Steel Recycling Institute

www.recycle-steel.org

LCI DATA FOR STEEL PRODUCTS

Steel Product:	**Hot-Dip Galvanized (HDG)**
Region:	**North America**
Scope:	**Cradle to Gate, Excluding End-of-Life (EoL) Recycling**

Data provided by:

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July 2017

worldsteel ASSOCIATION

The Steel Recycling Institute provides steel LCI data in cooperation with worldsteel.

1 Introduction

The following data is provided in this report: North American average, 1kg of Hot-Dip Galvanized Steel, cradle-to-gate, excluding end-of-life (EoL) recycling.

The data provided has been generated based on the World Steel Association (worldsteel) data collection and methodology for calculating the Life Cycle Inventory (LCI) for steel products; full details are available in the worldsteel Life Cycle Assessment Methodology Report, 2011.

2 Data description

A description of the steel products provided in this report:

Product	**Technical purpose of product or process**
Hot-Dip Galvanized (HDG)	Obtained by passing cold rolled coil through a molten zinc bath, in order to coat the steel with a thin layer of zinc to provide corrosion resistance. It can be found on the market in coil or in sheets and is further processed into finished products by the manufacturers. Hot-Dip Galvanized Steel features excellent forming properties, paintability, weldability, and is suitable for fabrication by forming, pressing and bending. Applications include building applications (e.g., wall elements, roofing applications), automotive applications (e.g., body in white for vehicles underbody auto parts), lighting fixtures, drums and various kinds of sections applications, profiled sheets, etc. Typical thickness between 0.3 - 3 mm. Typical width between 600 - 2100 mm.

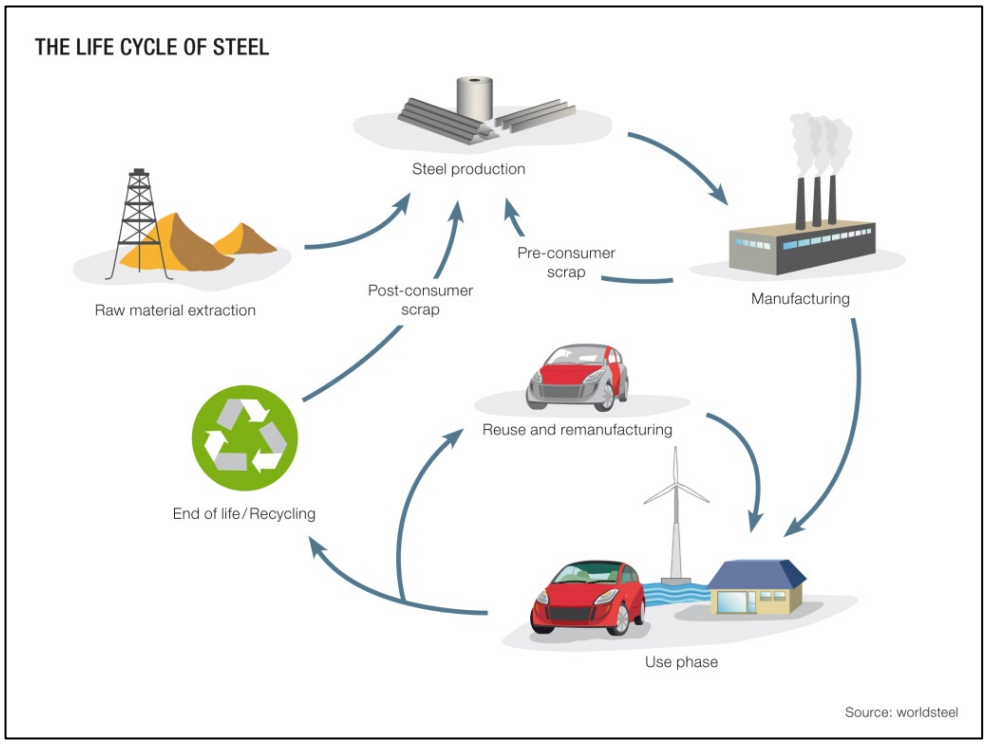
The data being provided is cradle-to-gate and excludes EoL recycling. This means the data provided does not consider a burden for scrap input or a credit for the EoL recycling. More details about this are given in the section on methodology. Further information on the recycling methodology can be found in Appendix 10 of the worldsteel LCA Methodology Report.

The reference year for the steel production data ranges from 2006 to 2010, depending on each company providing data. Upstream data ranges from 2000 to 2010; see Appendix 6 in the worldsteel LCA Methodology Report.

The flow list includes the main inputs and outputs of the steelmaking process. Please note that the data inputs are expressed in **kg** and the outputs in **grams**.

3 Methodology

The methodology used to develop this data is detailed in worldsteel's 2011 LCA Methodology Report, which can be requested via the worldsteel website www.worldsteel.org.



3.1 Summary of methodology

The quality and relevance of LCA/LCI results, and the extent to which they can be applied and interpreted, depends critically upon the methodology used. It is therefore important that the methodology is transparent and well documented. ISO standards have been developed to provide guidance on methodological choices and to set down rules for transparency and reporting. The relevant ISO standards are:

ISO 14040: 2006 – Environmental management – Life cycle assessment – Principles and framework
ISO 14044: 2006 – Environmental management – Life cycle assessment – Requirements and guidelines

The goal of collecting and developing LCI datasets is to facilitate the range of emerging impact assessment methods in future studies.

This worldsteel LCI study of North American steel production has been undertaken in accordance with ISO 14040 and ISO 14044 and the methodology report underwent a critical review from an independent Critical Review Panel (CRP) of LCA specialists. This approach improved the integrity of the study and can help guide methodology. The full CRP Report is included in the 2011 worldsteel LCA Methodology Report.

The study is a cradle-to-gate LCI study, excluding EoL recycling. This means the data provided does not consider a burden for scrap input or a credit for the EoL recycling. It covers all of the production steps from raw materials 'in the earth' (i.e., the cradle) to finished products ready to be shipped from the steelworks (i.e., the gate). It does not include the manufacture of downstream products or their use.

The steel product manufacturing system encompasses the activities of the steel sites and all major upstream processes, including the production and transportation of raw materials, energy sources and consumables used in the steelworks. In addition, the recovery and use of steel industry by-products outside of the steelworks are

taken into account using, in most cases, the method of system expansion.

The data includes steel production from both the integrated route (blast furnace/basic oxygen furnace) and the electric arc furnace route. This mix of technologies is representative of the actual production mix for North America.

4 LCI data: cradle-to-gate for 1kg steel, North American Hot-Dip Galvanized (HDG)

Inputs (mass, kg)

Carbon dioxide	0.01599967
Crude oil (resource)	0.05881026
Dolomite	0.0947887
Ferrous scrap	0.4386219
Hard coal (resource)	0.625906
Iron ore	0.9661151
Lignite (resource)	0.03205394
Limestone (calcium carbonate)	-0.02429561
Natural gas (resource)	0.1379791
Tin ore	5.311787E-015
Uranium (resource)	3.530925E-006
Water	Pending
Zinc ore	0.09684809

Tin ore approx. 14% tin content.

Emissions to air (mass, g)

Cadmium (+II)	4.021E-005
Carbon dioxide	2054
Carbon monoxide	11.25
Chromium (total)	0.0002306
Dioxins (unspec.)	8.749E-010
Hydrogen chloride	0.06193
Hydrogen sulphide	0.08199
Lead (+II)	0.0009471
Mercury (+II)	5.985E-005
Methane	4.551
Nitrogen dioxide	0.03243
Nitrogen oxides	6.853
Nitrous oxide (laughing gas)	0.01518
NMVOC (unspecified)	0.31
Particles to air	2.315
Sulphur dioxide	4.882

Emissions to fresh water (mass, g)

Ammonia (NH4+, NH3, as N)	0.03177
Biological oxygen demand (BOD)	0.006053
Cadmium (+II)	9.066E-005
Chemical oxygen demand (COD)	0.6346
Chromium (total)	0.00128
Iron	0.2522
Lead (+II)	0.0002447
Nickel (+II)	0.0002093
Nitrogenous Matter (unspecified, as N)	0.06953
Phosphate	0.0001873
Phosphorus	0.0004386
Solids (dissolved)	0.004599
Zinc (+II)	0.002615

Environmental Indicators

IPCC 5th Assessment Report (AR5), Global Warming Potential, 100 yr (GWP-100) excl. biogenic carbon [kg CO_2-Equiv.]	2.20
IPCC 5th AR5, GWP-100 incl. biogenic carbon [kg CO_2-Equiv.]	2.18
IPCC 5th AR5, GWP-20 excl. biogenic carbon [kg CO_2-Equiv.]	2.45
IPCC 5th AR5, GWP-20 incl. biogenic carbon [kg CO_2-Equiv.]	2.43
CML2001 - Nov. 2010, Global Warming Potential (GWP 100 years) [kg CO_2-Equiv.]	2.16
Primary energy demand from ren. and non ren. resources (net cal. value) [MJ]	27.9

5 Data usage

An LCI study has been carried out by worldsteel to quantify resource use, energy and environmental emissions associated with the processing of steel industry products, from the extraction of raw materials in the ground through to the steel factory gate.

LCI data were calculated for products derived via the blast furnace/basic oxygen furnace route (based on iron ore and steel scrap) and the electric arc furnace route (mainly based on steel scrap). The products included in the study are of general relevance to a wide range of downstream applications including those in the construction, automotive and packaging sectors.

A key goal of worldsteel and the Steel Recycling Institute (SRI) is to provide support on the environmental credentials of steel to customers and users of steel, with the intention that specifiers and users of these materials have access to relevant data to facilitate their own informed decision-making. In this regard, worldsteel and SRI are willing to support the implementation of this database in LCA software and LCA tools.

By using the data, you agree with the following points:

- The worldsteel LCI database is provided free of charge and may not be sold to other parties.
- When the worldsteel database is included in a database for different products, it shall be supplied with the main database of the software (or tool); i.e., at no extra cost for the buyer, nor as an extra library.
- The data sheets shall include a reference source (i.e., contact details either for the worldsteel and SRI web sites or directly to the worldsteel and SRI LCA Managers; see below).
- The 2011 worldsteel LCA Methodology Report shall be provided on request to users of the data.
- Version updates will be available following data improvements and extra LCI information supplied by companies around the world. Please accept these updates (e.g., version changes), and update the database system as required.
- The database vendor will provide worldsteel with information about the users of the database (e.g., on a 6-monthly basis, and at least once a year).
- The datasheets are supplied only for the purpose of the study for which they were requested. Should they be required for any another purpose, worldsteel or SRI must be contacted beforehand.
- The user shall not provide the database on public websites or communicate the full inventories externally without worldsteel or SRI agreement.
- The user shall not tamper with the LCI data in any way.

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