	No
1A2f	Cementa AB	Slite	406	<10%	≤20%	Yes, improve thermal values and classifica-tion of fuels in QS

3.2.1 Plant description

3.2.1.1 AB Fortum Värme samägt med Stockholm stad

After waste combustion was excluded in the QS data, the remaining difference is due to differences in reported amounts of fuels. Gas/diesel oil, residual fuel oil and coal have higher energy amounts reported from the QS, and the amounts of gas works gas is lower. It is likely to believe that the energy amounts reported in the ETS is more correct since data is verified and since plant specific thermal values has been used.

The precision in QS data should be improved or data from the ETS should be considered to be used in the GHG inventory.

3.2.1.2 E.ON Värme Sverige AB, Norrköping

After waste combustion was excluded in the QS data, the remaining difference is that the energy amount of used car tires is higher in ETS data. In the ETS, the plant has only reported the amount of combusted car tires (in ton) and the CO_2- emissions. In the QS-data the amount of car tires combusted were reported in cubic meters. To calculate the energy amounts the national emission factor for "Other non specified fuels" was used, which is not plant specific. Besides, it was therefore not possible to make an adequate comparison in energy terms.

As long as the plant does not report any thermal value in the ETS, no further actions are found useful.

3.2.1.3 E.ON Värme Sverige AB, Örebro

The difference in energy amount is due to a higher thermal value is used for residual fuel oil in the ETS compared to in the QS (ETS: average 38,82 TJ/m^3 and QS: 38,16 TJ/ m^3). When comparing the fuel consumption in cubic meters however, the differences are within the uncertainty limit, and no further actions are needed.

3.2.1.4 Karlskoga kraftvärmeverk AB

After waste combustion was excluded in the QS data, the difference in the data sets is only a few percent. This difference is caused by a fuel called PTP in ETS data and that is classified as "Other non specified fuels" in the QS data. The energy amounts cannot be correctly compared since there is a risk that the thermal value used in QS data is not totally adjusted for this fuel. The difference is however very small, and no further action is considered needed.

3.2.1.5 Mälarenergi AB, Västerås

All parts of the plant need to be included in the comparison since single parts can not be identified in QS data. The difference between the data sets is that the fuel amount, and especially the energy amount of coal, is higher in the QS data. Upon contacting the plant the explanation to this difference was that the reported data to

the ETS system is more accurate.[7] The plant's ambition is to report the same amount, but since the QS data are reported quarterly and the ETS data are calculated after finishing the current year, this had not been possible so far.

The precision in QS data should be improved or data from the ETS should be considered to be used in the GHG inventory.

3.2.1.6 Vattenfall AB, Uppsala

After waste combustion was excluded in the QS data, the remaining difference is that QS data includes higher fuel and energy amounts of peat. By contacting the plant it was clear that the peat is mixed with biogenic saw dust.[8] Hence, some of the peat should be classified as biogenic as done in the ETS (called biomass fuels from "Härjedalen Miljöbränsle"). When excluding the saw dust from the ETS data the difference in the data sets is within the uncertainty limit. The plant will separate the saw dust from the peat in the next reporting to the QS, and hence no further actions are considered needed if revisions for earlier years are not desired.

3.2.1.7 Söderenergi, Södertälje

The classifications of fuels differs in QS and ETS data. In the ETS, more fuels are classified as biogenic. When summarizing both biogenic and fossil fuels for the plant, the difference lies within the uncertainty limit.

The energy amount of peat is higher in the QS data which is explained in the ETS that peat is partly mixed with wood briquettes (biofuel) and is hence reported partly as a fossil and partly as a biogenic fuel in the ETS.

Finally, in the ETS data the fuel with the EWC code 191210 is reported, that is combustible waste, partly biogenic, with 20% plastics according to the plant.[9] This fuel is probably classified as wood waste in the QS.

The overall conclusion is that the classification of biomass and fossil fuels in the QS should be considered to be revised for 2006 and in relevant cases also for earlier years.

3.2.1.8 Tekniska verken i Kiruna

After waste combustion was excluded in the QS data, the remaining difference is that QS data on peat is a few TJ higher than in the ETS data, which might be explained by higher accuracy in the end of the year when data to the ETS is reported. The difference is however very small and no further action is considered needed.

[7] Contact at Mälarenergi, Erik Holmen, Erik.holmen@malarenergi.se
[8] Contact at Vattenfall AB, Lars Perols, lars.perols@vattenfall.com
[9] Contact at Söderenergi, Katja Pettersson, katja.pettersson@soderenergi.se

3.2.1.9 Tekniska verken i Linköping

After waste combustion was excluded in the QS data, some differences in energy amounts for different fuels still remains. In the ETS higher energy amount are reported as biogenic and the difference between the data sets is a bit lower when all fuels are included.

The precision in QS data should be improved and the classification of biomass and fossil fuels should be considered to be revised in the QS-data for 2006 and in relevant cases also for earlier years.

3.2.1.10 Perstorp Oxo

In the QS data natural gas and "Other petroleum" are included, but the fuels giving rise to CO_2-emissions in the ETS are not natural gas but refinery gases and internal by-products. In the study performed by SMED in 2006 the conclusion was that the natural gas should be excluded in the QS data since it is not used as an energy source. Upon contacting the plant within this project[10] it was found out that natural gas is used within the process to produce products and some off-gases. The products are sold and does hence not give rise to any emissions, which however the off-gases do. In the ETS system the plant is allowed to report a mass balance on in- and outgoing carbon and they do not report any activity data. This is due to that if they would base the calculations only on the in-going fuels the emissions would be higher than in the reality.

Hence, to get correct fuel and energy amounts for emission calculations the natural gas and the "Other petroleum" in the QS data need to be excluded and replaced with ETS data. But the problem remains that no activity data are reported, and hence national emission factors need to be used to get the energy amount that is needed to calculate both CO_2 and other emissions. National emission factors will not give the accurate energy amounts. In the plant's environmental report the total energy amount is reported and that could be a valuable source. However, to get precise emissions for the plant, new emission factors from those internal fuels need to be developed.

In the ETS study in 2005 it was decided to exclude the natural gas, which will be made in 2006, but this should be further studied.

3.2.1.11 Borealis AB

ETS data and QS can not be compared since QS data includes all used fuels and energy used, whereas in the ETS data only part of the production is included. In earlier studies Borealis reported fuel consumptions used both for energy production and within the process, whereas in the ETS only the energy production part is included in the current system. This was confirmed by contacting the plant and information was given that in 2008 all production will be included in the coming

[10] Contact at Perstorp Oxo. Arne Alexandersson: arne.alexandersson@perstorp.com

trading system.[11] Further comparisons might be interesting after the first year of reporting in 2009, until then, no further actions are considered needed.

3.2.1.12 Stora Enso Fine Paper, Grycksbo Bruk

The amount and energy in residual fuel oil differs slightly between the two data sets, which might be due to the same reasons as for Mälarenergi AB described above, that is, data is verified and has therefore a higher quality in the ETS. The difference is however very small and no further action is considered needed.

3.2.1.13 Stora Enso Skoghall AB, Skoghalls bruk

The amount and energy in residual fuel oil differs slightly between the data sets, which might be due to the same reasons as for Mälarenergi AB described above, that is, data is verified and has therefore higher quality in the ETS. The difference is though very small and no further action is considered needed.

3.2.1.14 Cementa AB, Slite

The reported energy amount in the QS data is higher due to higher amounts of coal and other non specified fuels.

The difference in coal is due to different thermal values; SMED uses a national thermal value of 27.2 GJ/m^3 and the plants uses 24.9 GJ/m^3. In the ETS a number of fuels are reported as partly biogenic and partly fossil. In the ETS only meat and bone flour are classified as biogenic.[12]

If the plant specific thermal value for coal is used in the QS and the energy amount that is reported as biogenic in the ETS are excluded from the QS, the difference between ETS data and QS data is less then ten percent, which is within the uncertainty limit. No direct actions are considered needed, but again the QS data could be improved by especially a better separation of biogenic and fossil fuels.

[11] Contact at Borealis, Jonny Andersson, jonny.andersson@borealisgroup.com
[12] Contact at Cementa, Slite; Ingela Kippel Rasmusson, telephone: 0498- 281 270

4 Discussion

A general difference between fossil fuel consumption in the QS and in the ETS is that waste combustion is included in the QS as it contains all fuels classified as fossil. However, since waste is not included in the ETS, the data sets can never be directly comparable. Of the total difference of 28% observed between the data sets, waste combustion accounted for half of it. When excluding waste from QS data, the difference between the data sets are 12 %. If the ambition is to decrease this figure there are a few issues to focus on in the QS; the correctness of reported fuels, the aggregation of fuels into fuel groups and separation of fuels into biogenic and fossil fuel groups, which are described below.

Generally, thermal values and emission factors used in the GHG inventory is not plants specific and will hence result in differences in emissions on plant level. Besides, data reported to the QS often differs slightly from data in the ETS. The reasons may be various, but one might be that correct data is not available for each quarter and hence the figures are estimated.

In the QS is unconventional fuels are grouped and called for instance "Other not specified fuels". The aggregation of fuels into such fuel groups results in very uncertain emissions factors, since they are not specific for the current fuel and plant. To calculate more accurate emissions, it should be considered to exclude some commonly used fuels and define more appropriate emission factors and thermal values. This has already been made for refinery gas and petroleum coke in earlier studies, but could be made also for other fuels.

Another problem is that some of those unconventional fuels are incorrectly classified in the QS. In the ETS, some of these fuels are often partly biogenic and should hence be classified as "Other biomass". This calls for improved collection of future QS data and if possible revised QS time series, if better coherence between the two data sets is desired.

It is not clear how much the CO_2 emissions would change, if revisions of emission factors and classifications of fuels would be made. The total energy consumption of those unconventional fuels is very small compared to the overall use. It would be interesting to estimate the energy consumption from unconventional fuels compared to the total use in the study of the 63 plants in the ETS in 2005, since the results would indicate how large the potential for improvements is. Another interesting discussion point is how large differences between ETS data and GHG inventory data that can be internationally accepted. QS data will always result in some differences and if that is not accepted, ETS data has to be used.

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