SMED Report No 97 2011

Emissions from integrated iron and steel industry i Sweden

Model for estimation and allocation of energy consumption and CO_2 emissions for reporting to the UNFCCC

Tomas Gustafsson, IVL Swedish Environmental Research Institute
Annika Gerner and Maria Lidén, Statistics Sweden

2011-06-15

Contract No 309 1107

Commissioned by the Swedish Environmental Protection Agency

Published at: www.smed.se
Publisher: Swedish Meteorological and Hydrological Institute
Address: SE-601 76 Norrköping, Sweden
Start year: 2006
ISSN: 1653-8102

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.

Contents

Summary

SSAB's two integrated iron and steel production plants in Luleå and Oxelösund are among the largest point sources of greenhouse gases in Sweden. Their reported emissions included in Sweden's annual submission to the UNFCCC have been reviewed and revised in several previous studies. In a 2010 SMED pilot study it was concluded that there was a need to further review the energy allocation model for the Luleå and Oxelösund plants as well as the reported energy consumption and CO_2 emissions from excess energy gases utilized outside the SSAB premises for power and heat production. In the light of the pilot study, this study aimed at developing a robust and sustainable model for present reported time-series for future estimations.

In cooperation with SSAB representatives, information on annual material input, calorific values and energy flows were assessed and used as basis for estimation of total energy consumption and model for energy allocation. In addition, energy statistics from Statistics Sweden and EU ETS data were evaluated. The results show that the present estimations of energy consumption in the IPCC energy sector based on data from the plant-specific annual environmental reports and energy statistics from Statistics Sweden are sufficient also for future reporting to the UNFCCC. Furthermore, this report includes recommendations on revisions and future reporting of CO_2 emissions from combustion of SSAB excess energy gases (reported in CRF 1A1a) as well as of energy allocated to non-energy use of fuels in industrial processes (CRF 2C1) and feedstocks (CRF 1Ad).

1 Background

SSAB is one of the global leaders in high strength steel production. A significant share of greenhouse gas emissions in Sweden, as reported to the UNFCCC, originates from SSAB's two integrated iron and steel works in Luleå and Oxelösund. Several studies have been carried out to ensure that emissions from these facilities are reported in accordance with IPCC guidelines. Due to the complexity and extent of SSAB's operations, it has been difficult to allocate solid fuel energy consumption properly on IPCC categories. Current method is described in a memorandum by SMED[1], which also includes a proposed outline for a more robust and accurate model for the estimation and allocation of energy from solid fuels. This model has also been discussed with representatives of SSAB, which, however, wish that the model is upgraded before it is implemented.

Energy consumption and emissions of CO_2 from energy gases sold by SSAB to for example Lulekraft AB are currently estimated from energy statistics combined with national calorific values and emission factors. These data do not always match data reported to EU ETS. It is also important for the allocation model discussed above that external flows are accounted for as accurately as possible. There is therefore a need to analyze, and possibly correct, the method of collection and calculation of the sold energy gases.

The purpose of this study is to develop a robust and sustainable model for the assessment of internal and external energy flows in close cooperation with representatives of SSAB in Luleå and Oxelösund. As emissions and energy flows related to liquid fuels generally are straightforward to estimate, focus in this study is on solid fuels. In addition, the project aimed to ensure that CO_2 emissions from energy sold from SSAB are reported in accordance with verified emission data reported to EU ETS.

This study focuses on the Swedish greenhouse gas inventory sectoral approach data reported to the UNFCCC. It has not been within the scope of this study to evaluate or suggest changes to the data reported as the reference approach.

[1] Current methodologies for estimating and reporting to the UNFCCC of energy consumption and CO_2 emissions from SSAB's integrated iron and steel industries, and needs for improvements. SMED PM 2010 (in Swedish)

2 Description of SSAB’s iron and steel production processes

SSAB’s two iron ore-based integrated iron and steel plants in Luleå and Oxelösund produced about 3400 kton steel in 2010. Figure 1 shows a simplified schedule of the material and energy flows in the two plants, and to which IPCC category they are related to. The complex iron and steel production processes include several more stations, materials and energy flows, but in this study only those related to the major solid fuel energy carriers are described. In addition, there are some differences between the two plants, the most significant being that only one contains a rolling mill station (Oxelösund).

The iron and steel making process begins at the coking plant (CRF 1A1c) to which coking coal is supplied and coke and coke oven gas (COG) is produced. The coking plant uses derived COG and (for one plant) blast furnace gas (BFG) as fuels. Together with pulverized coal (injection) the coke serve as reduction agents in the blast furnace (CRF 2C1) where pig iron is produced from iron-ore pellets. During the blast furnace process, BFG is produced and used together with COG as fuels. The pig iron is transferred into the LD converter and later to the steelworks (CRF 2C1) where steel slabs are tapped. Scrap steel is added to the process and derived COG and LD gas (LDG) are used as fuels.

The Oxelösund plant has a rolling mill (CRF 1A2a) where the steel is post-treated before leaving the plant. The larger output from the integrated iron and steel plants are, besides steel, excess gases (COG, BFG and LDG used for heat production), steam for district heating, tar, benzene and coke breeze. Oil, LPG and electricity are used at several stations. Throughout the process some excess gases are flared, i.e. COG from the coking plant (CRF 1B1c), BFG from the blast furnace (CRF 2C1) and LDG from the LD converter (CRF 2C1). Figure 1 shows the material input on the left hand side and the plant outputs as blue boxes outside the system boundary. During the process energy losses occur at all stations, e.g. as steam, flue gas, cooling water, slag, etc.

Throughout the iron and steel production processes large amounts of derived energy gases (COG, BFG and LDG) are produced. Approximately half of these gases are combusted internally as fuels, e.g. for heating of cowpers. The remaining gases are utilized for power and heat production, serving the nearby municipalities. There are however differences between the Luleå plant and the Oxelösund plant regarding how the large amounts of excess gases are handled.

In the Luleå plant, the gases are collected in a gas holder and sold to external companies, the largest being LuleKraft AB. LuleKraft AB utilizes the mixed gases for power and heat production and is thus reported under IPCC category 1A1a. For the Oxelösund plant, the excess gases are distributed to a power and heat production plant inside the SSAB premises, from which steam for district heating is sold to the nearby municipality. Energy consumption and associated emissions from these gases are therefore allocated to SSAB (CRF 1A2a).

In principle, the utilization of the excess gases is the same in Luleå and Oxelösund, but due to different ownerships energy consumption and emissions are allocated differently in the UNFCCC reporting. This is in line with the Swedish reporting of CO_2 emissions to the EU ETS and the suggested methodology in 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3: 1.8).

Emissions of CO_2 are released at all stages of the iron and steel production processes and stem from the use of fuels for heating as well as raw materials fed into the processes. Estimated CO_2 emissions from SSAB in Luleå and Oxelösund for reporting to the UNFCCC by IPCC category are based on detailed plant-specific carbon mass-balances. The carbon contents at various stages of the processes are monitored closely to ensure high quality steel. Measuring or estimating energy contents, flows and losses at the same stages are not done as frequent.

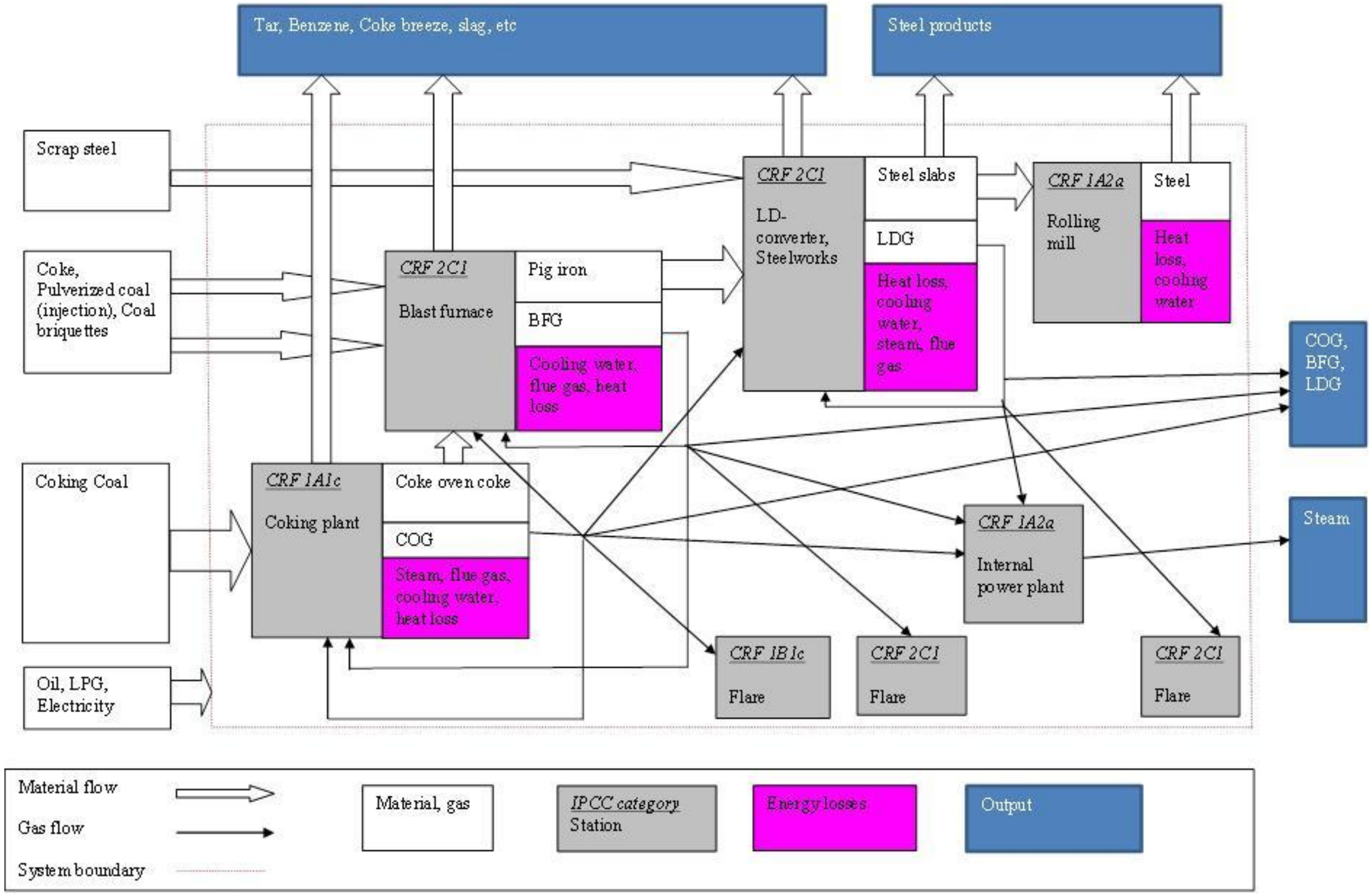

Figure 1. Material and energy flows in SSAB's two integrated iron and steel production plants

3 Model for energy allocation

3.1 Present model for estimating energy consumption

In the latest annual submission (submission 2011) of Sweden's greenhouse gas inventory to the UNFCCC, SSAB's solid fuel energy consumption are based on information on utilized fuels (mainly energy gases) from its plant-specific annual environmental reports together with national energy statistics from Statistics Sweden. In Table 1 it can be seen that solid fuel energy consumption data are collected from different sources. Most of the energy consumption is allocated to Other Stationary (CRF 1A5a) based on the assumption that remaining energy input in the national energy balances not accounted for in the other categories stem from transformation losses of energy during the entire iron and steel production processes. During the preceding pilot study to this project, representatives at SSAB provided information suggesting that some of the energy consumption accounted as transformation losses of energy actually was not released as heat but kept as feedstock in output materials such as steel, tar, slag, etc (see Figure 1).

Table 1. Allocation of solid fuel energy consumption of SSAB's two integrated iron and steel production plants 2009 (submission 2011)

IPCC Category	CRF	Station	Solid fuel energy consumption (TJ)	Data source
Public electricity and heat production	1A1a	External heat and power production plants in Luleå	C	Energy statistics by external plant
Manufacture of solid fuels	1A1c	Coking plant	3 352	Environmental reports
Iron and steel	1A2a	Rolling mill and internal heat and power production	2 426[2]	Environmental reports
Other Stationary	1A5a	Transformation losses of energy	31 194	Difference between coal inserted in coke ovens according to the national energy balances and total energy consumption for SSAB (Luleå and Oxelösund plants) in the other IPCC categories
Fugitive emissions from solid fuel transformation	1B1c	Flare at coking plant (COG)	314	Environmental reports
Iron and steel production	2C1	Blast furnace and steelworks (including flaring of BFG and LDG)	5 229	Environmental reports

C Confidential

[2] The majority of the energy is sold as steam to the Oxelösund municipal district heating grid

3.2 Proposed model for energy allocation

In order to model energy flows in the SSAB iron and steel production processes, information on input, output and energy consumption and losses at different stations are needed. For the years 2004 onwards information on input in terms of coking coal, pulverized coal (injection), external coke, scrap steel, oil and LPG are provided in the annual environmental reports of Luleå and Oxelösund plants. Calorific values by energy carrier have been provided from both plants and due to their small annual variations the calorific values are held constant over the entire time series.

For years prior to 2004, input on solid fuels for the Luleå plant has been obtained in this study in close cooperation with representatives of SSAB Luleå. Based on the material input and calorific values, the total annual energy input could be estimated. For years prior to 2004, data on solid fuels for the Oxelösund plant has up to date[3] only been available for 1991. In order to estimate the total energy input for remaining years, information on total CO_2 emissions have been used as surrogate parameter. The average relationship between total CO_2 emissions and total energy input for available years has been multiplied with total CO_2 emissions for missing years.

All material input and calorific values obtained in this study are attached in Appendix A (Table A 1 through Table A 4).

The following sections describe the proposed allocation models for each plant.

3.2.1 Luleå plant

SSAB Luleå has provided the results of a comprehensive internal mapping of all major energy carrier via input, output and losses as well as energy flow charts of internal recycled matter (e.g. steel, energy gases, scrap metal, etc) for each station for 2006. This enables tracking of all energy flows within the system boundary (see Figure 1). In addition, SSAB Luleå provided a simplified energy flow chart for 1989. Comparing the energy flow charts for 2006 and 1989, it was obvious that the allocation of energy on different stations resulted in very similar figures, which suggests that the same allocation model could be applied for all years. In order to establish a sustainable and robust model for allocation of energy, in this study, we have used the information on material input, sold energy gases (for external power and heat production), energy losses at different stations and various outputs.

It could be argued that derived energy gases used as fuels better measures energy consumption in the energy sector, but to ensure that all energy is accounted for and

[3] There is an on-going internal process at SSAB Oxelösund aiming at obtaining information on solid fuel input material for remaining years. Results from this process will hopefully be available for implementation in the 2013 submission to the UNFCCC.

that no double counting of energy occurs, energy losses by station is proposed as allocation parameter. Table 2 shows the allocation of solid fuel energy based on information on energy losses, sold energy gases and energy stored in feedstocks.

Table 2. Allocation of solid fuel energy by station in Luleå plant

Station	CRF	Allocation of solid fuel energy	Comment
External power and heat production	1A1a	20%	Sold energy gases
Coking plant	1A1c	6%	Steam, flue gas, cooling water, heat loss
Internal power and heat production	1A2a	0%	Only oil and LPG
Flare at coking plant	1B1c	1%	COG
Blast furnace	2C1	15%	Cooling water, flue gas, heat loss
Steelworks	2C1	10%	Heat loss, cooling water, steam, flue gas
Feedstocks	1Ad	48%	Steel products, tar, benzene, coke breeze, slag

The above SSAB energy model (Table 2) has been compared with data on energy consumption for CRF 1A1a from energy statistics (see section 4) and with data on excess gases provided by SSAB for this study. Taking into account the uncertainty related to that calorific values used in each dataset might differ, energy statistics are well correlated with data on excess gases provided by SSAB. Energy statistics are also well correlated with results from the above model for 1997 and later years. It seems that for the early 90's, the model might be overestimating energy consumption for CRF 1A1a. As also concluded in section 4, energy statistics are found to be a valid data source for estimating energy consumption in CRF 1A1a for all years.

For CRF 1A1c and 1B1c, high quality data are available in the environmental reports from 2004[4]. The model produces similar results for CRF 1A1c, however the time series is smoother. For CRF 1B1c, the model seems to be overestimating energy losses compared to energy consumption data from the environmental reports.

For CRF 1A2a, the model is not applicable since only liquid fuels such as oil and LPG are used in Luleå.

For CRF 2C1 and 1Ad, data from energy statistics or environmental reports are not sufficient to estimate energy consumption and related emissions. In this case, the model provides the best option for estimating solid fuel energy.

[4] For years prior to 2004, CO_2 emissions from SSAB have been used as surrogate parameter to estimate energy consumption data.

Hence, we suggest complementing the above model using energy consumption data according to energy statistics and environmental reports in CRF 1A1a, 1A1c and 1B1c, and allocating the remaining energy on CRF 1Ad and 2C1 using information on energy losses in the blast furnace and steelworks together with estimated energy stored in the feedstocks as allocation parameters (Table 3).

Table 3. Suggested data source for energy consumption by CRF in Luleå plant

Station	CRF	Data source
Total energy input: coking coal, purchased coke, pulverized coal (injection), scrap steel	-	Estimations based on activity data from Environmental reports for 2004 onwards and plant-specific calorific values. Prior to 2004 activity data has been obtained in contact with SSAB
External power and heat production	1A1a	Consumed energy gases from Energy statistics (see section 4)
Coking plant	1A1c	Consumed energy gases from Environmental reports
Internal power and heat production	1A2a	Consumed oil and LPG from Environmental reports
Flare at coking plant	1B1c	Consumed energy gases from Environmental reports
Blast furnace and steelworks	2C1	Model (about 25% of total energy input)
Feedstocks	1Ad	Model (about 48% of total energy input)

3.2.2 Oxelösund plant

For the purpose of this study the Oxelösund plant has not been able to provide as detailed information on energy flows for different stations as the Luleå plant, but the iron and steel processes in the two plants are similar. Hence, in this study, we have applied the Luleå model also on Oxelösund.

The allocation model outputs for CRF 1A1c, 1A2a and 1B1c have been compared with data from environmental reports and energy statistics. The results show that the time series based on energy statistics are higher than the model outputs and show more fluctuations, whereas data from the environmental reports show good coherence with the model outputs. For the purpose of annual updating of energy consumption, data from the environmental reports for CRF 1A1c, 1A2a and 1B1c together with the model outputs for CRF 1Ad and 2C1 seem to be the preferred option.

The conclusion is therefore to continue using the same data sources for CRF 1A1c, 1A2a and 1B1c and apply the model outputs for the Luleå plant to allocate energy on CRF 1Ad and 2C1 (Table 4).

Table 4. Suggested data source for energy consumption by CRF in Oxelösund plant

Station	CRF	Data source
Total energy input: coking coal, purchased coke, pulverized coal (injection), scrap steel	-	Year 1991, 2004-2010: Estimations based on activity data from Environmental reports and plant-specific calorific values. Year 1990, 1992-2003: CO_2 emissions 1991, 2004-2006 used as surrogate parameter to calculate IEF (CO_2/TJ)
Coking plant	1A1c	Consumed energy gases from Environmental reports
Power and heat production, rolling mill	1A2a	Consumed energy gases, oil and LPG from Environmental reports
Flare at coking plant	1B1c	Consumed gases from Environmental reports
Blast furnace and steelworks	2C1	Model (about 25% of total energy input)
Feedstocks	1Ad	Model (about 48% of total energy input)

3.3 Future activity data for SSAB

Within this project, SSAB:s staff in Luleå has provided a time-series covering 1990-2003 of data on consumption of coal, coke, etc as material inputs, as well as detailed information on energy flows in different parts of their production processes. To produce energy flow data on this form every year would increase the work burden for the plant staff. Hence, for future years, it would be desirable to use existing data sources instead, such as environmental reports and energy statistics. This, of course, requires energy statistics of high quality that is consistent with the data produced by SSAB. Hence, energy statistics should be evaluated each year with data from the environmental reports. Based on the conclusions in the previous section, data for 2011 onwards for SSAB Luleå and Oxelösund should be collected as follows:

Station	CRF	Data source
Total energy input: coking coal, purchased coke, pulverized coal (injection), scrap steel	-	Data from Environmental reports. If data in the future for some reason are missing in Environmental reports, data should be obtained by personal contacts with SSAB.
External power and heat production	1A1a	Consumed energy gases from Energy statistics (see section 4)
Coking plant	1A1c	Consumed energy gases from Environmental reports
Iron and steel	1A2a	Consumed energy gases, oil and LPG from Environmental reports
Flare at coking plant	1B1c	Consumed gases from Environmental reports
Blast furnace and steelworks	2C1	Model (about 25% of total energy input)
Feedstocks	1Ad	Model (about 48% of total energy input)

4 Energy consumption and CO_2 emissions from SSAB's excess energy gases

Four other companies consume excess energy gases from SSAB, not for iron and steel production, but for electricity and heat production: Lulekraft AB, Luleå Energi AB and Nordkalk AB in Luleå, and Oxelö Energi AB in Oxelösund. Most years, Lulekraft AB account for more than 95 per cent of the excess energy gases. As discussed in section 2 and 3.2.2 above, the consumption of energy gases (and related emissions) at SSAB Oxelösund AB for the purpose of electricity and heat production is included in the model described above and allocated to CRF 1A2a.

The following sections describe plausible data sources as basis for the energy consumption and emission reporting to the UNFCCC.

4.1 Data sources

Ideally, we would like a data source that meets the following requirements:

- Data published no later than three-four months after January 1 each year
- Data by fuel type
- Data on energy consumption and CO_2, verified emissions
- Data available from 1990 and onwards
- Involves no extra work load for the plant staff

There are five possible data sources, each having its advantages and disadvantages as shown in Table 5: 1) the annual survey of Electricity supply, district heating and supply of natural and gasworks gas (AREL), 2) the quarterly fuel statistics (KvBr, currently used), 3) environmental reports (ER), 4) EU ETS and 5) direct contacts with the plants.

Table 5. Advantages and disadvantages of available data sources for SSAB's excess energy gases.

Source	Advantages	Disadvantages
AREL	• Energy amounts reported • Data by fuel type	• Data available after almost one year • Data exists for 1990 and later years, however data 1990-1996 are difficult to extract on plant level with acceptable quality • Oxelö Energi not included
KvBr	• Energy amounts reported • Data by fuel type • Data available in April • Time series from 1990	• Gap in time series for Oxelö Energi 1990-1997, 2000 • Outliers for SSAB Oxelösund 1997-98, 2000-01 needs to be verified or interpolated
ER	• Data available in April	• Difficult to obtain data for all years, only data for 2006 – available online. • Emissions not separated by fuel type • Oxelö Energi not included
EU ETS	• Data available in may each year • CO_2 emissions verified	• Data not available 1990-2004 • Energy data not clearly separated by fuel type for all plants
Plants	• Data available at any time	• Extra work load for the plant staff

4.2 Analysis

Comparing data sources leads to the following conclusions:

Lulekraft AB and Luleå Energi AB:

- Energy amounts for Luleå Energi (and Nordkalk) are very small and do not affect national totals. Amounts are too small to motivate a more complicated methodology.
- For Lulekraft, the coherence between AREL/KvBr and EU ETS for total energy amounts is good (differences less than 5%) for 2006 and later years.
- For Lulekraft, differences for CO_2 are larger, <15% for all years when ETS is available (2005 and later). ETS values are higher. This is due to the use of standardized CO_2 emission factors when calculating CO_2 with AREL/KvBr-data.
- The best solution would be to use EU ETS data. However, this is not possible for 1990-2004. Also, data in the EU ETS are not clearly separated by fuel type. Most energy is reported as "mixed gas", and when comparing with AREL and KvBr it is obvious that coke oven gas, blast furnace gas as well as LD-gas are

included, which makes it impossible to use this energy data to estimate non-CO_2 emissions.
- AREL shows relatively good coherence with KvBr, however the time series is less stable in AREL. Also, we do not have access to data of acceptable quality from AREL 1990-1996.
- SSAB in Luleå has provided additional data on total CO_2 for gases sold to Lulekraft AB and Luleå Energi AB 1990-2010. This data corresponds very well with ETS data 2005-2009, differences are only 1% which could be attributed to rounding errors.

Nordkalk AB and Oxelö Energi AB:
- Energy consumption and related emissions are very small and do not affect national totals. Amounts are too small to motivate a more complicated methodology.

SSAB Oxelösund AB
- As discussed in section 2 and 3.2.2 above, the consumption of energy gases (and related emissions) at SSAB Oxelösund AB is included in the model described above and allocated to CRF 1A2a.

4.3 Proposed method for submission 2012 and later

We would suggest the following method:

Lulekraft AB and Luleå Energi AB:
- KvBr should be kept as data source for all years for energy amounts.
- All non-CO_2 emissions should be estimated using national emission factors.
- CO_2 emissions for 1990-2010 should be estimated using CO_2 data provided by SSAB Luleå.
- CO_2 emissions for 2011 and coming years for Lulekraft should be taken from EU ETS to obtain the highest accuracy and to avoid underestimation of emissions.
- CO_2 emissions for 2011 and coming years for Luleå Energi should be estimated using national emission factors since emissions are too small to motivate a more complicated methodology.

Nordkalk AB and Oxelö Energi AB:
- Amounts are too small to motivate a more complicated methodology.
- KvBr should be kept as data source for all years.
- All emissions should be estimated using national emission factors.

SSAB Oxelösund AB
- As discussed in section 2 and 3.2.2 above, the consumption of energy gases (and related emissions) at SSAB Oxelösund AB is included in the model described above and allocated to CRF 1A2a.

5 References

Data from surveys by Statistics Sweden:

- Quarterly fuel statistics
- Annual energy statistics (electricity, gas and district heating)
- Monthly fuel, gas and inventory statistics

Results from and documentation on these surveys are available online at http://www.scb.se/Pages/SubjectArea____6059.aspx

Environmental reports from SSAB Luleå and Oxelösund, 2004-2010. Available on-line: http://www.ssab.com/en/Media/Downloads/

European Union Emissions Trading Scheme. Swedish data reported 2005-2010.

IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan

Personal communication

Karlsson, Jonny. SSAB Tunnplåt AB, Metallurgi. May 2011.

Krantz, Per. SSAB Oxelösund AB. May 2011.

Wahlberg, Leif. SSAB Tunnplåt AB, Metallurgi. May 2011.

Appendix A.
Material input and calorific values obtained in this study

Table A 1. Material input in SSAB Luleå's iron and steel production process (ton)

Year	Coking coal	External coke	Injection coal	External scrap metal	Source
1990	937 000	60 000	100 000	175 000	Contact with SSAB
1991	1 000 600	0	112 300	103 000	Contact with SSAB
1992	1 007 600	10 000	105 000	154 200	Contact with SSAB
1993	975 000	15 000	110 000	143 800	Contact with SSAB
1994	928 700	80 000	109 900	91 000	Contact with SSAB
1995	920 000	70 400	102 000	141 400	Contact with SSAB
1996	922 900	152 000	109 100	129 000	Contact with SSAB
1997	919 900	84 000	92 100	135 200	Contact with SSAB
1998	927 000	102 000	156 300	151 000	Contact with SSAB
1999	916 300	100 000	187 600	132 600	Contact with SSAB
2000	920 700	56 300	146 700	63 900	Contact with SSAB
2001	909 800	60 880	293 855	44 600	Contact with SSAB
2002	820 339	174 449	304 900	41 040	Contact with SSAB
2003	773 125	218 400	303 216	102 000	Contact with SSAB
2004	940 000	94 600	319 000	130 100	Environmental report
2005	946 100	39 300	314 000	113 200	Environmental report
2006	944 700	16 900	318 000	89 700	Environmental report
2007	948 900	11 700	342 300	98 400	Environmental report
2008	942 600	23 300	324 500	118 000	Environmental report
2009	785 900	52 000	171 300	74 400	Environmental report
2010	895 800	117 900	286 500	114 700	Environmental report

Table A 2. Calorific values by input material in SSAB Luleå

Calorific value	Coking coal	External coke	Injection coal	External scrap metal	Source
GJ/ton	31.31	29.66	31.31	7.35	Contact with SSAB

Table A 3. Material input in SSAB Oxelösund's iron and steel production process (ton)

Year	Coking coal	External coke	Injection coal	External scrap metal	Source
1991	603 900	58 000	105 000		Environmental report
2004	624 290	200 760	154 539	99 783	Environmental report
2005	623 972	136 901	170 217	94 289	Environmental report
2006	619 416	93 125	149 269	109 950	Environmental report
2007	615 808	106 476	161 977	52 407	Environmental report
2008	503 430	102 209	115 875	41 613	Environmental report
2009	514 335	12 388	74 342	0	Environmental report
2010	583 274	127 310	94 754	16 476	Environmental report

Table A 4. Calorific values by input material in SSAB Oxelösund

Calorific value	Coking coal	External coke	Injection coal	External scrap metal	Source
GJ/ton	27.5	31	31	7.35	Environmental report