LCA report | Traffic Beam Barrier 1450 mm & 2850 mm

Goal and scope

The goal of this study is to provide necessary data of the products *Traffic beam barrier 1450 mm* and *Traffic beam barrier 2850 mm* to gain insights into the environmental impacts that can work as a basis for decision making in order to reduce possible negative environmental impacts from the product.

The intended audience of this LCA are Ramudden Global, customers and other parties with an interest in the environmental impacts of this product.

Declared products

The declared products are Traffic beam barrier 1450 mm and Traffic beam barrier 2850 mm.

*Table 2: Content declaration of **Traffic beam barrier 1450 mm.***

Product components	Weight (kg)
Steel S235	57
Concrete C30	165
Zinc coating	3,5
Total	205

*Table 3: Product declaration of **Traffic beam barrier 2850 mm.***

Product components	Weight (kg)
Steel S235	102
Concrete C30	346
Zinc coating	7
Total	435

Declared unit

The declared unit of this LCA is 1 piece of product.

Reference service life

30 years.

Geographical scope

The LCA has been modeled for global raw material supply and Swedish sales. Therefore, it might not be applicable for sales outside of Europe.

Impact categories

The choice of impact categories is based on the obligatory indicators for construction products according to EN 15804+A2.

Table 4: Included impact categories.

Impact category	Subcategory
Global warming potential (GWP)	Fossil | Biogenic | Lans use and land use change | Total
Ozone depletion potential (ODP)	
Acidification potential (AP)	
Eutrophication potential (EP)	Aquatic freshwater | Aquatic marine | Terrestrial
Photochemical ozone creation potential (POCP)	
Abiotic depletion potential (APD)	Minerals and metals | Fossil fuels
Water deprivation potential (WDP)	

System boundaries

The choice of system boundaries is based on the obligatory modules for construction products according to EN 15804. This includes the product stage (A1-A3) which consist of raw material extraction and processing, processing of secondary material input e.g. recycling processes, transport to the manufacturer, manufacturing, and transport to customer. Future waste management (C1-C4) and its consequences outside the product lifecycle (D) has also been included.

Table 5: Description of system boundaries.

Module A1	Extraction and processing of raw materials; reuse of materials from previous product systems; processing of secondary materials; generation of electricity, steam, and heat from primary energy sources; energy recovery and other recovery processes from secondary fuels.
Module A2	Transportation to the factory gate and internal transport.
Module A3	Production of ancillary materials or pre-products; manufacturing of products and co-products; manufacturing of packaging. Transportation from factory to customer (Ramuddens depots).

End-of-life stage

Module C1	Deconstruction, including dismantling or demolition of the product.
Module C2	Transportation of the discarded product to the recycling site and final disposal.
Module C3	Waste processing e.g. collection of waste fractions from the deconstruction and waste processing of materials for reuse, recycling, and energy recovery.

Module C4	Disposal including physical pre-treatment and management of the disposal site.
Module D	Benefits and loads beyond the product system boundary, like secondary materials or fuels and raw material substitution.

LCA standard | Product category rules | Software & database

The standards that have been used are EN 15804+A2 for European construction products and the ISO standards 14040 and 14044.

The Product Category Rules (PCR) that has been used 2019:14 for construction products. The PCR provides requirements, guidelines and rules for an EPD of a specific product category.

This LCA has been conducted using the software SimaPro and the Ecoinvent 3 database.

Life cycle inventory analysis

Inventory of raw materials (A1)

The steel components are manufactured in China. A generic dataset from Ecoinvent 3 was used for the modeling of the material input. According to Worxsafe, recycled steel is used for the steel frame. However, secondary steel-production is often still supplemented with a high proportion of pig iron (40-50%) due to a deficiency of scrap iron on the market. Based on this, an assumed distribution of 40% pig iron and 60% iron scrap was made for the modelling of the steel components. The dataset was also modified by changing to Chinese conditions for input water and electricity mix. Specific zinc amount used for galvanization of the steel was also modelled in this dataset.

The concrete is also produced in China. A generic dataset from Ecoinvent 3 was used for the modeling of the material input. The dataset was modified by changing to specific amounts provided by Worxsafe, as well as changing to Chinese conditions for input water and electricity mix and global conditions for other input materials (as no Chinese datasets were available).

Transport (A2)

Generic datasets from Ecoinvent 3 have been used for the transportation. The transport has been calculated by ton-km, meaning that the weight of the goods being transported in tons has been multiplied by the distance transported in kilometers.

The steel is produced in Rizhao, China and then transported by truck to Qingdao, China, where the steel and concrete components are assembled. This has been modelled with generic datasets for global truck transport.

Manufacturing and transport to customer (A3)

The barriers are manufactured at the factory in Qingdao, China. The concrete is mixed in a concrete truck and then poured into molds where the concrete hardens. Specific energy quantity has been used for the mixing of concrete. This has been modelled with a generic dataset representing a Chinese energy mix.

The finished barriers are then transported by container ship from Qingdao, China to Gävle, Sweden. When the barriers arrive in Gävle they are transported by truck to the different depots. This was calculated as an average distance between Gävle and the different depots based on previous transports of the products between year 2020 and 2023. The distance was then multiplied by the wight of the goods being transported in tons. These

transports have been modelled with generic datasets for global container ship transport and European truck transport.

Deconstruction (C1)

No material or energy impacts are expected to occur in this module.

Transport to waste management (C2)

In the end-of-life stage the barriers can either be reused or recycled. The recycling can take place at different recycling facilities (Skanska, Stena, NCC), and therefore no definite transport distance can be determined. In order to create some sort of estimation of this transport, the transportation distance to waste management has been assumed to be 100 km. The locations for reuse of the barrier are also unknown and therefore the distance to reuse has been assumed to be 50 km.

Waste processing (C3)

When the barriers no longer meet the requirements for being used on roads due to traffic safety regulations, about 90% are sent for reuse to, for example, farms, ports, motorways, parking lots etc. The remaining 10% are sent to recycling. Generic datasets for waste management from Ecoinvent 3 have been used when modeling the scenario for recycling. These datasets are based European conditions.

Waste disposal (C4)

No material or energy impacts are expected to occur in this module.

Benefits and loads beyond the system boundary (D)

This module includes the avoided production of barriers due to reuse. As there is no specific time limit for how long the barriers can be reused, an assumption was made that they can be reused as long as their technical life length. Because of this, the environmental impacts from the production of steel and concrete were divided by half for 90% of the products, which is presented in module D.

Table 7: Inventory analysis for Traffic beam barrier 1450 mm and Traffic beam barrier 2850 mm.

	Material	Data description	Dataset	Data quality	Source
A1 - Raw material supply	Steel S235	Production and processing of steel produced in China.	Steel, unalloyed {RoW}| steel production, converter, unalloyed | Cut-off, U	Specific amounts modelled with generic dataset. Dataset has been modified by changing to water and electricity from China, and by changing the input of scrap iron to 60% and the input of pig iron to 40% to represent Chinese production of recycled steel.	Worxsafe | Ecoinvent v3 | Wang et al., (2023)

	Concrete C30	Production of concrete	Concrete, 37MPa {CH}| concrete production, 37MPa, for civil engineering, with cement, Portland | Cut-off, U	Specific amounts modelled with generic dataset. Dataset has been modified by changing to electricity from China and input materials representing global production instead of European, as well as removing the waste scenario as that has been modeled separately.	Worxsafe | Ecoinvent v3
	Zink coating	Galvanization of zinc	Zinc coat, coils {RoW}| zinc coating, coils | Cut-off, U	Specific amounts modelled with generic dataset. Dataset has been modified by changing to electricity from China and natural gas representing global production.	Worxsafe | Ecoinvent v3
A2- Transport	Transport by truck	Transportation of steel from Rizhao to Qingdao.	Transport, freight, lorry >32 metric ton, EURO6 {RoW}| transport, freight, lorry >32 metric ton, EURO6 | Cut-off, U	Specific transportation distance multiplied by the wight of the goods being transported in tons, modelled with generic dataset.	Worxsafe | Ecoinvent v3
	Transport by truck	Internal transport at manufacturing site in Qingdao.	Transport, freight, lorry >32 metric ton, EURO6 {RER}| transport, freight, lorry >32 metric ton, EURO6 | Cut-off, U	Specific transportation distance multiplied by the wight of the goods being transported in tons, modelled with generic dataset.	Worxsafe | Ecoinvent v3
A3 - Manufacturing	Electricity	Electricity used for the manufacturing in China.	Electricity, medium voltage {CN}| market group for electricity, medium voltage | Cut-off, U	Specific quantity modelled with generic dataset.	Worxsafe | Ecoinvent v3

	Transport by container ship	Transportation of barriers from Qingdao, China to Gävle.	Transport, freight, sea, container ship {GLO}|transport, freight, sea, container ship| Cut-off, U	Specific transportation distance multiplied by the wight of the goods being transported in tons, modelled with generic dataset.	Worxsafe | Ecoinvent v3
	Transport by truck	Transportation of the barriers from Gävle to the different depots in Sweden.	Transport, freight, lorry >32 metric ton, EURO6 {RER}| transport, freight, lorry >32 metric ton, EURO6 | Cut-off, U	Average transportation distance multiplied by the wight of the goods being transported in tons, modelled with generic dataset.	Worxsafe | Ramudden | Ecoinvent v3
C1 - Deconstruction	-	-	-	-	-
C2 – Transport to waste treatment	Transport by truck	Transportation to waste treatment. Assumed distance to recycling is 100 km, and assumed distance to reuse is 50 km.	Transport, freight, lorry >32 metric ton, EURO6 {RER}| transport, freight, lorry >32 metric ton, EURO6 | Cut-off, U	Assumed transportation distance multiplied by the weight of the goods being transported in tons, modelled with generic dataset.	Ramudden | Ecoinvent v3
C3 – Waste processing	Recycling of concrete	Material recycling of concrete.	Waste reinforced concrete {CH}| treatment of waste reinforced concrete, recycling | Cut-off, U	Specific amounts modelled with generic dataset.	Ramudden | Ecoinvent v3
	Recycling of steel	Material recycling of steel parts.	Waste reinforcement steel {CH}| treatment of waste reinforcement steel, recycling | Cut-off, U	Specific amounts modelled with generic dataset.	Ramudden | Ecoinvent v3
C4 – Waste disposal	-	-	-	-	-

D – Benefits and loads beyond the life cycle	Reuse of product	Avoided production of barriers resulting from reuse of the products.	No dataset used-calculated and modelled in Excel	Specific amounts modelled in Excel.	Ramudden

Results

Table 8: Result of the environmental impacts from Traffic beam barrier 1450 mm.

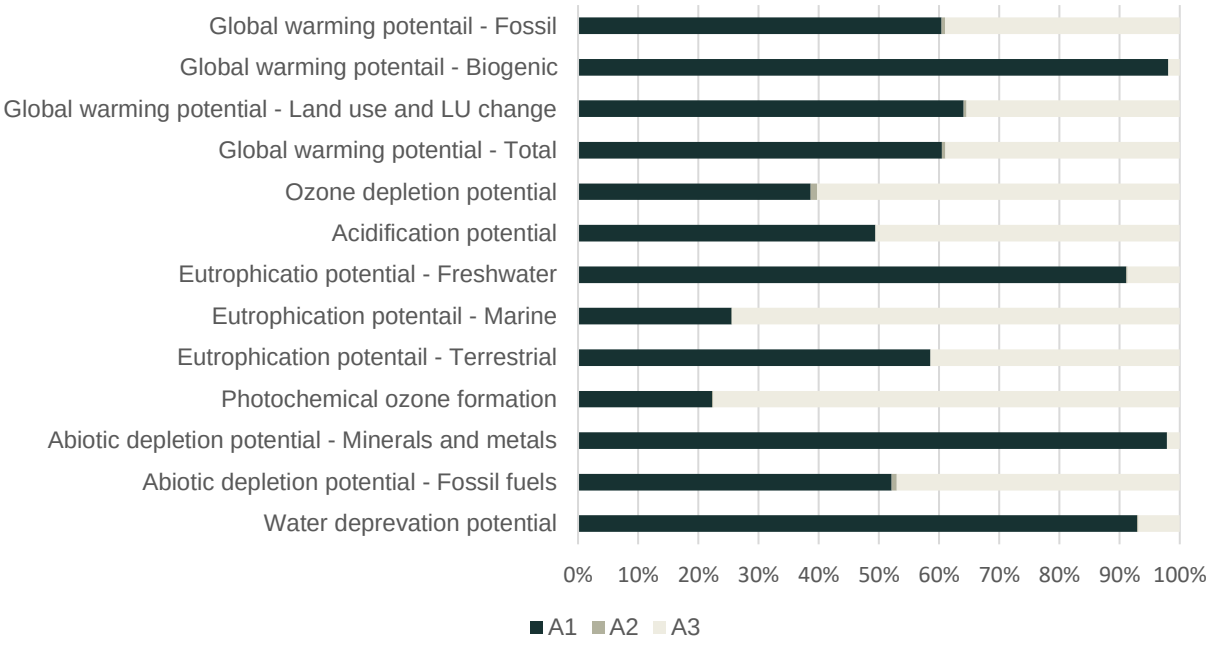
Indicator	Unit	A1-A3	C1	C2	C3	C4	D
Global warming potential - Fossil	kg CO2 eq	1,64E+02	0,00E+00	1,17E+00	4,30E-01	0,00E+00	-4,88E+01
Global warming potentail - Biogenic	kg CO2 eq	1,71E-01	0,00E+00	6,25E-04	4,70E-05	0,00E+00	-8,15E-02
Global warming potential - Land use and LU change	kg CO2 eq	9,01E-02	0,00E+00	4,14E-04	3,73E-05	0,00E+00	-2,81E-02
Global warming potential - Total	kg CO2 eq	1,64E+02	0,00E+00	1,17E+00	4,30E-01	0,00E+00	-4,89E+01
Ozone depletion potential	kg CFC11 eq	1,47E-06	0,00E+00	2,43E-08	6,58E-09	0,00E+00	-2,80E-07
Acidification potential	mol H+ eq	3,01E+00	0,00E+00	2,76E-03	3,88E-03	0,00E+00	-7,37E-01
Eutrophication potential - Freshwater	kg P eq	4,07E-02	0,00E+00	8,22E-05	1,26E-05	0,00E+00	-1,74E-02
Eutrophication potentail - Marine	kg N eq	4,83E-01	0,00E+00	7,24E-04	1,80E-03	0,00E+00	-6,35E-02
Eutrophication potentail - Terrestrial	mol N eq	1,03E+01	0,00E+00	7,83E-03	1,97E-02	0,00E+00	-2,93E+00
Photochemical ozone formation	kg NMVOC eq	1,41E+00	0,00E+00	4,79E-03	5,87E-03	0,00E+00	-1,61E-01
Abiotic depletion potentail - Minerals and metals	kg Sb eq	4,06E-03	0,00E+00	3,26E-06	1,53E-07	0,00E+00	-1,79E-03
Abiotic depletion potentail - Fossils fuels	MJ	1,69E+03	0,00E+00	1,75E+01	5,62E+00	0,00E+00	-4,46E+02
Water deprevation potential	m3 depriv.	4,04E+01	0,00E+00	8,35E-02	1,22E-02	0,00E+00	-1,73E+01
“E” means exponent (10^x). For example, 1,64E+02 means $1,64*10^2$ and can be read as 164.							

Table 9: Result of the environmental impacts from Traffic beam barrier 2850 mm.

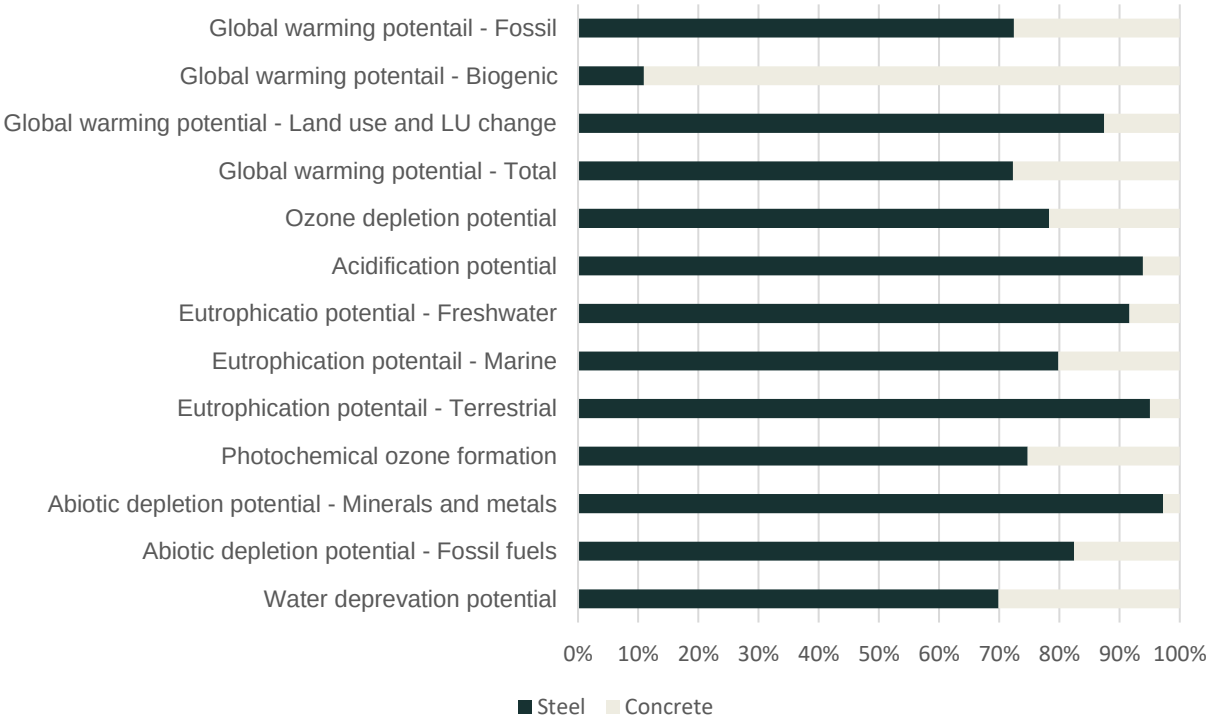
Indicator	Unit	A1-A3	C1	C2	C3	C4	D
Global warming potential - Fossil	kg CO2 eq	3,27E+02	0,00E+00	2,48E+00	7,81E-01	0,00E+00	-9,44E+01
Global warming potential - Biogenic	kg CO2 eq	3,98E-01	0,00E+00	1,33E-03	8,53E-05	0,00E+00	-1,89E-01
Global warming potential - Land use and LU change	kg CO2 eq	1,74E-01	0,00E+00	8,78E-04	6,78E-05	0,00E+00	-5,21E-02
Global warming potential - Total	kg CO2 eq	3,27E+02	0,00E+00	2,48E+00	7,81E-01	0,00E+00	-9,46E+01
Ozone depletion potential	kg CFC11 eq	2,98E-06	0,00E+00	5,17E-08	1,19E-08	0,00E+00	-5,31E-07
Acidification potential	mol H+ eq	5,89E+00	0,00E+00	5,85E-03	7,04E-03	0,00E+00	-1,34E+00
Eutrophication potential - Freshwater	kg P eq	7,53E-02	0,00E+00	1,74E-04	2,28E-05	0,00E+00	-3,19E-02
Eutrophication potentail - Marine	kg N eq	9,93E-01	0,00E+00	1,54E-03	3,27E-03	0,00E+00	-1,20E-01
Eutrophication potential - Terrestrial	mol N eq	1,98E+01	0,00E+00	1,66E-02	3,58E-02	0,00E+00	-5,28E+00
Photochemical ozone formation	kg NMVOC eq	2,92E+00	0,00E+00	1,02E-02	1,07E-02	0,00E+00	-3,10E-01
Abiotic depletion potential - Minerals and metals	kg Sb eq	7,29E-03	0,00E+00	6,92E-06	2,78E-07	0,00E+00	-3,21E-03
Abiotic depletion potential - Fossil fuels	MJ	3,36E+03	0,00E+00	3,72E+01	1,02E+01	0,00E+00	-8,41E+02
Water deprevation potential	m3 depriv.	7,86E+01	0,00E+00	1,77E-01	2,21E-02	0,00E+00	-3,35E+01

"E" means exponent (10^x). For example, 3,27E+02 means $3,27*10^2$ and can be read as 327.

Distribution of environmental impacts from modules A1-A3



Distribution of environmental impacts from module A1



Interpretation of results

The result shows that for most of the impact categories, the biggest environmental impacts come from the raw material supply in module A1. This is mainly caused by the Chinese steel production which is dependent on using coal as fuel for electricity and heat generation in the steel-making process. The transportations in module A3 also have a high impact. This is mainly due to the transportation of the barriers from China to Sweden which is a big contributor when it comes to Ozone depletion potential, Acidification potential, Eutrophication potential of marine and Photochemical ozone formation potential. For one category, GWP-biogenic, the production of concrete contributes to the biggest impact.

Compared to module A1-A3, the end-of-life modules C1-C4 does not have a high impact for any of the categories.

Recommendations

Based on the results from the LCA, some recommendations can be made in order to reduce the environmental impacts. Since the steel production is the biggest contributor to the environmental impacts, this would be the stage where the most significant changes could be made. As the steel frame is made of recycled material some efforts have already been made. However, the high impact seems to derive from the type of energy used for producing the steel which is mainly due to the use of coal in the Chinese electricity mix and steel-making process. Therefore, encouraging the steel supplier to use more electricity from renewable recourses or changing to a steel supplier who already uses more renewable energy would probably lead to a reduction of the environmental impacts.

Changing to a European steel producer would likely also reduce the impacts. Especially since the European steel sector uses electric arc furnaces (steel-making process based on electrical energy) to a greater extent, rather than the coal- and coke- based basic oxygen blast furnaces. As well as renewable energy to a greater extent. Since the transportation of the barriers from China to Sweden was another big contributor to the environmental impacts, this is also a reason for changing to a European steel supplier.

Appendix

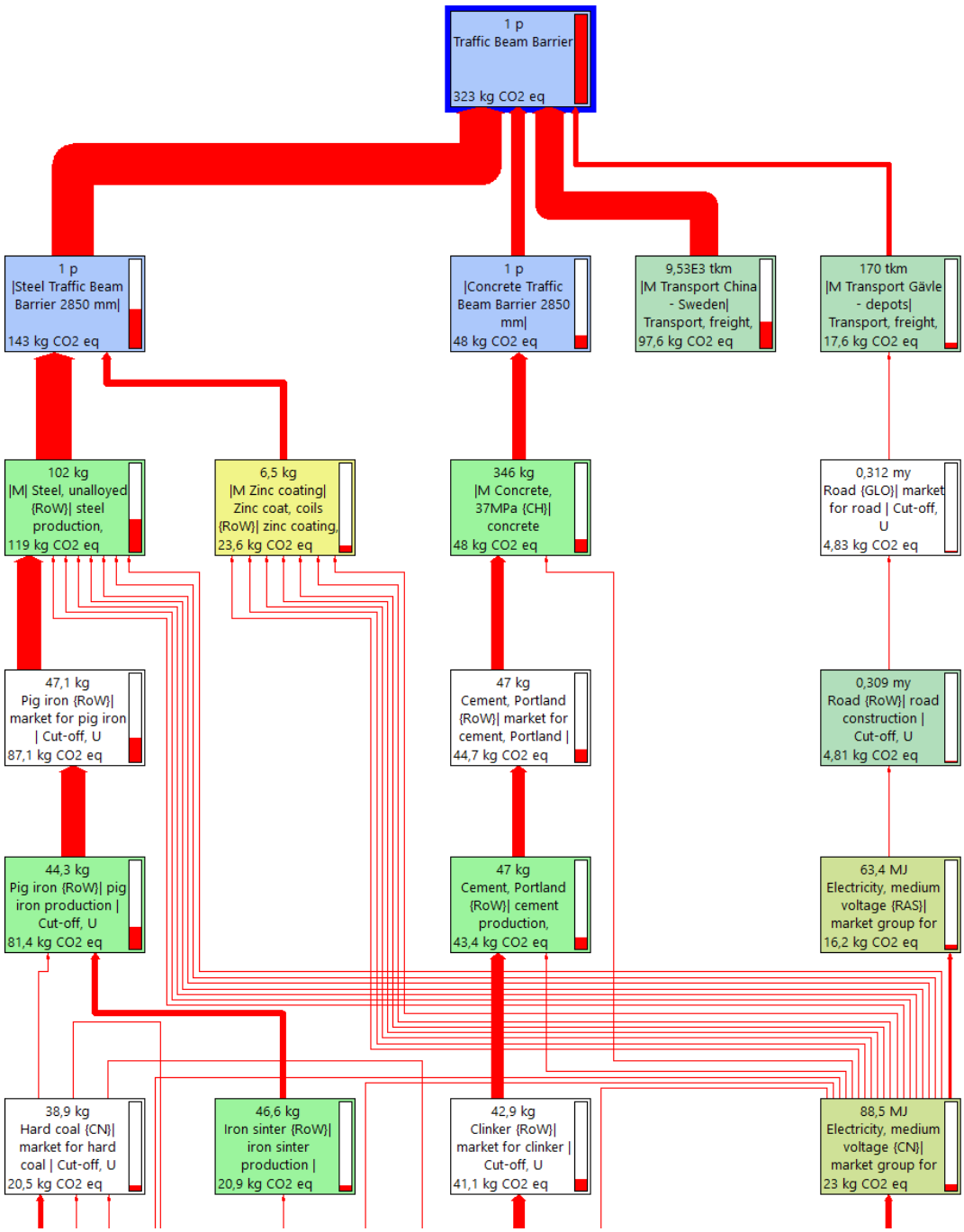



Figure 1: Network showing the distribution of the input materials impact on global warming potential.