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Swedish Environmental Emissions Data

Revision of estimated greenhouse gas emissions for integrated iron and steel production

For reporting to the United Nation
Framework Convention
on Climate Change

Tina Skårman, Tomas Gustafsson, IVL

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

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Background

In Sweden there are three producers of primary iron and steel, i.e. the basis of their production is iron ore pellets. Two plants produce pig iron and steel as part of their integrated coke ovens, blast furnaces and steel converters.

Steel production along with CO_2 emissions and consumed amounts of energy gases (coke oven gas, blast furnace gas and LD-gas) and other fuels, are reported by the plants in their environmental reports since 2003. Carbon mass balances and associated CO_2 emissions are also reported to the EU ETS since 2005. For some years, CO_2 emissions to the EU ETS did not include all plant stations (rolling mills), and additional information from the plants was obtained in order to ensure that no omissions occurred. Since 2008 annual CO_2 emissions reported by the plants in their environmental reports are equal to those reported to the EU ETS. For 2003 onwards, information on activity data and emissions for all plants (CRF 1.A.1.c, 1.A.2.a, 1.B.1.c and 2.C.1.2) are taken from the environmental reports.

During 2009 a calculation model was developed for the two integrated primary pig iron and steel plants. Amounts of pig iron produced 1990-2002 were obtained directly from both plants, together with total CO_2 emissions 1990-2002 for one of the plants. For the other plant, CO_2 emissions 1990-2002 were calculated using its steel production 1990-2002 and an average CO_2 IEF 2003-2007. Allocation of CO_2 emissions on different sub-categories (CRF 1.A.1.c, 1.A.2.a, 1.B.1.c and 2.C.1.2) was based on the plant specific average distributions 2003-2007.

Consumed amounts of different energy gases and other fuels 1990-2002 were derived by applying the Good Practice Guidance surrogate method using the average values 2003-2007 and the CO_2 emissions as the surrogate parameter. Activity data reported in CRF Reporter in CRF 2C1.2 is produced amount of primary pig iron.

Emissions of CH_4 and N_2O are calculated based on the divided energy gases and national emission factors for all subsectors (except that no N_2O from processes is assumed).

During the preparation of submission 2013 for reporting to the Climate Convention (UNFCCC) a significant increase in the CO_2 implied emission factor (IEF) for year 2011 for the two primary pig iron production plants was noticed (see Table 1). This was due to the fact that the reported CO_2 emissions were overestimated for one of the plants. During 2011 one of the two blast furnaces at the plant was out of operation from July until December, and consequently the production of pig iron decreased compared

to the previous year. At the same time the production rate at the coke plant was kept under normal conditions. This resulted in an increased intermediate stock of coke at the plant (SSAB, 2012-09-24). After consulting the operator it was concluded that the operator did not take into account any intermediate stock change of produced coke in the carbon mass balance used when calculating the CO_2 emissions, i.e. large amounts of carbon assumed to be released into the atmosphere was actually stored in the coke stocks. This led to an overestimation of CO_2 emissions not in line with the IPCC methodologies prescribed by the UNFCCC for annual greenhouse gas (GHG) emission inventory reporting. The same method has been used for all years since emission year 2005, i.e. the first year for reporting to EU ETS. The exclusion of the change in storage of coke in the carbon mass balance is more pronounced for years when for example the operation of the blast furnaces has been restricted (e.g. 2011). During 2012 the operator applied to the county administrative board to change their monitoring methodology for CO_2 according to ETS, i.e. including any intermediate stock change of produced coke in the carbon mass balance. However, the method change will not apply until emission year 2012. During 2013 the Swedish EPA initiated the present project in order to achieve an accurate time series for CO_2 emissions from the plant for the submission 2014 reporting to the UNFCCC .

Table 1. CO_2 implied emission factors (IEF) for primary pig iron production submission 2013 to the UNFCCC.

Year	CO_2 IEF (kton CO2/kton primary pig iron produced)
1990	0.80
1995	0.78
2000	0.70
2005	0.58
2006	0.57
2007	0.56
2008	0.58
2009	0.55
2010	0.68
2011	0.75

In the course of the project it was discovered that CO_2 and CH_4 emissions from the sinter plant operated in 1990-1995 at one the two producers were

not estimated in line with the 2006 IPCC Guidelines[1]. Together with the Swedish EPA it was decided to extend the project to also include suggestions of revised CO_2 and CH_4 emissions from the sinter plant 1990-1995.

Aim and goal

The aim of the project is to develop a consistent time series for 1990-2012 of CO_2 and CH_4 emissions for the integrated primary iron and steel plants in Sweden for reporting to the UNFCCC. The goal is that the new time series will be implemented in the reporting of submission 2014.

[1] No default methodology for sinter plants is available in 1996 IPCC Guidelines or the IPCC Good Practice Guidance. For reporting of submission 2015, the 2006 IPCC Guidelines will replace the present IPCC documents.

Methodology

Iron and steel production

Direct contact has been taken with the operator of the plant of concern. For the purpose of UNFCCC reporting, the operator has revised its data by year excluding the annual amounts of produced coke stored at the facility from its carbon mass balance (SSAB, 2013-04-10). The operator has delivered a revised time series, 2005-2012, of CO_2 emissions allocated on different subcategories (CRF 1.A.1.c, 1.A.2.a, 1.B.1.c and 2.C.1.2). The current SMED calculation model has been updated according to the new information from the operator.

Due to the fact that an average CO_2 IEF 2003-2007 is used in the calculation model to calculate the CO_2 emissions and the amounts of derived energy gases (and CH_4 and N_2O emissions) for 1990-2002, the new information also affects the reported emissions for previous years.

Data provided from the plant is in some cases sensitive and considered as confidential. In such case, data shown in this report has been aggregated.

To be in line with the IPCC Good Practice Guidance, the CO_2 IEF has been compared with default EF from IPCC and when significant differences occur they are be explained.

Sinter production

In submission 2013, CO_2 emissions 1990-1995 from the sinter plant at one of the facilities producing iron and steel were assumed to be included in the plants total CO_2 emissions. The total CO_2 emissions were estimated using produced amounts of sinter. According to the 2006 IPCC Guidelines, CO_2 and CH_4 emissions from sinter production should be added to the production of iron and steel, unless the coke breeze used in the sinter process could be accounted for in the coal entering the facility or as purchased coke. The calculation model 1990-1995 is based on average data from 2003-2007 when no sinter plant was operational and thus emissions from sinter production have to be added.

No plant-specific emission measurements or other national estimates are available in Sweden to derive the emissions of CO_2 and CH_4 from sinter production 1990-1995. In accordance with the 2006 IPCC Guidelines, emissions should be estimated using production data with its default

emissions factors (0.2 ton CO_2/ton sinter produced and 0.7 kg CH_4/ ton sinter produced).

Information on production of sinter has previously been obtained from the company.

Results

Figure 1 shows, for both integrated iron and steel production plants, total greenhouse gas (GHG) emissions (kton CO_2 equivalent) reported 1990-2011 in submission 2013 (blue legend) and the revised GHG emissions suggested for submission 2014 (red legend). The largest changes in emissions are found for 1990-1995 and 2011 (Figure 1).

Adding of emissions from sinter production 1990-1995 led to increased GHG emissions by about 3-7% of the total emissions from integrated iron and steel production. The recalculated CO_2 emissions 2005-2011 due to the exclusion of intermediate storage of coke from the carbon mass balance led to large changes in 2011 (about 9%) and minor differences 2005-2010 (about 1%). The changes in CO_2 emissions 2005-2006 affected the calculation model for all GHG emissions for 1990-2002 although these recalculations had minor impact on the emission levels (less than 1%).

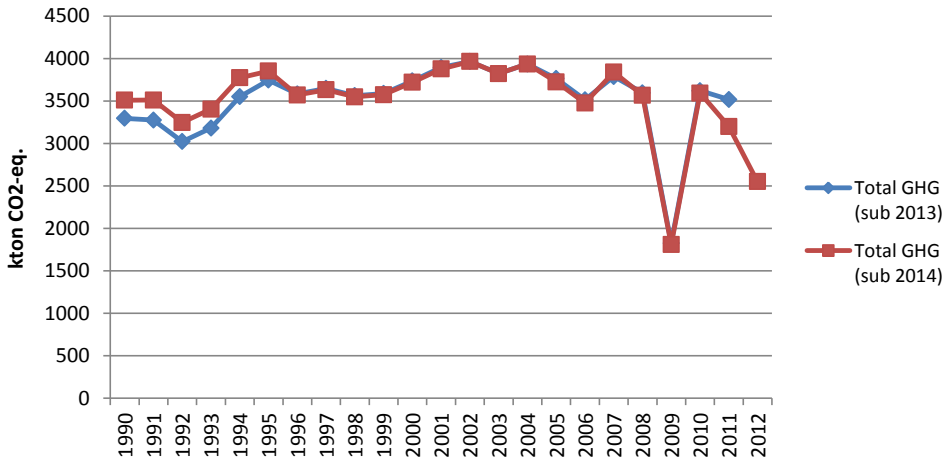

Figure 1. For integrated iron and steel production, total GHG emissions (kton) reported 1990-2011 in submission 2013 (blue legend) and the revised GHG emissions suggested for submission 2014 (red legend).

Figure 2 shows the default IPCC CO_2 EF for pig iron production and the CO_2 IEF for primary pig iron production in Sweden after suggested revisions. It is obvious that the Swedish CO_2 IEF (0.54-0.78 kton CO_2/ton pig iron) is significantly lower than the default IPCC value (1.35 kton CO_2/ton pig iron). The main reason for the large difference is due to the allocation model used in the Swedish inventory, where large amounts of derived gases (and associated CO_2 emissions) produced in the processes (blast furnace and LD-steel converters) are used in the coke plant and for power and heat production purposes.

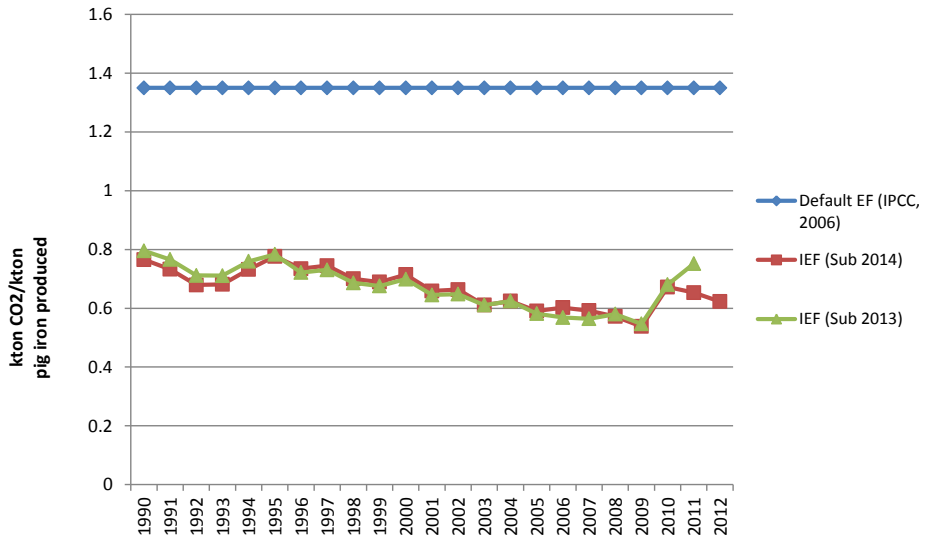

Figure 2. Default IPCC CO_2 EF for pig iron production and the CO_2 IEF for primary pig iron production in Sweden after suggested revisions.

Conclusions and discussion

SMED recommends that GHG emissions 1990-2011 are revised due to new information on intermediate storage of produced coke 2005-2011 for one plant. This has a large effect in 2011, but would also lead to minor revisions of the whole emission time series.

SMED recommends revising CO_2 and CH_4 emissions from sinter production 1990-1995 to be more in line with the methodology presented in 2006 IPCC Guidelines.

To the UNFCCC released amount of actual CO_2 emissions are reported annually, but due to the recalculations there will be discrepancies in the annual CO_2 emissions used in the reporting to the UNFCCC and the plant-specific data already reported to the EU ETS 2005-2011.

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Personal communication

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