PE INTERNATIONAL
EXPERTS IN SUSTAINABILITY

BCSA

Steel Tubes

Key Information

General Process Description	This dataset represents average end-of-life conditions for structural steel tubes used in a building in the UK.
Reference Flow	1kg of structural steel tube
Reference Year	2012

Modelling & Assumptions

Detailed model description

This dataset represents average end-of-life conditions for steel tubes used in a building in the UK. The modelled product is a hot formed structural tube. The reference unit is 1kg of steel tube. Users wishing to use this data to make comparisons between different structures and/or different materials should consider the amount of material required for the relevant structural function as comparing on a per kg basis may be misleading.

The scrap input into the manufacture of steel tubes is 0.121kg of scrap/kg of product.

Recycling Rates

The recycling, reuse and landfill rates used in modelling the end of life treatment of steel tubes are as follows. The modelled product is a hot formed structural tube used in a building in the UK.

Material	***Steel Tubes***
Recycling Rate	Recycling: 93%
	Reuse: 7%
	Landfill: 0%
Reference	[Eurofer 2012]

The end of life rates for heavy structural steel tubes in the cited reference were compiled from a survey of members of the National Federation of Demolition Contractors (NFDC) in 2012. The survey quantified the percentage of steel in buildings recovered from typical building demolition sites.

Module Description

The dataset includes the following waste processing steps (EN 15804 module code shown in brackets):

- **Demolition (C1):** Demolition has been modelled based on information related to the demolition of office building structural systems [Athena 1997]. The cited report listed energy demands from diesel for the demolition of concrete, wood and steel-based structural frames. Energy demand varies depending on the type of building element being demolished, so an average for 1kg of steel building elements was made. Overall, the average energy demand for demolition from diesel was calculated to be 0.233 MJ/kg. Steel scrap is assumed to reach an end-of-waste stage following demolition and no further processing prior to remelting or reuse has been modelled. Consequently, module C3 contains no values.

- **Transport of steel (C2):** Transport distances for steel sent to landfill or reuse are based on average travel for construction steel scrap sent to waste transfer stations, an average distance of 21km [BRE 2012]. Steel scrap generated in the UK and sent for recycling was deemed to have three potential destinations: BF steel production in the UK, EAF steel production in the UK or export. An average was made based on the weighted transport distance to BF, EAF and export using information on steel waste arisings and fates [EMR 2006] [EEF 2010]. For BF, transport distance was calculated based on average distance by road from ten UK urban areas to Scunthorpe and Port Talbot (where Tata Steel operate blast furnaces). For EAF, transport was based on distance to South Wales and South Yorkshire where all bar one of the UK's EAF producers are based. For export, transport by road and ship to Luxembourg and Germany was deemed representative. Based on this averaging method, the overall transport distance for 1kg of steel scrap was calculated to be 463km by road and 158km by ship.

- **Landfill of steel tubes (C4):** The landfill rate for steel tubes is 0%, therefore module C4 has no values.

- **Benefits/Loads associated with steel tube reuse (D):** Reuse of steel tubes was assumed to displace the need for the production of new steel tubes from BF/EAF sources on a 1:1 basis. This material is assumed to reach end of waste in module C1, so there are no additional reuse preparation processes and no losses assumed. The benefits associated with reuse are reported in module D.

- **Benefits/Loads associated with steel recycling (D):** The benefit of recycling steel was calculated based on the "net scrap" generated over the lifetime of the product. This net scrap value was calculated based on the output of steel scrap sent to recycling at end-of-life minus the input of steel scrap into the product system to produce structural steel tubes. The end of life recycling rate was 93% or 0.93kg of scrap/kg of steel tube and the average input of scrap into the modelled tube product is 0.121 kg of scrap/kg of product, resulting in a net scrap of 0.809 kg/kg of steel tube. The credit applied uses the worldsteel value of scrap, based on the difference between the LCI of EAF steel and a 100% primary BF route [worldsteel 2011]. Values reported for the use of secondary material are based on the net scrap and reused material made available from the system. Users should note that if there is a higher or lower scrap input into the manufacture of the structural steel tubes, results in module D will change as the "net scrap" value will decrease or increase accordingly.

Representativeness

Time representativeness	Recycling rates and other assumptions are based on the most recent data available, the oldest of which was published ten years ago. Background data is for the year 2013.
Geographical Representativeness	The methods and rates modelled are based on research into the disposal of steel construction materials in the UK. Background datasets are UK specific, EU average or Global average (see included datasets list), but are deemed representative for end of life waste treatment in the UK
Technological Representativeness	All technological processes deemed relevant for waste treatment of steel tubes in the UK have been modelled. Results reported in module D are only representative for scrap inputs close to the modelled value of 0.121kg/kg of product.

Included Datasets

Dataset List	GB: Thermal Energy from Light Fuel Oil
	EU-27: Diesel Mix
	Global: Euro 5 Truck, 9.3t payload capacity
	Global: Euro 5 Truck, 22t payload capacity
	Global: Ship - Bulk commodity carrier, 10,000t DWT
	EU-27: Landfill of inert matter (steel)
	Global: Value of scrap - worldsteel

Conformity with EN 15804

The models used in this work have been designed to be conformant with the EN 15804 standard. Wherever possible, upstream datasets that are conformant with the EN 15804 standard have been used (see "Included Datasets"). However, not all data providers have been able to update their datasets to comply with the reporting of water and waste indicators according to the standard. The following datasets used in this work are not conformant with EN 15804.

- *Global: Value of scrap – worldsteel*
- *Global: Steel hot rolled coil*

These inventories represent 89% of the EoL modelling by mass, so net use of fresh water and three waste categories have not been reported.

The models and results have been produced in line with the EN 15804 standard and have undergone quality assurance by experts within PE INTERNATIONAL. However, no formal review process through a third party has been undertaken therefore the results are unverified.

Environmental Parameters Derived from the LCA

Parameters describing environmental impacts		C1	C2	C3	C4	D
Global Warming Potential	kg CO2 eq.	0.0191	0.0396	0	0	-1.38
Ozone Depletion Potential	kg CFC11 eq.	1.32E-14	1.87E-13	0	0	3.92E-08
Acidification Potential	kg SO2 eq.	3.90E-05	1.38E-04	0	0	-0.00331
Eutrophication Potential	kg PO4 eq.	7.65E-06	2.97E-05	0	0	-1.05E-04
Photochemical Ozone Creation Potential	kg Ethene eq.	3.54E-06	-3.27E-05	0	0	-7.25E-04
Abiotic Depletion Potential (elements)	kg Sb eq.	2.12E-10	1.47E-09	0	0	-1.27E-05
Abiotic Depletion Potential (fossil)	MJ	0.264	0.545	0	0	-14.5

Parameters describing primary energy		C1	C2	C3	C4	D
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value	2.24E-04	0.0204	0	0	0.649
Use of renewable primary energy resources used as raw materials	MJ, net calorific value	0	0	0	0	0
Total use of renewable primary energy resources	MJ, net calorific value	2.24E-04	0.0204	0	0	0.649
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value	0.264	0.547	0	0	-13.1
Use of non-renewable primary energy resources used as raw materials	MJ, net calorific value	0	0	0	0	0
Total use of non-renewable primary energy resources	MJ, net calorific value	0.264	0.547	0	0	-13.1
Use of secondary material	kg	0	0	0	0	0.817
Use of renewable secondary fuels	MJ, net calorific value	1.31E-06	3.49E-06	0	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	1.37E-05	3.66E-05	0	0	0
Net use of fresh water	m^3	*	*	*	*	*

Other environmental information describing waste categories		C1	C2	C3	C4	D
Hazardous waste disposed	kg	*	*	*	*	*
Non-hazardous waste disposed	kg	*	*	*	*	*
Radioactive waste disposed	kg	*	*	*	*	*

Other environmental information describing output flows		C1	C2	C3	C4	D
Components for re-use	kg	0.0700	0	0	0	0
Materials for recycling	kg	0.930	0	0	0	0
Materials for energy recovery	kg	0	0	0	0	0
Exported energy	MJ per energy carrier	0	0	0	0	0

*Values not reported due to non-conformant upstream datasets

References

Athena 1997	Athena Sustainable Materials Institute, 1997. *Demolition Energy Analysis of Office Building Structural Systems.*
BRE 2012	Anderson, J., Adams, K. and Shiers, D., 2012. *Minimising the Environmental Impact of Construction Waste*. In press. BRE: Watford
BS EN 15804:2012	British Standards Institution, 2012. *BS EN 15804:2012 Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products. London: BSI*
EEF 2010	EEF, 2010. *UK Steel Key Statistics 2010.* EEF: London.
EMR 2006	European Metal Recycling, 2006. *Metals Recycling - UK ferrous scrap market.*
Eurofer 2012	*Eurofer survey of National Federation of Demolition Contractors (NFDC),* 2012. Survey data compiled by Tata Steel Europe RD&T. Rotherham, UK. http://www.steelconstruction.info/The_recycling_and_reuse_survey
worldsteel 2011	World Steel Association, 2011. *Life Cycle Inventory Study for Steel Products - Methodology Report.* Brussels: World Steel Association