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Assignment Report

Environmental Declaration of steel products for the Norwegian Steel Association and Contiga AS

Summary

SINTEF Building and Infrastructure has carried out type III environmental declaration (EPD) of 4 products for The Norwegian Steel Association (cradle to gate) and 4 products from Contiga AS (cradle to grave). The declarations are based on life cycle assessment.

The environmental declarations have been carried out according to ISO/FDIS 21930, and product category rules (PCR) “Steel as construction materials". The calculations have been carried out with the EcoDec-tool.

Address of the building			Built (year)
	Method Life cycle assessment	Keywords Materials Environment	Filename Project report

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1 Introduction

SINTEF Building and Infrastructure has carried out type III environmental declaration of steel products from The Norwegian Steel Association and Contiga AS based on life cycle assessment (inventory). Life cycle assessment is a methodology used to assess the environmental potential impacts and burdens connected to the complete service life of a product.

The environmental declaration has been carried out according to ISO/FDIS 21930, and product category rules (PCR) “Steel as construction materials". The goal has been to present EPDs according to the requirements given by the program operator. The calculations of the EPDs have been carried out with the EcoDec-tool[1].

The product category rules (PCR) in appendix 1 give the guidelines for carrying out the environmental product declarations.

This report contains the PCR applicable to “Steel as construction materials”, 4+4 Environmental Product Declarations, the project documentation and the verification report.

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The EPDs and this report have been prepared by members of Norwegian Steel Association and SINTEF Byggforsk.

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2 Description of company/organization and product

2.1 Description of company/organisation

The Norwegian Steel Association PO Box 242, NO-1326 Lysaker, Norway, organization NO 985942897 MVA, is the industrial body of Norwegian steel suppliers and manufactures of steel products.

Contiga AS is manufacturing prefabricated solutions of building frame structures of steel and concrete. The company is manufacturing steel and concrete products in Oslo, Moss, Fredrikstad, Kongsvinger, Flisa and Stjørdal. Contiga AS is certified according to ISO 9001, certificate no: 95-OSL-AQ-6299 and ISO 14001, certificate no: 2003-OSL-SYMI-8195 from Det Norske Veritas.

[1] Non commercial tool for making EPDs, developed at SINTEF Building and Infrastructure.

2.2 Description of the products

A) I, H, U, L, T and wide flats are hot-rolled sections used in frame structures made by European manufacturers: Prefabricated and erected on-site by Norwegian steel contractors.
Dimensions: IPE 80-600, HEA/B/M 100-600, UNP/UPE 80-400, L 40-200, L 65x50 - 200x150, T 30-140 and wide steels:160-500, t=5-40. The requirements of the EN 10025 standard are applied. The standard steel grade is S355. Density of steel: 7,850 kg/m³

B) Cold finished structural hollow sections (CFSHS): Circular, square and rectangular sections are used in frame structures, made of hot-rolled steel strip by cold-rolling and welding by European manufacturers. Prefabricated and erected on-site by Norwegian steel contractors. Dimensions: Square HS: 25x2 - 300x12,5. Rectangular HS: 50x25x2 - 400x200x12,5 and Circular HS: 21,3x2 - 711x60. The requirements of the EN 10219 standard are applied. The standard steel grade is S355. Density of steel: 7,850 kg/m³.

C) Hot finished structural hollow sections (HFSHS): Circular, square and rectangular sections are used in building frame structures, made of hot-rolled steel by European manufacturers. Prefabricated and erected on-site by Norwegian steel contractors. Dimensions: Square HS: 40x3 - 400x20. Rectangular HS: 50x30x3,2 - 500x300x20 and Circular HS: 21,3x2 - 711x60. The requirements of the EN 10210 standard are applied. The standard steel grade is S355. Density of steel: 7,850 kg/m³.

D) HSQ, ISQ og HSK sections are made of welded hot-rolled steel plates used in building frame structures. Plates are made by European manufacturers. Sections are prefabricated and erected on-site by Norwegian steel contractors. Dimensions: H = 150-600, B1 = 110-600, B2 = 140-700, d = 5-12, t1/t2 = 6-60. The requirements of the EN 10025 standard are applied. The standard steel grade is S355. Density of steel: 7,850 kg/m³.

Cradle to gate EPD (4 products, A-D) based on data from European steel mills have been carried out. Cradle to grave EPD (4 products, A-D) based on data from European mills and Contiga AS (erected on-site) have been carried out for these products.

3 Content of substances

Life cycle inventory of the raw materials are shown in appendix 3.

Substances listed on the Norwegian OBS-list have not been found in the raw materials used in the steel production. The paint, TEMALAC FD 50 and TEMAPRIM EUR consists of one substance (solvent naphtha) found on the Norwegian observation list. The Norwegian observation list is defined by the Norwegian government as a list of toxic substances which can represent a health threat.

4 Declared unit and Functional unit

The declared unit is defined as per **kg steel** and the functional unit (cradle to grave) is defined as per **kg building frame structure with an average service life of 100 years**. Expected average service life of the building is 60 years. The number of replacement during the service life of the building will be none. Package is included.

5 System boundaries

The system boundaries are shown in the diagram on page 4 of the EPDs. The estimated scope of collected data is shown on the data sheets for each raw material presented in appendix 3.

5.1 Transport

The following transport distances are included:
- Transport of raw materials from extraction/supplier to manufacturer. Complete transport distances are shown on the data sheets for raw materials (appendix 3).
- Transport of steel products from steel mill to wholesaler (average distance estimated to 900 km)
- Transport of steel products from wholesaler to manufacturer of steel frames (average distance estimated to 100 km)
- Transport of building products from manufacturer to building site (average distance estimated to 400 km)
- Transport from building site to recycling/incineration and land fill (average distance estimated to 50 km)

Transport data is based on *The Norwegian Emission Inventory* (SFT - Norwegian Pollution Control Authority, February 2000, see appendix 6).

5.2 Building site

Data on energy consumption on the building site is based on information given by Contiga AS, see appendix 5.

5.3 Use scenario

The building frame structure does not need any mechanical maintenance during the use phase. Average service life of the paint is expected to be 60 years. This is based on that the loss of paint will be 1,3 µm a year (Corrosion category C1[2]) and that the minimum thickness of the paint will be between 80 and 120 µm. The building frame structure will not be painted during the service life of the building (60 years).

The steel products will have no impact on the indoor environment. The paint from Tikkurila Coating Oy has not been classified according to CR 1752:1999, but it is expected there will be no impact on the indoor environment.

5.4 Demolition

Energy consumption on demolition is assumed to be the same as for the building site.

5.5 End of life scenario

The use/maintenance phase and the demolition phase are based on a typical scenario for the product and are shown on page 4 of the EPDs.

End of life scenario is included in LCI data for the steel products and is based on a recovery rate (RR) of 96 %. Recovery rate is the fraction of steel recovered as scrap during one life cycle of a steel product[3].
The flows of the recycled material will then become inputs into the production of the next product, see figure on page 4 of the EPDs.

[2] NS-EN-ISO 12944-2:1999
[3] Application of the IISI LCI Data to Recycling Scenarios. International Iron and Steel Institute.

6 Cut-off rules

Processes and activities that altogether do not contribute to more than 2 % of the total mass and 1 % of the total energy use may be omitted from the inventory analysis unless data are available. This rule does not apply to hazardous and toxic substances.

The cut-off for steel products is estimated to zero; only cutting wheels and angel grinders have been omitted.

7 Allocation rules

The allocation of scrap inputs and outputs are using a closed material loop recycling methodology. Steel scrap recovered for recycling is allocated a credit to the arising scrap. When scrap is used in the manufacturing of a new product there is an allocation associated with the scrap input. Based on guidance from ISO this scrap can be allocated a value with avoided impacts such as an alternative source of equivalent (virgin) ferrous metal (quoted from reference in foot note 3). The data from IISI (appendix 3) are based on these principles and are used as input data in the EPD.
For the manufacturing process at Contiga plant in Kongsvinger, the environmental impacts and use of resources are collected from year 2005, see appendix 4. The production process at Contiga plant, include all the four building frame structures. The energy consumption due to the production of these building frames is defined according to the information provided by Contiga AS. The environmental impacts (inputs and outputs) from the process are allocated to the different building frames according to weight. Welding tread, welding electrodes and short blasting are treated as steel materials.

For the manufacturing phase the amount of used materials like welding tread, welding electrodes, short blasting, oxygen and Secure 18 are allocated to the *HSQ, ISQ and HSK sections*, *Hot finished structural sections (HFSHS)*, *Cold finished structural hollow sections (CFSHS)* and *Hot rolled sections: I, H, U, L, T and wide steels* according to fractions of 1/8, 1/8, 1/8, 5/8.
I.e *Hot rolled sections: I, H, U, L, T and wide steels* is using 5 times more materials than the other products.
The consumption of paint is allocated to the same products according to fractions of 3/10, 3/10, 3/10 and 1/10. These fractions have been agreed upon by the project working group.

Allocation of materials, energy etc. to the different building frame structures is shown in appendix 4.

8 Data Quality requirements

8.1 Calculation rules

- Loss in the manufacturing process

Approx. 4,5 % of the steel used in production will be sent for recycling.

- Loss on building site

There is no loss at the building site.

8.2 Data collection

The data are representative according to temporal, geographical and technological requirements.
Temporal: The obtained information from the manufacturing process is annual approximate values from 2005.
Geographical: The geographic region of the production sites included in the calculation is Europe.
Technological: Data represent technology in use.

8.3 Description of data

Cradle to gate data of the raw materials are collected from databases, literature (generic data) or from raw material suppliers. Source, estimated scope and uncertainty are shown for each raw material in appendix 3.

The following data has been applied:

- Both generic and specific data (Ruukki) for the production of the building frame structures (see appendix 3).
- Specific data for Contiga AS manufacturing process (see appendix 4).

The data is supplied for an agreed purpose following consultation with an LCA manager from an IISI member organization. The tables in appendix 3 show the original IISI LCI data and the extracted data to the EcoDec format. In simplifying such a complex subject there is always a risk that information can be misinterpreted. To avoid any such misinterpretation, these data should not be disclosed to third parties. The Recovery Rate represents a typical figure for the amount of steel that is recovered during one life cycle of the steel product. In this case the Recovery Rate is 96%.
Energy data is derived from the material inputs.

In addition to the data from IISI, data from Ruukki is applied for the process for making cold finished structural hollow sections (CFSHS, see appendix 3).

The mix of electricity used is based on the mix of primary fuels as shown in table 4 of ECO-PROFILES of the European plastic industry – METHODOLOGY[4]. For Norway the electricity mix for 2005 is based on 97,2% production in Norway, 2,2 % import from Sweden, 0,4 % import from Denmark and 0,3 % from Finland. (see appendix 6).

Data from production of Oxygen, Nitrogen and CO_2 is based on information given by Svein Hasle Yara Industrial AS.
The energy consumption of producing 1 NM^3 liquid air is 1 kWh.
The necessary amount of air to produce 1 kg of liquid Nitrogen is 4,3 kg
The necessary amount of air to produce 1 kg of liquid Argon is 208 kg
The necessary amount of air to produce 1 kg of liquid Oxygen is 12,97 kg
The energy consumption of producing CO_2 from the ammonia production in Porsgrunn is 0,14 kWh/kg
Secure 18 consists of 18% CO_2 and 82 % Argon. (see appendix 3)

Safety data sheets and environmental declaration for the paint used is shown in appendix 3.

[4] I Boustead, APME, Brussels 2003

Data sources listed in table 1 have been used.

Table 1 Databases and data supplier

Material	Manufacturer/Database
Steel	IISI (International Iron and Steel Institute) http://worldsteel.org
Electricity	ECO-PROFILES of the European plastics industry Methodology Plastics Europe http://www.plasticseurope.org/
Paint	Ecoinvent http://www.ecoinvent.ch/ Byggsektorns Kretsloppsråd och Sveff (Sveriges färgfabrikanters Förening) http://www.kretsloppsradet.com/webdoc.asp
Oxygen, Nitrogen, CO_2	Yara Industrial AS http//:www.hgc.hydro.no

8.4 Characterization factors

Characterization factors used, see also PCR “Steel as construction materials", are shown in appendix 6.

9 Additional environmental information

Contiga AS quality- and environmental management system is show in appendix 7.

Oslo, 27.03.2007
SINTEF Byggforsk
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10 Environmental declarations of:

Cradle to gate (Norwegian Steel Association)
I, H, U, L, T and wide flats NEPD no 054
Steel plates for HSQ, ISQ and HSK sections NEPD no 064
Hot finished structural hollow sections (HFSHS) NEPD no 065
Cold finished structural hollow sections (CFSHS) NEPD no 070

Cradle to grave (Contiga AS)
Hot rolled sections: I, H, U, L, T and wide flats NEPD no 081
HSQ, ISQ and HSK sections (welded plated beams) NEPD no 076
Hot finished structural hollow sections (HFSHS) NEPD no 078
Cold finished structural hollow sections (CFSHS) NEPD no 079