Methodology for the free allocation of emission allowances in the EU ETS post 2012

Sector report for the iron ore industry

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Disclaimer and acknowledgements

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The views expressed in this study represent only the views of the authors and not those of the European Commission. The focus of this study is on preparing a first blueprint of an allocation methodology for free allocation of emission allowances under the EU Emission Trading Scheme for the period 2013 – 2020 for installations in the iron ore industry. The report should be read in conjunction with the report on the project approach and general issues. This sector report has been written by the Fraunhofer Institute for Systems and Innovation Research.

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1 Introduction

In the iron ore sector, iron ores and concentrates (excluding roasted iron pyrites) are produced. The main products are iron ore pellets which are used as raw material for iron making. It is through this product that the iron ore sector is concerned by the ETS and the iron ore sector has been part of the ETS for the pellet production since the first phase.

In order to acquire information and data on the iron ore sector, the Fraunhofer Institute for Systems and Innovations Research (ISI) is in contact with Euromines.

According to Annex I of the original[1] and amended[2] Greenhouse Gas Emission Allowance Trading Directive, which will be referred to as the Directive, 'Metal ore (including sulphide ore) roasting or sintering, including pelletisation' is to be included in the ETS. Table 1 gives an overview of the NACE classification of this Annex I activity.

Table 1 Classification of the iron ore industry according to the Annex I of the amended Directive and corresponding activity in NACE Rev. 1.1 classification

Annex I category of activities	NACE code (Rev. 1.1)	Description (NACE Rev.1.1)
Metal ore (including sulphide ore) roasting or sintering, including pelletisation	13.10	Mining of iron ores

Information on the number of iron ore and concentrates production installations in the EU 27 that are included in the ETS has been provided by Euromines[3]. An overview of the installations is given in Table 2.

Table 2 Overview of EU27 installations included in the ETS (Euromines, 2009)

Activity	Number of ETS installations in EU27[1]	Notes
Iron ore roasting or sintering including pelletisation	3	There are six pelletizing plants at mining sites, which are technically integrated and summarized as three installations.

[1] All installations are situated in Sweden, there is one further integrated steel plant in the EU27 in the Netherlands, where pellet production takes place (communication from Eurofer). No information is, at present, available on this plant.[2]

Apart from the existing installations for iron ore pelletisation, there is currently an ongoing project for a new pelletising plant in Austria. The planned capacity could be around 1.4 Mt of pellet production. The project is still in the early planning phase and an earliest start-up date is estimated to be in 2013. About 710.000 t of direct CO_2 emissions are annually expected by the installation operator.

[1] Directive 2003/87/EC
[2] Directive 2009/29/EC amending Directive 2003/87/EC
[3] Personal communication, Euromines hardcopy, received on 31st of May 2009. Norway and Iceland are not included.

Exact emissions data for the years 2005 - 2007 are available from the Community Transaction Log CITL (Table 3, download on 25th of June 2009). It can be seen that the verified emissions were in the range of 573 kt CO_2 equivalents in 2008, increasing from previous years and exceeding allowances.

Table 3 Allowances and verified emissions from the 3 sinter pellet installations for the years 2005 to 2012 (CITL, 2009)

	LKAB Kiruna		LKAB Malmberget		LKAB Svappavaara		Total	
Year	**Allow-ances (t CO_2)**	**Verified emissions (t CO_2)**	**Allow-ances (t CO_2)**	**Verified emissions (t CO_2)**	**Allow-ances (t CO_2)**	**Verified emissions (t CO_2)**	**Allow-ances (t CO_2)**	**Verified emissions (t CO_2)**
2005	271	266	75	82	94	90	439	439
2006	271	254	75	93	94	92	439	440
2007	271	279	108	136	94	96	473	511
2008	319	353	133	109	86	110	537	573
2009	386	n.a.	133	n.a.	86	n.a.	604	n.a.
2010	406	n.a.	149	n.a.	86	n.a.	640	n.a.
2011	416	n.a.	159	n.a.	86	n.a.	660	n.a.
2012	431	n.a.	159	n.a.	86	n.a.	676	n.a.

A further estimation of emissions can be determined from data on production volume, fuel use and process emissions of the years 2005-2007 that have been provided by Euromines. An overview of the data provided by Euromines is given in Table 4.

Table 4 Production of agglomerated iron ores and concentrates, fuel consumption and process emissions from iron ore pelletising installations currently covered by the EU ETS, excluding installations in Norway and Iceland, Figures calculated on industry data, based on best approximation to date (Euromines, 2009a)

Year	**Production volume (kt)**	**Fuel use (GJ/t)**	**o.w. gas (%)**	**o.w. oil (%)**	**o.w. other (%)[1]**	**Process emissions (kg CO_2/t product)[2]**
2005	16359	0.3115	0 %	40 %	60 %	6
2006	16872	0.3233	0 %	43 %	57 %	5
2007	18796	0.3044	0 %	49 %	51 %	12
Average	**17402**	**0.3131**	**0 %**	**44 %**	**56 %**	**8**

[1] We interpret this as coal (to be checked).
[2] Process emissions arise due to the carbon content of the iron ores.

From the data given in Table 4 the overall amount of direct emissions of the iron ore sector can be calculated with the help of IPCC default conversion factors for oil and coal (IPCC, 1997)[4]. The results are given in Table 5. They are somewhat higher than the CITL data and

[4] 0.0741 t CO_2/GJ for gas/diesel oil and 0.0983 t CO_2/GJ for anthracite coal

differences should be checked with Euromines. CO_2 emissions from the sector are estimated with 530 kt which is in the same order as the CITL data.

Table 5 Estimation of the total emissions of the iron ore sector (Euromines 2009, calculations from Fraunhofer ISI 2009)

Year	Production volume (kt)	Specific emissions from fuel use (kg CO_2/t product)	Specific process emissions (kg CO_2/t prod.)	Total specific emissions (kg CO_2/t prod.)	Total emissions (t CO_2)
2005	16359	27.6	6	33.6	549662
2006	16872	28.4	5	33.4	563525
2007	18796	26.3	12	38.3	719887
Average	**17402**	**27.4**	**8**	**35.4**	**616031**

No data on electricity consumption is available until that date. According to stakeholders from the iron ore mining industry, electricity consumption plays a significant role in the sector.

2 Production process and GHG emissions

2.1 Description of the production process

In the iron ore sector, iron ores and concentrates (excluding roasted iron pyrites) are produced. A distinction can be made between non-agglomerated iron ores and concentrates (sinter fines) and agglomerated iron ores and concentrates. The main products within agglomerated iron ores are iron ore pellets which are used as raw material for primary iron and steel making. The stand-alone production of non-agglomerated iron ores and concentrates is not covered by the EU ETS, since the amounts of emissions are too small.

The production of iron ore pellets can be described as follows: Non-agglomerated iron ores (sinter fines) are mixed together with additives in a ratio that depends on the desired pellet quality and on the quality of the sinter fines. The mixture is then brought into a round pellets shape ("green pellets") and burnt at a temperature between 1200 and 1300°C, resulting in hard, transportable iron ore pellets. Production of pellets is mainly carried out at the site of the mine or its shipping port. The iron ore pellets are thereafter sent to the steelwork site for use in the blast furnace.

2.2 Direct emissions and steam use

In the pellet production process, direct CO_2 emissions result from the fuel used for the burning process and in form of process emissions due to the carbon content of the iron ores (typically less than 0.3% in weight for the existing pelletisation installations).

3 Benchmarking methodology

3.1 Background

Emissions from iron ore mining activities in the EU ETS represent currently around 600 kt of CO_2. Compared to the overall industrial emissions from the EU27 under the ETS of around 800 Mt, this represents about 0.075%. These figures may be doubled with the possible new installation in Austria. In addition, the processes involve a very limited number of installations. We therefore recommend treating the whole iron ore sector through a fall-back approach (see section 5 of the report on the project approach and general issues). Combining pellets and sinter in one benchmark could be an alternative but may pose problems. (For more detailed explanation, see also chapter 4)[5]

3.2 Relevant PRODCOM codes

As mentioned earlier we recommend treating the whole iron ore sector with a fall-back approach and do not consider benchmarking described as follows an adequate approach. In case the final decision is, however, made in favour of benchmarking, we regard only one benchmark for the production of iron ore pellets necessary (Table 6). This product would cover 100 % of the actual emissions from the iron ore sector.

Table 6 Possible benchmark product of the iron ore sector and its corresponding PRODCOM code

Product	**Corresponding PRODCOM codes**	**PRODCOM description**
Iron ore pellets	13.10.10.50	Agglomerated and agglomerated iron ores and concentrates (excluding roasted iron pyrites)

In case that the new Austrian plant with direct emissions of about 700 kt[6] was installed, the benchmark mentioned above would cover only about 46% of the iron ore sector.

[5] See also the iron/steel report: Although used alternatively to sinter as input for the blast furnace, composition and product characteristics of pellets differ significantly from sinter. A common benchmark for sinter and pellets is therefore not recommended.

[6] Estimation of the installation operator

4 Emission intensity data

The NACE code 13.10 (Mining of iron ores) covers the production of sinter, sinter fines (non-agglomerated iron ores), and iron ore pellets (agglomerated iron ores)[7]. As emphasized in chapter 3, we recommend treating the whole iron ore sector with a fall-back approach (see section 5 of the report on the project approach and general issues) and do not consider product benchmarking an adequate approach. Below we nevertheless discuss differences in emission intensities between the products sinter (as treated in the report on the iron & steel sector), iron ore pellets that are currently produced in European ETS installations and pellets that might be produced in the currently planned new installation in Austria. This data supports our opinion that product benchmarking is not an appropriate approach for the iron ore sector.

Differences between iron ore pellets and sinter:

Iron ore pellets and sinter are comparable in the way that they have the same use in the production of crude steel. They differ, however, in raw material input, production technology and product characteristics. Sinter is practically always produced at the steelwork site, where it allows solid wastes to be recycled, coke breeze is available for use as a fuel and the degradation of sinter during transport and handling is unproblematic. According to the guidelines for national emission inventories (IPCC, 2006)[8], sinter production has an emission factor of 0.20 t CO_2/t sinter, a data collection of Eurofer[9] results in a factor of approximately 0.25 t CO_2/t sinter. That means that the emission intensity of sinter making is about six to seven times higher than that of pellet production. Due to the function the sinter process has at integrated iron and steel plants to recycle iron containing solid waste, we recommend to treat sinter and pellet production separately within our work.

Differences between different kinds of iron ore pellets:

In addition to the three existing pelletisation installations in Sweden, a new installation is planned in Austria with an earliest start-up date in 2013. The production of a new form of pellets called "super-fluxed pellets" is in preparation, whose technical features will according to Euromines be completely different from pellets that are currently produced within the EU for two reasons. Firstly, Swedish iron ores are oxidic (hematite - Fe_2O_3 and magnetite - Fe_3O_4) and Austrian iron ores carbonatic (siderite - $FeCO_3$ and ankerite – $Ca(Fe^{2+},Mg,Mn)(CO_3)$). Secondly, Swedish input materials contain 66% iron oxide, while Austrian materials contain 33% before calcination and 40-45% after calcination. The difference is due to the carbon content of Austrian iron ores (about 9.75% in weight[6]), leading to significantly higher process emissions than in existing pelletisation plants. Besides the larger amount of process emissions, the energy requirements are expected to be higher as well, since special treatment of the fines in form of concentration (similar to roasting and

[7] Installations that are exclusively producing non-agglomerated iron ores are not covered by the ETS.
[8] Volume 3, Chapter 4, Table 4.1
[9] See sector report on Iron and Steel

calcination in other industries) will be necessary to make them ready for pelletisation. According to Euromines the overall emission intensity will differ from currently produced pellets by a factor four approximately. (The specific emissions are estimated to be 130 kg CO_2/t pellets for this process in comparison to 35.4 kg CO_2/t pellets in existing installations, as mentioned in Table 5).

5 Additional steps required

Due to the extremely low number of installations and the small overall amount of direct emissions in the iron ore sector, the consortium does not consider benchmarking an appropriate approach. Nevertheless, in case that the choice of a benchmark approach would be made for the iron ore sector, the following additional data would be necessary to develop the benchmark.

1. For further work on the determination of final benchmark values based on the average of the 10% most carbon efficient installations, benchmark curves based on a reliable data collection and including installations from Norway and Iceland are required.

2. It would be essential that system boundaries would be made clear to all installations participating in the data collection, in order ensure high quality of the data provided.

6 Stakeholder comments

Comments on the interim report have been made by Euromines on the following issues[10].

Fall-back option

A fall-back option should take 2005-2007 as reference period and allocate emission rights based on average CO_2 emissions per t product during this period. This is critical in order to ensure that the allocation system is technologically neutral in allocating to new entrants from the new entrants reserve and for capacity expansions. Using standard conversion rates per t product produced allows for increased production to be allocated emission rights irrespective of type of technology or fuel used in the expansion. It should be noted that historically the industry has generally improved efficiency in CO_2 emissions per t product through production expansion.

Improvement factor

Given that substantial investments have already been made in improving the energy and emissions efficiency in the production of green iron ore pellets there is only limited scope for further reductions. The measures that have already been taken to achieve an improvement in energy efficiency within the sector have made the EU production of iron ore pellets one of the most energy efficient in the world. This fact has to be taken into account when deciding on a relevant improvement factor for the industry going forward. Euromines is currently conducting a detailed cost-benefit analysis in order to understand where the real areas for potential improvement lie; and how much the sector can commit to reducing its CO_2-emissions. The analysis will evaluate all areas for future improvement from use of raw material to new technologies and processes. Once the analysis is finalised Euromines will contact Ecofys/Fraunhofer Institute and relevant parties.

In the case an improvement factor is used; it shall be developed based on a holistic analysis of the potential for improvement in the whole value chain of the production of crude steel. This means taking into account the benefits of using green pellets in production of crude steel compared to alternative methods.

Planned new installation in Austria

The Austrian super fluxed pellets represent a different type of product. This is also clearly supported by the expertise prepared by the University of Metals and Mining in Leoben and also by the statement from Voestalpine blast furnace department as the final customer of the super fluxed pellets. For more details please see *(Schenk, Hiebler, 2009).*

[10] Personal communication – Euromines via e-mail, 13th of July 2009

Concerning a possible fall-back approach for the new installation Euromines understands the position that at this time it is not possible due to missing exact data to make definite suggestions how to treat this installation regarding CO_2 emissions. However, Euromines would like to support the idea of a fall-back approach together with an improvement factor. For the definition of an improvement factor for the new installation in the future two aspects should be taken into account:

a) The improvement factor should be based on emissions caused by fuel consumption and not on emissions caused by the input material (carbonatic iron ore)

b) It should be considered that the new installation will be built according to best available technology standards and therefore potentials for major CO_2 reductions from fuel consumption will be limited.

7 References

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