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Swedish Environmental Emissions Data

Improved Statistics on Process Emissions and Flaring

Anna-Sofia Kumlin, IVL Swedish Environmental Research Institute
Anna-Karin Nyström, Statistics Sweden

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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.

Summary

SMED was involved in two projects concerning the EU emission trading scheme[1] in the years 2003 and 2004. During these projects deficits in data used by SMED to report emissions of CO_2 to the EU Monitoring Mechanism and the UNFCCC were observed. Deficits include lack of activity data on the use of carbon-containing input materials within in the iron and steel industry and the production of light expanded clay aggregate (LECA). Deficits also include lack of activity data on the use of limestone and dolomite as well as flaring of excess gases, at a few plants from various industry sectors.

Within this project new activity data have been collected. Emissions have been updated and completed on the basis of collected data and data from the inquiry sent to concerned companies in order to establish the Swedish national allocation plan (NAP) for the EU emission trading scheme[2] (from here on referred to as "the inquiry for the Swedish NAP") in the winter of 2004.

For the *iron and steel sector* emissions from stationary combustion (CRF/NFR 1A2a) and from processes (CRF 2C1) have been updated. Updated emissions in CRF 2C1 are a result of new activity data on the use of carbon-containing input materials, such as electrodes, coal and coke, that are used to reduce iron ore or optimise conditions in the smelt. These emissions are defined as process emissions in the IPCC Guidelines.[3] In earlier submissions these emissions have only partly been included in CRF 2C1, some emissions were completely lacking and some were incorrectly reported in CRF/NFR 1A2a. The emissions that were incorrectly reported in CRF/NFR 1A2a have been updated and reallocated to CRF 2C1. Emissions in CRF 2C1 have been completed with data from eight additional plants. The whole time series has been updated in Submission 2005.

The production of *light expanded clay aggregate* gives rise to process emissions of CO_2 that have not been known nor reported in earlier submissions. Emissions arise from the use of limestone, clay and additives and amounted to 6,308 ton CO_2 in 2003. The whole time series for CRF 2A7 has been updated in Submission 2005.

The use of *limestone and dolomite* was found to be more extensive than what had been known for earlier submissions. New activity data on the use of limestone and dolomite has been collected from nine plants. The whole time series for CRF 2A3 has been updated. The results show higher emission levels, but the difference between 1990 and 2003 is smaller in Submission 2005 compared to Submission 2004.

Flaring of excess gases was found to be more extensive than what had been known for earlier submissions. New activity data has been collected from nine plants: four refineries, three steel producers, one chemical industry and one pulp producer. Calculated emissions will be reported in CRF 1B in Submission 2005 to the EU Monitoring Mechanism, the UNFCCC and the CLRTAP.

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[1] EU Directive 2003/87/EC on establishing a scheme for greenhouse gas emission allowance trading within the Community and the amending Council Directive 96/61/EC
[2] Ministry of Industry, Employment and Communications, Sweden's National Allocation Plan (2004-04-22), http://www.regeringen.se/content/1/c6/01/90/18/e9286dc2.pdf
[3] Revised IPCC Guidelines for National Greenhouse Gas Inventories: Workbook 2.13.2

1 Introduction

SMED was involved in two projects concerning the EU emission trading scheme[4] in the years 2003 and 2004. One of the projects involved collecting activity data, to quantify CO_2 emissions, from concerned companies to establish the Swedish national allocation plan (NAP) for the EU emission trading scheme.[5] This was done by means of an inquiry (from here on referred to as “the inquiry for the Swedish NAP”) sent out in the winter of 2004. In the work with the two projects, company-specific data from the yearly environmental reports and from the companies’ responses to the inquiry for the Swedish NAP were compared to reported emissions of CO_2 to the EU Monitoring Mechanism and the UNFCCC in Submission 2003 for the years 2000 and 2001. During this comparison work deficits in data used by SMED to report emissions of CO_2 to the EU Monitoring Mechanism and the UNFCCC were observed. Deficits include lack of activity data on the use of carbon-containing input materials within in the iron and steel industry and the production of light expanded clay aggregate (LECA). Deficits also include lack of activity data on the use of limestone and dolomite as well as flaring of excess gases, at a few plants from various industry sectors.

The use of fossil fuels from the Energy Statistics division at Statistics Sweden form the basis for the quantification of CO_2-emissions from stationary combustion and, in some cases, from processes, from the companies in this study that is reported to the EU Monitoring Mechanism and the UNFCCC. The above-mentioned input materials are not included in the scope of the survey in which data are collected at the Energy Statistics division, since they are not used for an energy purpose. This is the reason why these input materials and related emissions have not been assessed and reported in earlier submissions.

1.1 Aim

The overall aim of this project is to complete and update the statistics on emissions from the companies under study, for the whole time series (1990-2003). Reported activity data and calculated CO_2-emissions will be based on data from the inquiry for the Swedish NAP (for the years 1998-2002) and new data collected directly from the companies (1990-1997 and 2003). The whole time series will be updated in Submission 2005 to the EU Monitoring Mechanism, the UNFCCC and to the CLRTAP.

The project includes four sub-projects, which will be described, discussed and concluded in separate chapters of this report. The sub-projects include the following:

1. Combustion and process emissions from the iron- and steel industry, CRF/NFR 1A2a and CRF/(NFR) 2C1
2. Process emissions of CO_2 from the production of light expanded clay aggregate, CRF 2A7
3. Process emissions of CO_2 from the use of limestone and dolomite, CRF 2A3
4. Emissions of CO_2 from flaring, CRF/NFR 1B2ci

[4] EU Directive 2003/87/EC on establishing a scheme for greenhouse gas emission allowance trading within the Community and the amending Council Directive 96/61/EC

[5] Ministry of Industry, Employment and Communications, Sweden’s National Allocation Plan (2004-04-22), http://www.regeringen.se/content/1/c6/01/90/18/e9286dc2.pdf

2 Combustion and Process Emissions from the Iron- and Steel Industry, CRF/NFR 1A2a and CRF/(NFR) 2C1

This sub-project is divided into two separate chapters; one dealing with combustion and process emissions of CO_2, and one dealing with *other* process emissions from carbon-containing input materials within the iron and steel industry.

2.1 Data on the Use of Carbon-containing Input Materials

Process emissions of CO_2 from the use of carbon-containing input materials within the iron and steel industry have been reported from a few companies, for a few years, in earlier submissions. Results from the inquiry for the Swedish NAP show that and additional eight companies reported the use of carbon-containing input materials, such as coal electrodes, coal powder, coke and anthracite, for purposes other than combustion.

The use of anthracite has, in earlier submissions, been defined as a combustion fuel and associated emissions have subsequently been reported in tables CRF/NFR 1A2a. The main purpose of anthracite use is, however, to reduce iron ore or to obtain optimal conditions in the smelt, balancing the coal/metal content of the steel (depending on process). For this reason associated emissions should rather be accounted for as process emissions and be reported in CRF 2C1. Furthermore anthracite is classified as coal by the Energy Statistics division, whereas it is a pure form of coal, more like coke. For this reason, the currently used thermal value and emission factor for coal may be incorrect.

2.1.1 Aim

This sub-project has two aims. One is to collect data on used amounts of carbon-containing input materials and associated emissions of CO_2 for the years 1990-1997 and 2003 from the additional eight companies that reported the use of these input materials in the inquiry for the Swedish NAP. Based on collected data and data from the inquiry for the Swedish NAP (for the years 1998-2002) new data on process emissions of CO_2 will be calculated and reported in CRF 2C1, for the whole time series, in Submission 2005 to the EU Monitoring Mechanism and the UNFCCC.

An additional aim is to verify the used thermal value and emission factor (same as coal in Submission 2004) for the use of anthracite in iron and steel processes. And, if necessary, make recalculations based on a revised thermal value and emission factor.

2.1.2 Methodology

Data in the form of used amounts of carbon-containing input materials and associated emissions of CO_2 for the years 1990-1997 and 2003 were collected by means of an inquiry sent out to the companies in question. Data, in the same form, for the time period 1998-2002 had already been collected through the inquiry for the Swedish NAP.

Used thermal value and emission factor for anthracite were verified through contact with relevant actors, such as the Energy Statistics division at Statistics Sweden, Jernkontoret (trade association for the iron and steel industry in Sweden) and Höganäs AB (user of anthracite). The IPCC Guidelines as well as the Swedish guidelines on surveillance and reporting of basic data for the EU emission trading scheme[6] were also consulted. The verification showed differing results where carbon-contents, thermal values and emission factors could be found (see Annex 1).

According to the IPCC Good Practice Guidance, it is *good practice* to develop emissions estimates at plant-level because plants can differ substantially in their technology.[7] Default emission factors shall only be used when more detailed information on plant-level is not available.[8]

According to the Swedish guidelines on surveillance and reporting of greenhouse gas emissions in accordance with EU emission trading scheme it is recommended that plant-specific data be used in as far as it is “technically and financially” feasible. It may be interesting to synchronise basic data for the EU emission trading scheme with those for the international reporting to the EU Monitoring Mechanism, the UNFCCC and CLRTAP.[9]

For the above stated reasons as well as for the fact that there are no specific default thermal values and emission factors for the carbon-containing input materials under study, it has been decided, in consultation with the Swedish EPA,[10] that plant-specific data should be used for the whole time period. Plant-specific mass balances and data on input materials, specific carbon-contents and thermal values as well as process-specific CO_2-effiency, result in more accurate calculations of CO_2-emissions than calculations by means of activity data, default thermal values and emission factors.

The characteristics of collected data vary slightly between the companies and comments are given on plant-level in the following chapters. The Good Practice Guidance method Tier 1 has been used (in the sense that plant-specific data on carbon-containing input materials have been used) for most of the plants under study. For two of the plants activity data on steel production have been used. For Höganäs AB at Höganäs (covering about half of the total emissions from the plants under study, see Figure 2.3) the Good Practice Guidance method Tier 2 has been used in the sense that basic data include carbon-containing input materials *and* specific carbon-contents of output iron and rest products.

A completed time series for process emissions of CO_2 from carbon-containing input materials was recalculated and reported in CRF 2C1 in Submission 2005 to the EU Monitoring Mechanism and the UNFCCC. Also CRF/NFR 1A2a was recalculated due to that activity data on coal and coke has been excluded.

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[6] http://www.naturvardsverket.se/dokument/hallbar/klimat/utslappshandel/utslappshand/pdf/NFS_9_2004.pdf
[7] Good Practice Guidance and uncertainty Management in National greenhouse Gas Inventories, chapter 3.1.3.
[8] Revised IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual Chapter 2.13.1.
[9] Staffan Asplind, Swedish EPA.
[10] David Mjureke, Swedish EPA, Anna-Karin Nyström and Anna-Sofia Kumlin, 2004-06-11.

2.1.3 Activity Data for the years 1990-1997 and 2003

2.1.3.1 Sandvik AB[11]

At Sandvik AB several carbon-containing input materials are used in the electric arc furnace for the purpose of reducing the ferrous scrap. These input materials are Scandust (dust containing valuable alloys and about 5 % carbon from air cleaning filters) briquettes (containing 7 % carbon and scrap), Charge Chrome, coal electrodes and coal powder. Total CO_2-emissions from the use of these input materials amounted to 19,000 ton CO_2 in 2002.[12] These emissions have not been included in earlier submissions, because the input materials from which they originate are not included in the energy statistics of Statistics Sweden.

Activity data on Scandust, briquettes, Charge Chrome, coal electrodes and coal powder, but no emissions was collected for the years 1990-1997 and 2003. For the earlier years the use of Scandust material, coal powder and briquettes was not known exactly and has therefore been estimated by Sandvik. Data on carbon-contents in input scrap as well as output steel and slag products have not been reported. Sandvik considers these contents to be fairly equivalent, hence no difference in carbon-contents resulting in excess or reduced CO_2-emissions is assumed.

Sandvik reported activity data on used amounts of input materials along with associated CO_2-emissions to the inquiry for the Swedish NAP. As Sandvik did not report associated CO_2-emissions for the years 1990-1997 and 2003, the carbon-contents for each respective input material reported in the inquiry were used in to calculate associated CO_2-emissions for the whole time series.

2.1.3.2 Fundia Special Bar AB, Smedjebacken[13]

Fundia Special Bar AB produces special steel. In the electric arc furnace electrodes, coke, coal and cast iron shavings are used. Total CO_2-emissions from the use of these input materials amounted to 27,000 ton CO_2 in 2002.[14] These emissions have not been included in earlier submissions, because the input materials from which they originate are not included in the energy statistics of Statistics Sweden.

Activity data on electrodes, coke, coal and cast iron shavings as well as corresponding emissions of CO_2 was collected for the years 1990-1997 and 2003. Fundia remarked that data for earlier years were more uncertain. Data on carbon-content in input steel scrap as well as output steel and slag products were not reported as such calculations/measurements have not been performed.

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[11] Per Abenius, per.abenius@sandvik.com, 2004-04-29, personal communication
[12] Data from the inquiry for the Swedish national allocation plan (NAP) for the EU emission trading scheme. March 2004.
[13] Tommy Örtlund: tommy.ortlund@fundia.com. 0240-66 81 16, 070-637 52 58
[14] Data from the inquiry for the Swedish national allocation plan (NAP) for the EU emission trading scheme. March 2004.

2.1.3.3 Höganäs AB, Halmstad[15]

Höganäs AB is the world's largest producer of iron and metal powders.[16] In the electric arc furnace of Höganäs AB, Halmstad, coal electrodes, anthracite and petroleum coke are used. Total CO_2-emissions from the use of these input materials amounted to 15,000 ton CO_2 in 2002.[17] These emissions have not been included in earlier submissions, because the input materials from which they originate are not included in the energy statistics of Statistics Sweden.

Activity data on coal electrodes, anthracite and petroleum coke as well as corresponding emissions of CO_2 was collected for the years 1990-1997 and 2003. In data for the years 1998-2002 carbon-contents of input materials have been corrected for carbon bound in output iron powder and slag products, resulting in lowered emissions. This correction has not been done for the remaining years. In the calculations for Submission 2005 the higher carbon-contents of input materials used in 1990-1997 and 2003 have been used for the whole time series. From the calculations Höganäs concludes that they will most likely use IPCC default factors for used scrap and iron, to calculate CO_2-emissions resulting from the difference in carbon-contents of input scrap and output iron powder and rest products. A revision of the emissions may hence be needed for Submission 2006.

2.1.3.4 Höganäs AB, Höganäs[18]

In Höganäs AB, Höganäs, iron ore pellets are reduced to produce iron powder used, for instance, as components in car production. Coke and anthracite are used as reducing agents. Total CO_2-emissions from the use of these input materials amounted to 140,000 ton CO_2 in 2002.[19] In earlier submissions emissions of CO_2 from the use of coke were reported as process emissions. Compared to data from the inquiry to the Swedish NAP reported amounts were high. Anthracite was incorrectly defined as fuel used for stationary combustion and related emissions subsequently reported in CRF/NFR 1A2a.

Activity data on coke, anthracite, produced steel and rest materials were collected as well as corresponding emissions of CO_2 for the whole time period 1990-2003. Data from the inquiry for the Swedish NAP was not used, as carbon-contents of input materials had not been corrected for carbon bound in output iron powder and rest products. In Submission 2005 emissions of CO_2 from both coke and anthracite will be reported as process emissions.

2.1.3.5 Scana Steel AB, Björneborg[20]

Scana Steel AB produces alloyed steel in an electric arc furnace, where coal electrodes (100 % carbon) are used. Total CO_2-emissions from the use of this input material amounted to 1,300 ton CO_2 in 2002.[21] These emissions have not been included in earlier

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[15] Cecilia Svensson: Cecilia.Svensson@hoganas.com, 2004-05-11, 042- 33 83 16
[16] www.hoganas.com, 2004-08-09
[17] Data from the inquiry for the Swedish national allocation plan (NAP) for the EU emission trading scheme. March 2004.
[18] Pernilla Nydahl: pernilla.nydahl@hoganas.com, 2004-05-12, 042-33 80 00
[19] Data from the inquiry for the Swedish national allocation plan (NAP) for the EU emission trading scheme. March 2004.
[20] Anders Strand [Anders.Strand@scana.no], 2004-05-12, 0550-25199
[21] Data from the inquiry for the Swedish national allocation plan (NAP) for the EU emission trading scheme. March 2004.

submissions, because the input material from which the emissions originate are not included in the energy statistics of Statistics Sweden.

Activity data on coal electrodes and corresponding emissions of CO_2 was collected for the years 1990-1997 and 2003.

2.1.3.6 Outokumpu Stainless AB, Avesta[22]

Outokumpu Stainless AB in Avesta uses electrodes, coal and other carbon-containing materials in the production. In the inquiry for the Swedish NAP carbon bound in output steel products was reported. Total CO_2-emissions from the use of these input materials amounted to 38,000 ton in 2002.[23] These emissions have not been included in earlier submissions, because the input materials from which they originate are not included in the energy statistics of Statistics Sweden. Except for emissions from the use of coal in 1991, which were incorrectly reported in CRF/NFR 1A2a.

Outokumpu Stainless in Avesta provided activity data on electrodes, coal and other carbon-containing materials for the year 2003, along with production data for the whole time series. To estimate the emissions of CO_2 from input materials for the period 1990-1997, a quota was calculated for the years 1998-2003, where both emission and production data were known; ton CO_2 emitted per from input materials divided by the production in ton. A trend line was created. This trend line showed an increased CO_2-efficiency for the years 1998-2003. It is likely to believe that this trend has gone on since 1990, which gives the opportunity to calculate a quota, and subsequently emissions based on production data (ton CO_2 per ton steel) based on the trend line, for the remaining years.[24] In Figure 2.1, an illustrative example (not Outokumpu) of the used trend line is shown.

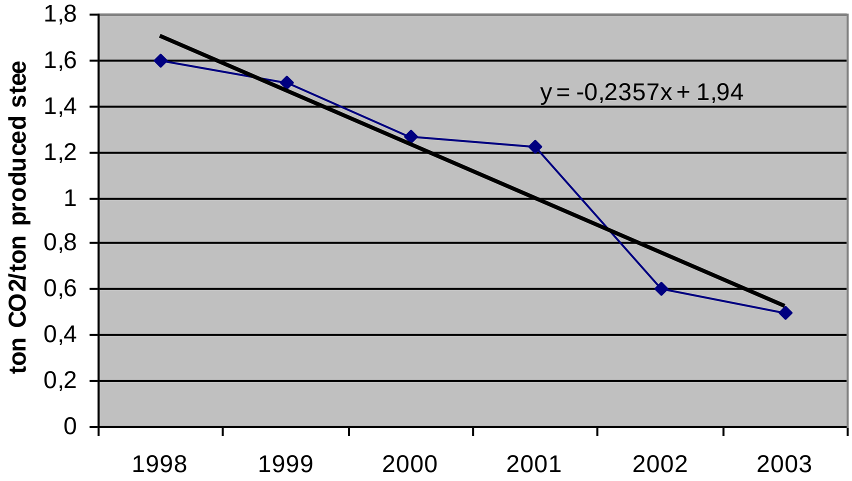

Figure 2.1 **Example (Not Outokumpu) of a diagram with the quota ton CO_2 emitted from input materials per ton produced steel and a resulting trend line**

[22] Christer Manngård: Christer.Manngard@outokumpu.com, 2004-05-10.
[23] Data from the inquiry for the Swedish national allocation plan (NAP) for the EU emission trading scheme. March 2004.
[24] Curt-Åke Boström, expert on industrial processes at IVL Swedish Environmental Institute, 2004-05-20.

2.1.3.7 Outokumpu Stainless AB, Degerfors[25]

Outokumpu Stainless in Degerfors uses electrodes, coal powder, coke and carbon from Chrome alloys and other input materials in the production. In the inquiry for the Swedish NAP carbon bound in output steel products was reported. Total CO_2-emissions from the use of these input materials amounted to 38,000 ton in 2002.[26] These emissions have not been included in earlier submissions, because the input materials from which they originate are not included in the energy statistics of Statistics Sweden.

Outokumpu Stainless in Degerfors, in analogy with the company division in Avesta, provided activity data on electrodes, coal powder, coke and carbon from Chrome alloys and other input materials for the year 2003, along with production data for the whole time series. A trend line was established and emissions calculated in the same way as for Avesta, as described in the previous chapter.

2.1.3.8 Ovako Steel AB, Hofors[27]

Ovako Steel AB in Hofors is a manufacturer of steel for rolling bearings and a major producer of other special engineering steels. Electrodes, coal (anthracite) and coke are used in the production. Total CO_2-emissions from the use of these input materials amounted to 31,000 ton in 2002.[28] Emissions from the use of these input materials have been partly included in earlier submissions; coal in 1991, 1994-2002 and coke in 2000. These emissions have been incorrectly reported as emissions from stationary combustion in CRF 1A2a. In Submission 2005 the incorrectly reported emissions will be updated and reallocated to CRF 2C1. Emissions in CRF 2C1 will be completed with new data for the remaining years.

Activity data on electrodes, coal (anthracite) and coke and corresponding emissions of CO_2 were collected for the years 1990-1997 and 2003. Data from the company's division in Hällefors were included in collected data for the years 1990-1991. In 1991 the steel production in Hällefors was transferred to Hofors. However, no use of the input materials coal and/or coke was reported from Hällefors in the years 1990-1991, as was the case with Hofors (see section above), hence no additional, incorrectly reported emissions in CRF 1A2a subject to reallocation.

2.1.3.9 Erasteel Kloster AB and Outokumpu Stainless AB, Torshälla

Erasteel Kloster AB has reported process emissions of CO_2 to the inquiry for the Swedish NAP. However, these emissions originate from the combustion of residual oils and LPG, and as such should be reported as emissions from stationary combustion, which was also done. Reported data to the inquiry for the Swedish NAP are concurrent with Energy Statistics where, combustion emissions arising from conventional fuels, but no process emissions, are found. No contact was made with Erasteel Kloster to collect complementary data, since it did not report process emissions from the use of carbon-containing input materials, for the years 1998-2002.

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[25] Niklas Wass: Niklas.Wass@Outokumpu.com, 2004-06-21

[26] Data from the inquiry for the Swedish national allocation plan (NAP) for the EU emission trading scheme. March 2004.

[27] Lars Dahlqvist: Lars.Dahlqvist@skf.com, 2004-05-03.

[28] Data from the inquiry for the Swedish national allocation plan (NAP) for the EU emission trading scheme. March 2004.

Outokumpo Stainless AB in Torshälla did not report process emissions of CO_2 to the inquiry for the Swedish NAP. Similar to Erasteel Kloster, reported data to the inquiry for the Swedish NAP are concurrent with data from the Energy Statistics division, where no process emissions are found. No contact was made with the company to collect complementary data, since it did not report process emissions from the use of carbon-containing input materials, for the years 1998-2002.

2.1.4 Calculation Results for CO_2

Recalculations of emissions from the eight plants have resulted in updated time series for both CRF/NFR 1A2a and CRF 2C1, see CO_2 in Figure 2.2. Note that the iron and steel producer SSAB are included in the CRF 1A2a, but not in CRF 2C1, since SSAB are separately reported in CRF 2C1 but not in CRF 1A2a.

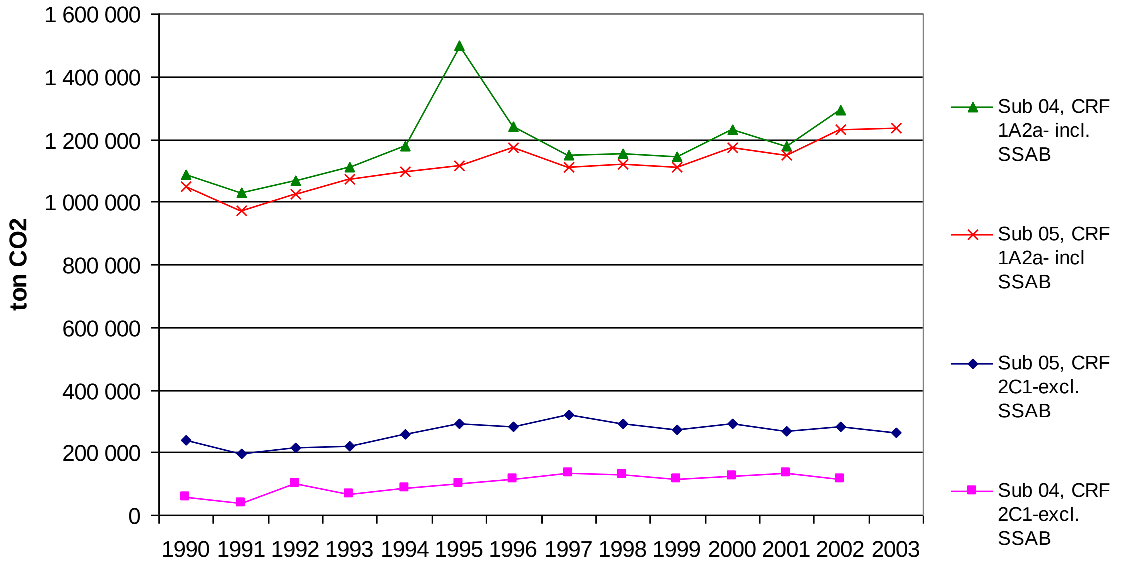

Figure 2.2 **Combustion and process emissions of CO_2 from the iron and steel sector as reported in Submission 2004 and 2005**

Lower emissions of CO_2 for CRF/NFR 1A2a in Submission 2005 are due to the fact that activity data on coal and coke from two plants have been updated and reallocated to CRF 2C1 – Other. As a result of the incorrectly reported coal and coke, emissions other than CO_2 have been reported twice (both in CRF/NFR 1A2a and CRF/NFR 2C1). This has been corrected for Submission 2005.

In Submission 2004 there is a peak in 1994 for CRF 1A2a. Within this project it was found that this peak was due to incorrectly reported data on LPG use from one of the plants. Data on LPG use have therefore been updated for this year and 1990-1993 as well as 1997-2001.

The updated time series for CRF 2C1 in Submission 2005 are due to new activity data on carbon-containing input materials, as described in previous chapters. As can be seen in Figure 2.2 emissions from several plants were missing in Submission 2004.

Total emissions of CO_2 per plant reported to the inquiry for the Swedish NAP, for the year 2002, are given in Figure 2.3. The largest emitter is Höganäs AB in Höganäs. Höganäs AB in Höganäs is a “primary” iron producer. Iron ore pellets, coke and anthracite are used as input materials in the process to reduce iron ore pellets and produce iron powder.

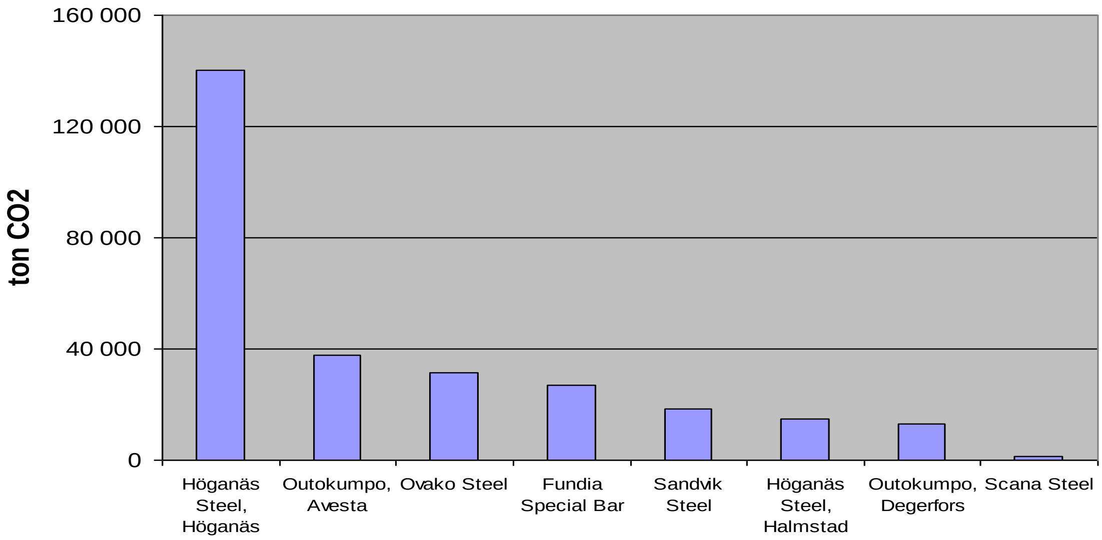

Figure 2.3 CO_2-emissions from processes in 2002 reported to the inquiry for the Swedish NAP

Activity data, emissions of CO_2 and implied emission factors that will be reported in CRF 2C1 in Submission 2005 are given in Annex 2. If data is reported in CRF 2C1 – Iron and Steel Production all data all activity data will have to be summarised. This makes verification difficult. For this reason data will be reported in “CRF 2C1 – Other” and emissions will be divided into four groups: electrodes, coal/anthracite, coke and “other”. The group “other” is very inhomogeneous. It includes Scandust, briquettes, Charge Chrome, foaming coal, coal powder and chrome alloys as well as steel production (from two plants). This group will not be easy to verify, but further divisions of activity data are not purposeful due to the small amounts used and the secrecy of Statistics Sweden. At least the implied emission factor for the group “other” is fairly steady.

2.1.5 Quality Assurance of Process Emissions of CO_2

The correctness and adequacy of the updated time-series have been checked. For each plant, data on carbon-contents of each specific input material have been compared between the reported years. For each input material, data on carbon-contents from the different plants have been compared.

2.1.6 Concluding Remarks

The plants under study may produce more detailed mass balances for carbon as basic data for the application of CO_2 emission allowances in the fall of 2004. A comparison of basic data for emission allowances and data collected and reported to Submission 2005 would be valuable prior to Submission 2006. Emissions should not differ significantly, but it is important to have consistency between data reported to the UNFCCC and basic data for EU emission trading scheme, as it is the intention to use the latter as basic data for Submission 2007.

Only plants affected by the EU emission trading scheme have been included in this study. Process emissions of CO_2 may occur from plants that are not included in the EU emission trading scheme, which implies an underestimation of total emissions. For the same reason emissions other than CO_2 may be overestimated if activity data on carbon-containing input material are incorrectly reported in CRF 1A2a, instead of CRF 2C1, as was described in chapter 2.1.4.

2.2 Other Process Emissions from the Use of Carbon-containing Input Materials

As a result of the suggested recalculations made for process emissions of CO_2 in chapter 2.1, the question arose whether or not it would be relevant to calculate other process emissions in analogy with process emissions of CO_2.

2.2.1 Aim

The aim of this sub-project is to analyse the quantification of process emissions of SO_2, NO_x, PAH, particles, metals and dioxins from the iron and steel plants in question, in order to conclude whether or not it would be relevant to calculate these in analogy with process emissions of CO_2.

Emissions that are particularly relevant to analyse in this case are SO_2 and NO_x, other emissions are only briefly discussed in Chapter 2.2.2 below.

2.2.2 Methodology

Process emissions of PAH, particles, metal and dioxins occur, but no significant amounts result from the carbon-containing input materials under study. Process emissions of PAH from the iron and steel sector mainly occur from coke-ovens, other sources of are of minor significance in relation to these.[29] As for process emissions of particles, metals and dioxins, it would be difficult to calculate them in analogy with process emissions of CO_2 as processes are of slightly different character and it is difficult to make calculations in a uniform manner. Emissions of these substances occur from various parts of the processes and it is more adequate to quantify total emissions from a plant's annual environmental report, which is currently the case.[30] For the reasons described above process emissions of PAH, particles, metals and dioxins have not been further analysed within this sub-project.

Emissions of NO_x and SO_2 from the processes of the iron and steel industry under study are currently quantified on the basis of annual environmental reports. Both for primary and secondary steelworks it is, in general, explicitly stated how much of each substance that is released from the BOF (Basic Oxygen Furnace) or the equivalent, or from the EAF (Electric Arc Furnace). Whether these emissions of NO_x and SO_2 originate from the fuels or other input materials used is difficult to say on the basis of the information and aggregated results in the environmental reports.

[29] Kindbom et al. 2004. SMED report: 'Emissions of particles, metals, dioxins and PAH in Sweden'.
[30] Curt-Åke Boström and Karin Kindbom, 2004-05-20.

In order to verify the current quantification of emissions of NO_x and SO_2 related to carbon-containing input materials to the processes of the iron and steel plants under study, two relevant and comparable statistical calculations have been made:

1. On the basis of activity data on carbon-containing input material, carbon-content and an emission-factor for NO_x and SO_2, respectively. The emission factors that have been used are for the combustion of the relevant input material,[31] as there are no specific emission-factors for process emissions of NO_x and SO_2 from the use of the input materials in question.

2. On the basis of production data and an emission-factor for NO_x and SO_2, respectively, for general process emissions from the production of raw iron or steel.[32]

These calculations have been made for all plants under study, for the year 2001. The resulting subtotals of process emissions of NO_x and SO_2, as well as used emission factors, from the iron and steel industry calculated by the above presented methods are given in Tables 2.3 and 2.4, below. Used thermal values are the ones used for the year 2001 in Submission 2004.[33]

2.2.3 Calculation Results for NO_x

Results of the different methods of quantification, as described in the previous chapter, for NO_x are shown in Table 2.3.

Table 2.3 Resulting emissions of NO_x using different methods of quantification

Method of Quantification	EF for NO_x	NO_x-emissions (tons)	Percentage of Submission 2004
1. Calculation on the basis of used input materials and emission factor for combustion of these materials	0.15 g NO_x/GJ used input material	337.1	60 %
2. Calculation on the basis of produced input iron or steel and emission factor from CORINAIR for iron and steel industrial processes	200 g NO_x/ton produced input iron or steel	425.0	76 %
3. Current method of quantification: subtotal for the year 2001 from Submission 2004 to the EU Monitoring Mechanism, UNFCCC and CLRTAP	Plant-specific	561.8	100 %

The methods 1 and 2 show lower results of emissions of NO_x than what was reported in Submission 2004 (method 3).

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[31] Sweden's National Inventory Report Submission 2004, Appendix 16- Emission factors and thermal values Energy

[32] EMEP/CORINAIR Inventory Guidebook 3rd edition, 2001.

[33] Sweden's National Inventory Report Submission 2004, Appendix 16- Emission factors and thermal values Energy

Generally speaking emissions of NO_x from these industrial processes are more likely to correlate with combustion conditions and the N_2-content of the air, considering the high temperatures under which the processes occur, rather than the N-content of the input material. Thus the results of method 1 are likely to be an underestimation of emissions of NO_x considering the fact that the used emission factors are for combustion of the relevant input materials under conditions for energy production. The results of method 2 are uncertain in the sense that emission factors are general, likely to be based on old measurements and may not be relevant for current Swedish conditions. It is difficult to say anything about the origin of the emissions factors and how complete they are.

2.2.4 Calculation Results for SO_2

Results of the different methods of quantification, as described in the previous chapter, for SO_2 are shown in Table 2.4.

Table 2.4 Resulting emissions of SO_2 using different methods of quantification

Method of Quantification	EF for SO_2	SO_2-emissions (tons)	Percentage of Submission 2004
1. Calculation on the basis of used input materials and emission factor for combustion of these materials	0.2 g SO_2/GJ used input material	621.5	442 %
2. Calculation on the basis of produced input iron or steel and emission factor from CORINAIR for iron and steel industrial processes	130 g SO_2/ton produced input iron or steel	276.3	197 %
3. Current method of quantification: subtotal for the year 2001 from Submission 2004 to the EU Monitoring Mechanism, UNFCCC and CLRTAP	Plant-specific	140.5	100 %

The methods 1 and 2 show higher results of emissions of SO_2 than what was reported in Submission 2004 (method 3).

Generally speaking the S-content of the input materials in question that are used in the industrial processes of the iron and steel plants under study is small which renders comparably low emissions of SO_2. The findings of a study, that involved a more in-depth analysis of how some specific iron and steel plants quantified emissions of SO_2, indicate that these emissions are generally calculated on the basis of S-content in used residual oils.[34] A conclusion to be drawn from this is that process emissions of SO_2 from the input materials in question are, in general, comparably low. The results of method 1 may be an overestimation of emissions of SO_2 considering the fact that the used emission factors are for combustion of the relevant input materials under conditions for energy production. The results of method 2 are uncertain in the sense that emission factors for produced steel are general and likely to be based on old measurements and may not be relevant for current

[34] Axelsson, U. et al. (2004). Strukturerad miljödatahantering inom järn- och stålindustri, Etapp 2; Miljöinformationssystem

Swedish conditions. It is difficult to say anything about the origin of the emissions factors and how complete they are.

2.2.5 Conclusion

Results show that the reported emissions of both NO_x and SO_2 for the studied year are more comparable to emissions calculated with method 2 – production volumes of raw iron and steel and emission factors of CORINAIR – than with method 1 – emission factors for combustion.

In conclusion, it is difficult to base the decision of changing method of quantification process emissions of NO_x and SO_2 from the relevant iron and steel plants, on the basis of the calculations presented in tables 2.3 and 2.4. In consultation with representatives from the Swedish EPA it has been concluded that it is more accurate to continue to base the quantification on reported plant-specific emissions.[35]

[35] David Mjureke, Swedish EPA, Anna-Karin Nyström and Anna-Sofia Kumlin, 2004-06-11.

3 Process Emissions of CO_2 from the Production of Light Expanded Clay Aggregate, CRF 2A7

Svenska Leca AB in Linköping produces light expanded clay aggregate (LECA). LECA are burnt clay bullets produced by drying and expanding clay through heating and addition of limestone and carbon-containing additives. This production process results in emissions of CO_2 from the stationary combustion of fossil fuels (reported in CRF 1A2f) as well as process emissions of CO_2 from the use of limestone and carbon-containing additives (reported in CRF 2A7). These process emissions of CO_2 have not been included in CRF 2A7 in earlier submissions.

3.1 Aim

The aim of this sub-project is to collect data on the production of LECA as well as the use of clay, limestone and carbon-containing additives and associated process emissions of CO_2, for the years 1990-1997 and 2003. Along with data from the inquiry for the Swedish NAP an emission factor – process emissions of CO_2 (ton) per produced amount of LECA (ton) – will be calculated for each year, for the whole time period (1990-2003). This emission factor will be compared to the currently used default emission factor for clinker production. Svenska Leca AB defines LECA as light clinker and it may thus have an equivalent CO_2 emission factor as clinker from cement production and emissions shall then be reported in CRF 2C1- Cement production for the whole time series in Submission 2005 to the EU Monitoring Mechanism and UNFCCC. If the emission factor from LECA differs significantly from the emission factor used for clinker production in CRF 2A1, emissions from LECA will be reported in CRF 2A7.

3.2 Methodology

Data on production of LECA (measured) as well as the use of clay, limestone and carbon-containing additives and associated process emissions of CO_2 (calculated) were collected for the years 1990-1997 and 2003 to complete data collected in the inquiry for the Swedish NAP.[36]

An emission factor– process emissions of CO_2 (ton) per produced amount of LECA (ton) – was calculated for each year, for the whole time period. These were used to calculate and report process emissions of CO_2 in Submission 2005 in CRF 2A7-Other.

3.3 Results

According to data reported to the inquiry for the Swedish NAP about 50 % of process emissions of CO_2 arise from clay and the remaining part from limestone and carbon-containing additives, see table 3.1.

[36] Svenska Leca AB. 2004-07-06. lars-erik.eriksson@leca.scancem.com

Table 3.1 Percent of process emissions of CO_2 from limestone, clay and carbon-containing additives according to data from Svenska Leca AB to the inquiry for the Swedish NAP

Year	$CaCO_3$	Clay	Additives
1998	28 %	50 %	21 %
1999	27 %	48 %	25 %
2000	29 %	52 %	19 %
2001	34 %	61 %	5 %
2002	31 %	52 %	17 %

Table 3.2 shows produced amount of LECA, summarised process emissions of CO_2 and the implied emission factor for each respective year.

Table 3.2 LECA production, Process emissions of CO_2 and the implied emission factor for each year reported by Svenska Leca AB

Year	Produced LECA (ton)	CO_2 from processes (ton)	EF (ton CO_2/ton LECA)
1990	47 782	2 981.7	0.062
1991	69 151	4 078.6	0.059
1992	76 478	4 456.5	0.058
1993	68 025	3 940.9	0.058
1994	87 857	5 082.1	0.058
1995	106 848	6 083.9	0.057
1996	71 310	4 050.0	0.057
1997	87 481	4 961.8	0.057
1998	119 849	5 759.6	0.048
1999	108 924	5 792.7	0.053
2000	113 179	6 140.7	0.054
2001	102 577	5 362.3	0.052
2002	114 662	5 944.0	0.052
2003	119 036	6 308.2	0.053

As can be seen in table 3.2, CO_2-emissions have increased since 1990 as a result of increased production of LECA. However, the CO_2-efficiency has also increased, i.e. CO_2-emissions per produced amount of LECA have decreased since 1990.

3.4 Conclusion

Process emissions of CO_2 from LECA production are increasing, but they at the same time they only correspond to about 0.3 % of the total CO_2-emissions in CRF 2A – Mineral Production.

The average implied emission factor for the whole time period is 0.056 ton CO_2 per ton produced amount LECA and the IPCC default emission factor for clinker production is 0.5071 ton CO_2 per ton produced amount of clinker, i.e. ten times higher.[37] This is due to the fact that much more limestone is needed to produce clinker than to produce LECA. For this reason process emissions of CO_2 from the production of LECA will be quantified based on plant-specific data. Emissions should not be reported with conventional production of cement clinker in CRF 2A1 – Cement production, but rather in “CRF 2A7 – Other production/Light Expanded Clay Aggregate”. This method will be applied in future submissions (2006 and onwards) as well.

[37] Revised IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual 2.3.2

Other possible methods would be to use data from the plant for the application of emission allowances, or, to use data from the plant's annual environmental report through the SMP system. However, the suitability of these data sources in relation to the purpose must first be verified.

Emissions of CO_2 from stationary combustion of fuels were compared with reported data in CRF 1A2f for the years 2000 and 2001. The results showed good correlation. For this reason no recalculations were necessary in CRF/NFR 1A2f.

4 Process Emissions of CO_2 from the Use of Limestone and Dolomite, CRF 2A3

Limestone and dolomite are used in various processes, such as production of glass, mineral wool and iron sinter (CRF 2A3), production of quicklime and dolomitic lime (CRF 2A2) and production of light expanded clay aggregate (CRF 2A7). This production gives rise to process emissions CO_2 that have been included in earlier submissions to the EU Monitoring Mechanism and the UNFCCC.

The inquiry for the Swedish NAP showed that a number of companies use limestone and dolomite to purify output gases of sulphur or to neutralise acid components, in so called scrubbers. This use has not been included in earlier submissions. In order to calculate a complete data set for limestone and dolomite use in CRF 2A3, data from these companies should be included in future submissions.

4.1 Aim

The aim of this sub-project is to verify old data and to collect a more complete set of data from companies that use limestone and dolomite within their production. From these verified and collected data, a new time series for process emissions of CO_2 will be calculated and updated in CRF 2A3, in Submission 2005, for the whole time period.

4.2 Methodology

Results from the inquiry for the Swedish NAP were used to establish a list of additional companies that use limestone and dolomite, resulting in process emissions of CO_2, in their production. The list, shown in table 4.1, consists of 12 additional companies. Emissions from these have not been included in earlier submissions.

All the companies in table 4.1 were contacted and data was collected from nine of them. Mälareenergi and Söderenergi reported the use of quick lime, which does not result in emissions of CO_2. KemaNord AB reported the use of limestone in carbide production. As KemaNord AB cooperates with Casco Products (both belong to Akzo Nobel Surface Chemistry)[38], the CO_2-emissions from carbide production are already included in CRF 2B4- Carbide Production. Svenska Leca AB has been studied separately in sub-project 2, see chapter 3.

[38] Madeleine.Holmgren@expancel.com, 2004-08-03.

Of the nine plants, data on limestone and/or dolomite use were collected from eight and two plants respectively for 1990-1997 and 2003.[39] Umeå Energi AB installed their scrubber in 2000 and Sydkraft in 1997 so data was not provided for earlier years from these companies. Some companies had problems to report data for all years and estimations had to be made.

Table 4.1 Additional companies reporting process emissions of CO_2 from the use of dolomite and limestone to the inquiry for the Swedish NAP

Sector	Company
Energy	Karlshamns Kraft AB, Mälarenergi AB, Sydkraft Öst Värme AB, Umeå Energi AB, Vattenfall AB Uppsala, Söderenergi AB
Iron and steel	Höganäs AB in Höganäs
Ceramic products	Svenska Leca AB, Wienerberger AB
Chemicals	KemaNord AB, Kemira kemi, Perstorp Support AB.

Some plants did not have historical data from 1990 and some assumptions were therefore made to complete the time series, see chapter 4.3.1 below.

Based on collected data and additional assumed data the time series for emissions of CO_2 were recalculated and updated in CRF 2A3, Limestone and dolomite use see chapter 4.3.2.

Activity data from the results of the inquiry for the Swedish NAP were used to verify data from companies that were already included in Submission 2004, see chapter 4.3.3.

4.3 Results

4.3.1 Data Collection and Assumptions of Lacking Data

Results of contacts, data collection and assumptions of lacking data are commented on below for each specific company.

Kemira Kemi 1990-1994: Data on limestone use was calculated on the basis of data on the total amount of used soda ash and limestone. The amount of used soda ash was known for the years 1995-2005. The mean value of used soda ash for these years was used to estimate the amount of used limestone in the years in 1990-1994.

Sydkraft AB 1990-1991: Data on dolomite use was estimated by creating a trend curve for the years 1992-2003. The linear equation was used to estimate dolomite use in 1990 and 1991. A trend curve was created for limestone as well, but due to the very high use of limestone since 2001, the linear equation used to estimate limestone use in 1990 and 1991 resulted in negative values. Instead, the mean value of limestone use in 1992-2000 was assumed for the years 1990 and 1991.

[39] Hakan.Borjesson@kemira.com, 2004-04-04; cecilia.svensson@hoganas.com 2004-05-11; marie-louise.marklund@umeaenergi.se, 2004-05-05; hakan.skoog@sydkraft.se, 2004-05-05 (Karlshamns kraft); per.widmark@eka.com, 2004-05-06 (KemaNord); jan.zetterberg@vattenfall.com 2004-05-10; anders.klarstrom@sydkraft.se, 2004-05-06; lennart.bergh@terca.com 2004-05-06 (Wienerberger AB) olof.ljungberg@perstorp.com.

Perstorp Support 1990-1997 and 2003: Did not respond to SMED's request. To the inquiry for the Swedish NAP they reported the use of 350 ton limestone per year during the time period 1998-2002. The same amount was assumed for the years 1990-1997 and 2003.

4.3.2 Calculations

Emissions of CO_2 from the use of limestone and dolomite within the production of glass, mineral wool and ore-based iron pellets [40] are currently calculated on the basis of IPCC default emission factors. Recalculations and calculations of emissions from additional companies within this study have been calculated by means of the same method;
Equation for emissions of CO_2 from limestone (1) and dolomite (2):

(1) Limestone (ton) * F * 44.0/100.1 = ton CO_2
(2) Dolomite (ton) * F * 88.0/184.4 = ton CO_2

F = the purity of the limestone and dolomite, respectively;
$F_{limestone} = 0.97$
$F_{dolomite} = 1.0$

Molecular weight of CO_2 = 44.0 g/mole
Molecular weight of 2*(CO_2) = 88.0 g/mole
Molecular weight of limestone ($CaCO_3$) = 100.1 g/mole
Molecular weight of dolomite ($CaMg(CO_3)_2$) = 184.4 g/mole

The calculations resulted in a new time series for process emissions of CO_2 showed in Table 4.2 below. Data show a decreasing trend since 1990 due to decreased demand of limestone in the chemical industry plant where production processes were altered, and thereby the use of limestone, in 1994.

Table 4.2 New data on limestone and dolomite use and calculated emissions of CO_2 reported in CRF 2A3 in Submission 2005

Year	Dolomite (kton)	Limestone (kton)	CO_2 (kton)
1990	13	93	46
1991	17	64	35
1992	20	63	36
1993	15	64	34
1994	16	52	30
1995	20	49	30
1996	18	54	32
1997	13	59	31
1998	13	43	25
1999	13	40	23
2000	10	39	21
2001	13	35	21
2002	14	39	23
2003	11	46	25

[40] IPCC Guideline, Reference Manual chapter 2.5.2

4.3.3 Verification of Old Data

Data used in Submission 2004 in CRF 2A3 from companies producing ore-based iron pellets, glass and mineral wool have been compared with data on limestone and dolomite use reported to the inquiry for the Swedish NAP. Data correlated very well for all companies, except from one mineral producer - Saint-Gobain Isover AB,[41] where data on dolomite use from the facility in Billesholm was lacking. Data for the whole time series have been collected and included in the calculations for Submission 2005 for the plant in Billesholm.

Figure 4.3 shows how emissions of CO_2 from the use of limestone and dolomite have increased between Submission 2004 and Submission 2005. The difference between the two submissions was the largest in 1990 (66 %) and smallest during the last years (20 %).

The emissions in submission 2004 showed an increased use of dolomite and limestone, which was due to increased consumption within the production of glass and ore-based iron pellets. Emissions from mineral wool production have decreased since 1990. In Submission 2004, total emissions increased by 51 % during the years 1990-2002. In Submission 2005, total emissions have still increased since 1990, but only 10 % during the years 1990-2003. The more stable trend line is a result of updated data within this study.

The dip in 1998 and 1999 is due to the fact that one mineral wool producer tested new input materials during those years, resulting in a lower need for dolomite. In 2000, the old input material was used again, resulting in an increased need for dolomite.

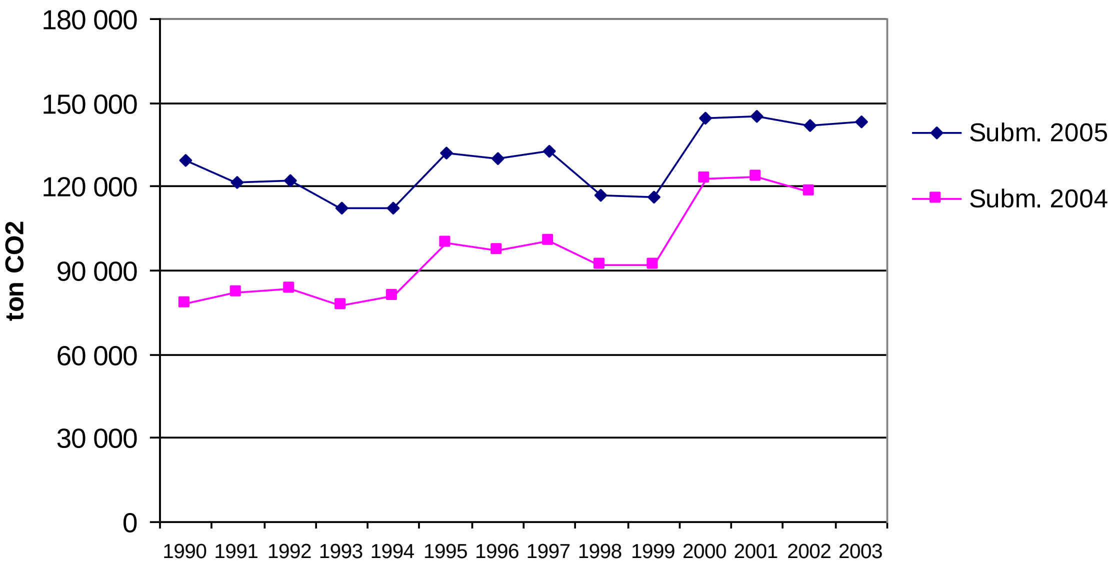

Figure 4.3 **Emissions of CO_2 from the use of limestone and dolomite reported in Submissions 2004 and 2005.**

[41] Lars-goran.oscarsson@isover.se, 0155-968 00

4.4 Conclusion

The emissions of CO_2 from the use of dolomite and limestone have increased as a result of new data collected in this study. New data show that the difference in emissions between 1990 and later years is smaller than it was thought to have been before. It is likely that the total use of limestone will increase in the future due to the increasing use in scrubbers. However this use is extremely small compared to the total amount (about 10 %). Changes in the iron pellet industry and glass industry would have a greater impact on emissions.

5 Emissions from Flaring, CRF/NFR 1B2ci

In the inquiry for the Swedish NAP, eleven plants reported emissions from flaring of fuels. Of these eleven, only two (SSAB in Oxelösund and in Luleå) were included in CRF 1B – Fugitive emissions, in earlier submissions. It was not known whether emissions from flaring were included in emissions from stationary combustion in CRF 1A or if these emissions were lacking completely in the reporting.

5.1 Aim

The aim of this part of the project is to clarify whether emissions from flaring of gases are included in CRF 1A, or if they are lacking in earlier submissions. If emissions are reported in CRF 1A, they should be reallocated to CRF 1B. If emissions are missing, they should be collected for the years 1990-1997 and 2003, and, along with data reported to the inquiry for the Swedish NAP (1998-2002), emissions will be calculated.

5.2 Methodology

The nine companies that reported emissions from flaring in the inquiry for the Swedish NAP are presented in table 5.1. The companies include four refineries, one chemical industry, three steel producers and one pulp producer. The refineries and the chemical industry emitted 99 % of the CO_2-emissions reported as emissions from flaring.

Table 5.1 Emissions of CO_2 from flaring, in 2002, reported to the inquiry for the Swedish NAP

Sector	Company	CO_2-emissions (ton)
Refinery	Skandinaviska Raffinaderi AB	35 000
Refinery	Preem Raffinaderi AB	19 300
Refinery	Nynäs Refining AB, Nynäshamn	3 920
Refinery	Shell Raffinaderier AB	1 979
Chemical industry	Borealis AB	38 200
Steel producer	Outokumpu Stainless AB, Avesta	78
Steel producer	Outokumpu Stainless AB, Degerfors	8
Steel producer	Outokumpu Stainless AB, Torshälla	15
Pulp producer	Rottneros AB	610*
Total emissions		**99 110**

* Where of 430 ton was already included in CRF 1A2d.

Activity data from these companies were collected and used for calculations of new emissions from flaring, reported in CRF 1B.

5.2.1 Collection of Data

Data on the amount of flared from the inquiry for the Swedish NAP (1998-2002) were compared to data on the use of fuels in the energy statistics, for all companies in Table 5.1. It was difficult to conclude whether flared fuels were included in the energy statistics. The fuels that are flared are also used for stationary combustion. Amounts of used fuels were in general higher in the energy statistics compared to data from the inquiry.

Some companies were contacted in order to conclude whether or not emissions from flared fuels were included in the energy statistics. Four refineries, the chemical industry and one steel producer responded that emissions were not included. For this reason these companies were asked to provide data from 1990-1997 and 2003. The refineries and the chemical industry provided data.[42]

One steel producer did not want to provide data due to lack of quality.[43] Since the amount of fuels flared was so low, and all three steel producers reported the same amount of flared fuels, for all years, to the inquiry for the Swedish NAP, it was assumed that the amount of flared fuels had been constant over the whole time series. The amount of flared fuels and associated emissions were added to CRF 1B. No data was excluded from CRF 1A, in this way emissions are not underestimated.

The pulp producer reported emissions from flaring of LPG and of a bioorganic rest product. The bioorganic rest product and associated emissions are already reported as emissions from stationary combustion in CRF 1A2d. However, since the amount is so small and uncertain it was decided not to reallocate these emissions to CRF 1B – Fugitive Emissions. The mean value of LPG use in 1998-2002 was assumed for the years 1990-1997 and 2003. This amount of flared LPG and associated emissions were added to CRF 1B. No data was excluded from CRF 1A, in order to avoid underestimations.

5.2.2 Calculations

All emissions for Submission 2005 to the EU Monitoring Mechanism, the UNFCCC and the CLRTAP were calculated on the basis of emission factors and thermal values used for stationary combustion:

$$\sum \text{Fuel consumption (unit)} * \text{emission factor (kg emission/GJ)} * \text{thermal value (GJ/unit)}$$

5.3 Results

The collection of new activity data on flared gases has been used for calculations of emissions reported in CRF 1B2c. In Figure 5.1 the emissions of CO_2, which will be reported in Submission 2005, are shown. The emissions vary due to the fact that fuels are only flared when necessary.

[42] marie.kjellen@scanraff.se, 2004-03-31; thomas.wennerberg@preemraff.preem.se, 2004-03-30; Jan.ohlsson@nynas.com, 2004-03-26; linda.werner@shell.com, 2004-05-05; Jonny.Andersson@borealisgroup.com, 2004-05-04.
[43] Niklas.Wass@Outokumpu.com, 2004-06-04

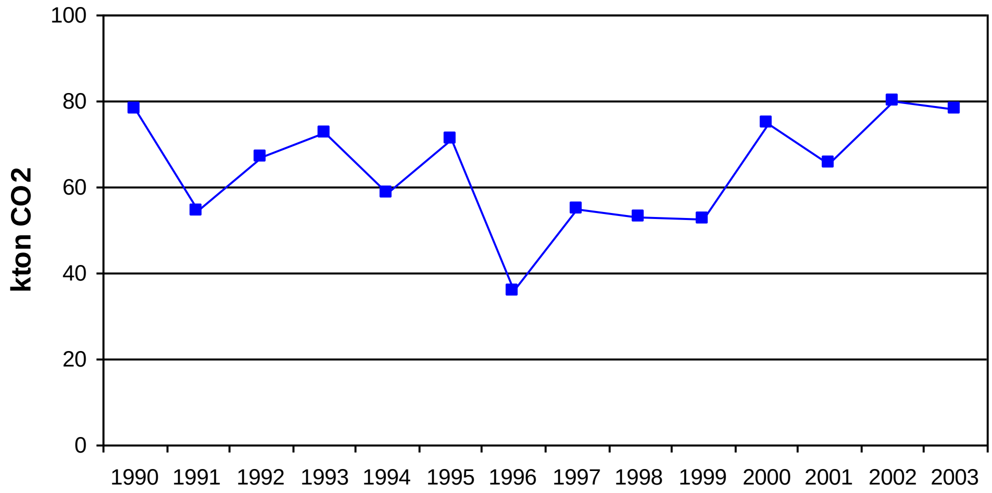

Figure 5.1 **CO_2-emissions (kton) calculated on the basis of new data on flared fuels**

In Figure 5.2 the emissions in CRF 1B2c are compared with emissions from flaring of blast furnace gas, coke oven gas and steel converter gas, reported in CRF 1B1c. The additional emissions quantified in this study are comparably of minor importance.

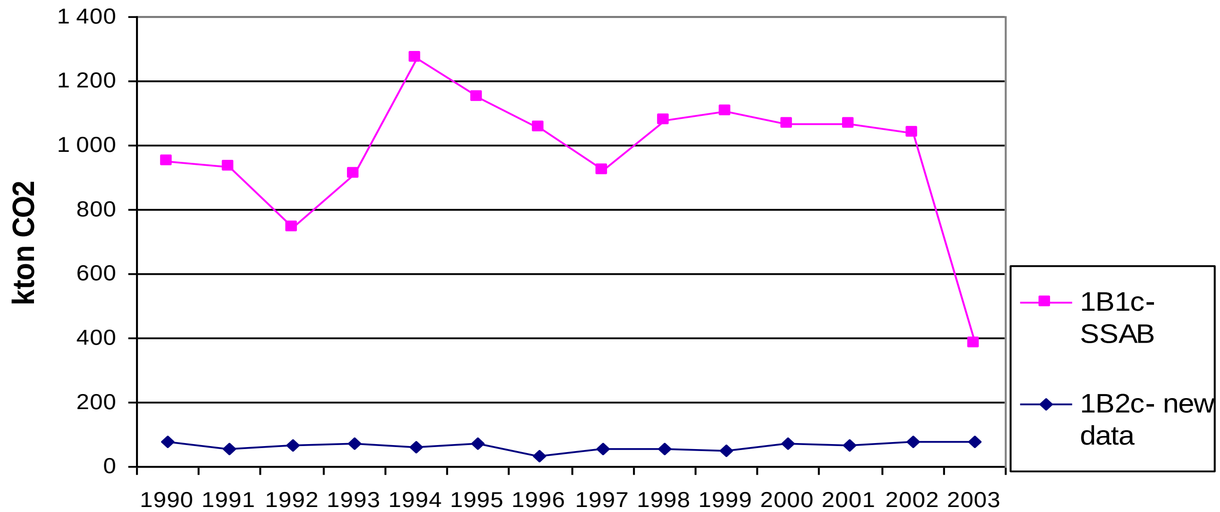

Figure 5.2 **CO_2-emissions (kton) calculated on the basis of new data on flared fuels (CRF 1B2c) compared to CO_2-emissions from flared gases at SSAB (CRF 1B1c)**

5.4 Conclusions

The collection of new activity data has resulted in higher emissions reported in CRF 1B, but compared to emissions from other flaring in CRF 1B these emissions are of minor importance. It is likely that there are other companies, not known by SMED, that also flare gases. However, all companies that reported flaring in the inquiry for the Swedish NAP are now included and therefore probably also the main part of emissions from flaring.

The intention is that data on flared fuels collected in the energy statistics survey for the year 2004. If data for 2004 is provided from the energy statistic, data will be collected directly from the companies or from basic data for the EU trading scheme.

Annex 1

Results of contacts in the verification of thermal value and emission factor for anthracite are given in Table 1.

Table 1 Thermal values and emission factors for fuels containing fossil carbon

Fuel type	GJ/ton	Ton CO_2/TJ	Ton CO_2/ton	Reference
Other Bituminous coal and anthracite	26.98	98.30	2.65	IPCC Guidelines[44]
Anthracite	33.12	82.81	2.74	Mass balance, Höganäs AB[45]
Anthracite	33.12	84.50	2.80	Inquiry for the Swedish NAP, Höganäs AB
Anthracite	25.00			Energy Statistics, Höganäs AB[2]
Anthracite	30.7			Energy Statistics, Ovako Steel[2]
Coking coal, other bituminous coal	27.21	90.7	2.47	Submission 2004
Coke	23.44	120.38	2.82	Mass balance, Höganäs AB
Coke	28.05	103	2.89	Submission 2004
Coke	23.44	132.27	3.10	Inquiry for the Swedish NAP, Höganäs AB

Jernkontoret, the trade association for the iron and steel industry in Sweden, was contacted for thermal value and emission factor on anthracite, but they did not have any.

Staffan Asplind at the Swedish NAP was consulted on the Swedish guidelines on surveillance and reporting of greenhouse gas emissions in accordance with the EU Directive 2003/87/EG. He confirmed our thoughts of synchronising basic data for this directive with those for the international reporting to the EU Monitoring Mechanism, UNFCCC, and the CLRTAP.

[44] Revised IPCC Guidelines for National Greenhouse Gas Inventories : Reference Manual 1.13
[45] Barbro Olsson, Statistic Sweden, 2004-04-16, 019-17 63 11

Annex 2

Table 2 **Activity data, CO_2-emissions and implied emission factors (IEF) reported in 'CRF 2C1 – Other' in Submission 2005**

Year	Input material	Amount (ton)	CO_2-emission (ton)	IEF
1990	Electrodes	8 769	32 064	3.66
1990	Coal/anthracite	18 481	53 375	2.89
1990	Coke	40 532	127 776	3.15
1990	Other*	444 128	24 885	0.06
1991	Electrodes	4 930	17 897	3.63
1991	Coal/anthracite	17 840	51 092	2.86
1991	Coke	32 179	101 390	3.15
1991	Other*	383 545	27 914	0.07
1992	Electrodes	4 382	15 841	3.62
1992	Coal/anthracite	20 051	57 656	2.88
1992	Coke	35 382	111 825	3.16
1992	Other*	493 441	30 149	0.06
1993	Electrodes	4 826	17 455	3.62
1993	Coal/anthracite	19 779	56 588	2.86
1993	Coke	32 709	103 672	3.17
1993	Other*	686 977	43 556	0.06
1994	Electrodes	5 075	18 375	3.62
1994	Coal/anthracite	26 338	76 215	2.89
1994	Coke	32 970	104 355	3.17
1994	Other*	947 789	58 153	0.06
1995	Electrodes	5 190	18 807	3.62
1995	Coal/anthracite	31 797	92 045	2.89
1995	Coke	38 126	120 802	3.17
1995	Other*	1 024 721	62 009	0.06
1996	Electrodes	4 469	16 205	3.63
1996	Coal/anthracite	27 515	79 232	2.88
1996	Coke	43 791	138 652	3.17
1996	Other*	1 408 692	49 178	0.03
1997	Electrodes	5 139	18 601	3.62
1997	Coal/anthracite	31 755	92 432	2.91
1997	Coke	48 529	152 970	3.15
1997	Other*	1 219 222	54 710	0.04
1998	Electrodes	4 746	17 177	3.62
1998	Coal/anthracite	25 817	74 694	2.89
1998	Coke	41 298	130 200	3.15
1998	Other*	1 316 490	72 155	0.05
1999	Electrodes	4 128	14 936	3.62
1999	Coal/anthracite	24 648	71 900	2.92
1999	Coke	38 963	122 850	3.15
1999	Other*	1 303 716	61 831	0.05
2000	Electrodes	4 292	15 581	3.63
2000	Coal/anthracite	29 465	86 064	2.92
2000	Coke	41 185	129 855	3.15
2000	Other*	1 416 931	61 535	0.04
2001	Electrodes	3 655	13 260	3.63
2001	Coal/anthracite	25 575	74 693	2.92
2001	Coke	35 636	112 449	3.16
2001	Other*	1 419 133	67 334	0.05

2002	Electrodes	3 886	14 099	3.63
2002	Coal/anthracite	24 778	72 581	2.93
2002	Coke	41 421	130 706	3.16
2002	Other*	1 531 840	66 619	0.04
2003	Electrodes	4 112	14 913	3.63
2003	Coal/anthracite	24 571	71 753	2.92
2003	Coke	37 219	117 390	3.15
2003	Other*	1 490 434	59 799	0.04

Other* includes a mixture of some rare input materials: Scandust, briquettes, Charge Chrome, coal powder and chrome alloys, and steel production data from two plants.