LCA report | ProTec 100 6m

Goal and scope

The goal of this study is to provide necessary data of the product *ProTec 100 6m* 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 product

The declared product is *ProTec 100 6m.*

Table 1: Product declaration of ***ProTec 100 6 m.***

Product components	Weight (kg)
Steel	166,6
Concrete	582
Rubber	1,4
Zink coating	6,226
Total	756

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.

Table 2: 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 (except for module D that has been excluded due to no expected impacts). 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 with modules C1-C4 has also been included.

Table 3: 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.

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 Čačak, Serbia. A generic dataset from Ecoinvent 3, representing the steel grade used for ProTec has been used for the modeling of the material input. The dataset has been modified by changing to specific amounts of steel provided by AVS Services, as well as changing to Serbian conditions for energy mix and water input. The dataset was also modified by changing to 10% recycled steel input in accordance with the information provided by the steel factory. Specific zinc amounts used for galvanization and specific steel amounts used for welding were also modelled in this dataset.

The concrete and rubber are produced in Overath, Germany. Generic datasets from Ecoinvent 3 were used for the modeling of the material inputs. The datasets have been modified by changing to specific amounts of material provided by AVS Services, as well as changing to German conditions for the electricity mix.

Transports (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 Čačak, Serbia and then transported by truck to Overath, Germany where the final product is assembled. This has been modeled with a generic dataset for European truck transport representing Euroclass 6 in accordance with information provided by the steel factory in Serbia.

The concrete and rubber are produced by a local supplier in near connection to the production site in Germany where the final product Is assembled. Therefore, this transport has been excluded from the assessment.

Manufacturing (A3)

The barriers are manufactured in Overath, Germany. When the concrete arrives to the production site it is ready-mixed and poured into casting molds where the concrete hardens. Therefore, no energy impacts are expected to occur in this stage.

This module also includes the transports from the production site in Germany to the different depots located in Sweden. This was calculated as an average distance between Overath, Germany and the different depots based on previous transports of the product between year 2021-2024.

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 are sent to recycling. The recycling can take place at different recycling facilities (Skanska, NCC) where the materials are crushed and then recycled. Because of this, no definite transport distance can be determined. In order to create some sort of estimation of this transport, the transport distance to waste management has been assumed to be 100 km.

Waste processing (C3)

This stage includes concrete crushing and the recycling of concrete and steel.

Waste disposal (C4)

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

Table 4: Inventory analysis for ProTec 100 6 m.

	Material	Data description	Dataset	Data quality	Source
A1 – Raw material supply	Steel S235	Production of steel	Steel, unalloyed {RER}| steel production, converter, unalloyed | Cut-off, U	Specific amounts modelled with generic dataset. Dataset has been modified by changing to electricity and water from Serbia, and by changing the material input to 10% recycled steel.	AVS | Ecoinvent v3
	Concrete C30/37	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 Germany.	AVS | Ecoinvent v3
	Zink coating	Zinc coating	Zinc coat, coils {RER}| zinc coating, coils | Cut-off, U	Specific amounts modelled with generic dataset. Dataset has been modified by changing to electricity and water from Serbia.	Unipromet | Ecoinvent v3

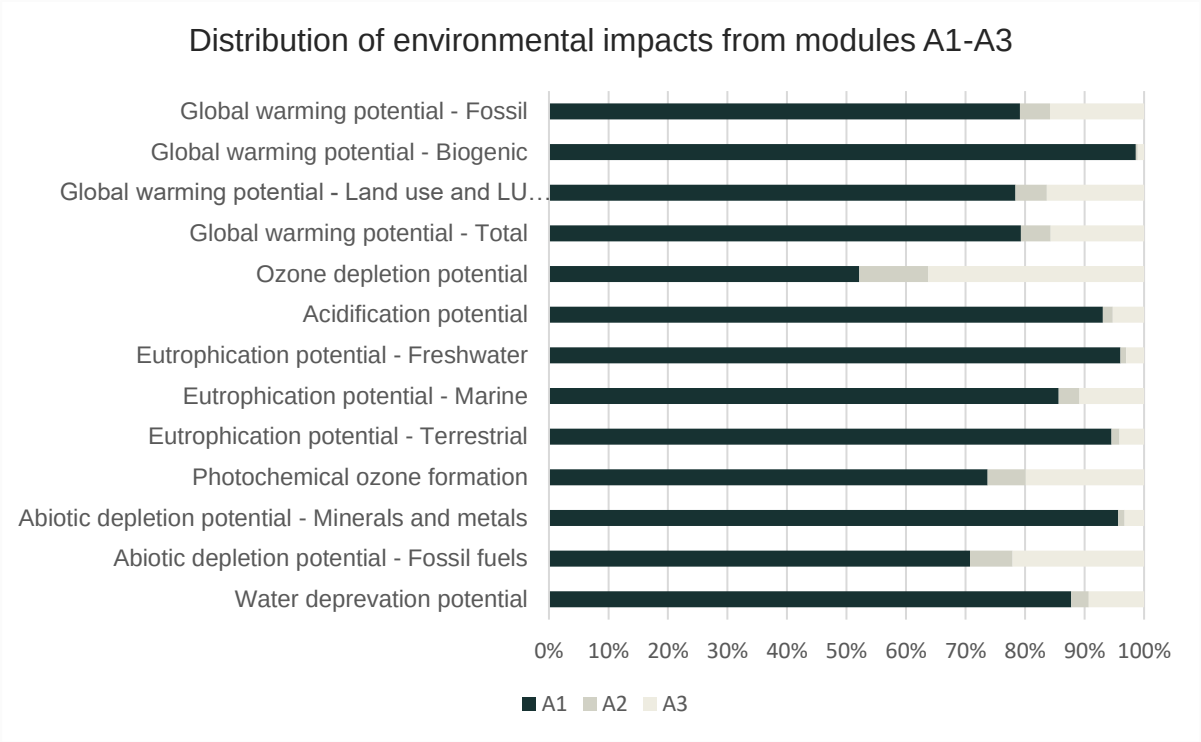
	Welding	Welding of steel parts	Welding, arc, steel {RER}| welding, arc, steel | Cut-off, U	Specific amounts modelled with generic dataset. Dataset has been modified by changing to electricity from Serbia.	Unipromet | Ecoinvent v3
	Rubber	Production of rubber	Synthetic rubber {RER}| synthetic rubber production | Cut-off, U	Specific amounts modelled with generic dataset. Dataset has been modified by changing to electricity from Germany.	AVS | Ecoinvent v3
A2 - Transport to manufacturer	Transport by truck	Transportation of steel from Čačak, Serbia to Overath, Germany	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.	Unipromet | Ecoinvent v3
A3 - Manufacturing	Transport by truck	Transport of barriers from Germany 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.	Ramudden | Ecoinvent v3
C1 - Deconstruction	-	-	-	-	-
C2 – Transport to waste management	Transport by truck	Transportation to waste treatment. Assumed distance to recycling is 100 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 concrete, not reinforced {Europe without Switzerland} | treatment of waste concrete, not reinforced, recycling | Cut-off, U	Specific amount modelled with generic dataset.	Ramudden | Ecoinvent v3

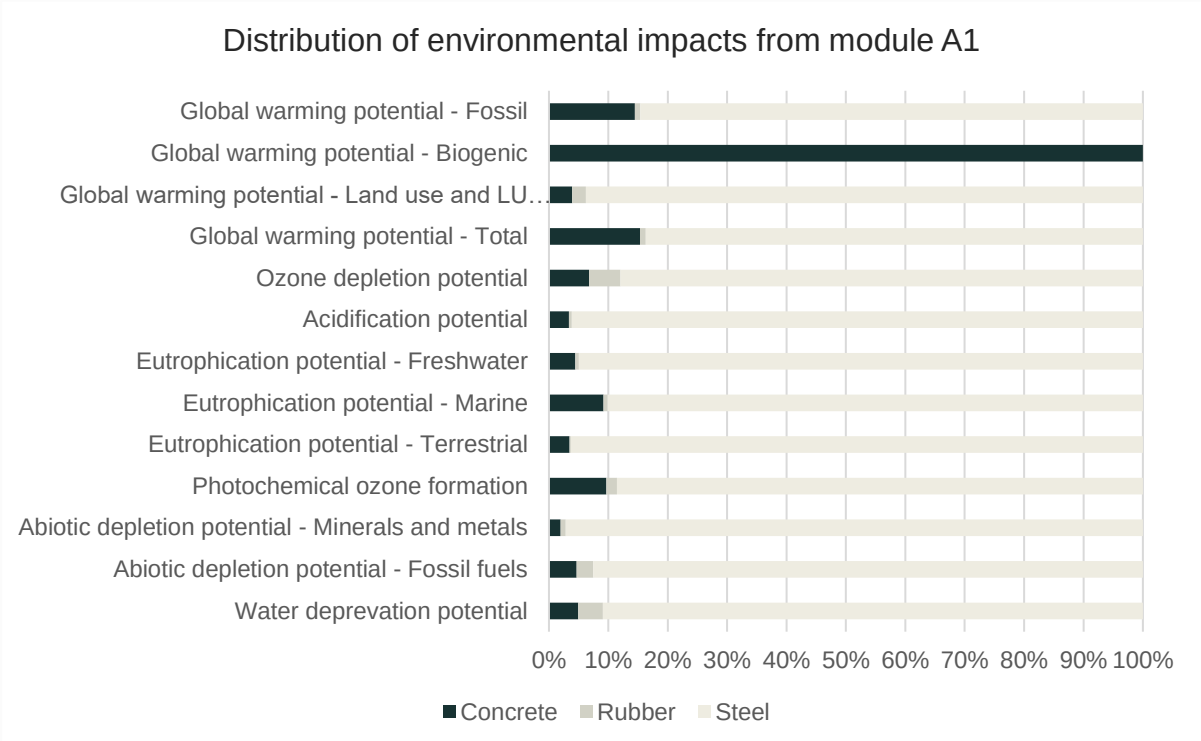
	Recycling of steel	Material recycling of steel	Waste reinforcement steel {CH}| treatment of waste reinforcement steel, recycling | Cut-off, U	Specific amounts modelled with generic dataset.	Ramudden | Ecoinvent v3
C4 – Waste disposal	-	-	-	-	-

Results

Table 5: Result of the environmental impacts from ProTec 100 6m.

Indicator	Unit	A1-A3	C1	C2	C3	C4
Global warming potential - Fossil	kg CO2 eq	5,34E+02	0,00E+00	7,83E+00	1,30E+01	0,00E+00
Global warming potential - Biogenic	kg CO2 eq	4,26E+00	0,00E+00	4,19E-03	1,42E-03	0,00E+00
Global warming potential - Land use and LU change	kg CO2 eq	1,83E-01	0,00E+00	2,78E-03	1,13E-03	0,00E+00
Global warming potential - Total	kg CO2 eq	5,39E+02	0,00E+00	7,84E+00	1,30E+01	0,00E+00
Ozone depletion potential	kg CFC11 eq	4,86E-06	0,00E+00	1,63E-07	1,99E-07	0,00E+00
Acidification potential	mol H+ eq	3,80E+00	0,00E+00	1,85E-02	1,17E-01	0,00E+00
Eutrophication potential - Freshwater	kg P eq	1,97E-01	0,00E+00	5,51E-04	3,80E-04	0,00E+00
Eutrophication potential - Marine	kg N eq	4,81E-01	0,00E+00	4,85E-03	5,44E-02	0,00E+00
Eutrophication potential - Terrestrial	mol N eq	1,36E+01	0,00E+00	5,25E-02	5,96E-01	0,00E+00
Photochemical ozone formation	kg NMVOC eq	1,74E+00	0,00E+00	3,21E-02	1,78E-01	0,00E+00
Abiotic depletion potential - Minerals and metals	kg Sb eq	7,19E-03	0,00E+00	2,19E-05	4,64E-06	0,00E+00
Abiotic depletion potential - Fossil fuels	MJ	5,73E+03	0,00E+00	1,18E+02	1,70E+02	0,00E+00
Water deprevation potential	m3 depriv.	6,51E+01	0,00E+00	5,60E-01	3,68E-01	0,00E+00
"E" means exponent (10^x). For example, 5,34E+02 means $5,34*10^2$ and can be read as 534.						


Distribution of environmental impacts from modules A1-A3
Global warming potential - Fossil
Global warming potential - Biogenic
Global warming potential - Land use and LU…
Global warming potential - Total
Ozone depletion potential
Acidification potential
Eutrophication potential - Freshwater
Eutrophication potential - Marine
Eutrophication potential - Terrestrial
Photochemical ozone formation
Abiotic depletion potential - Minerals and metals
Abiotic depletion potential - Fossil fuels
Water deprevation potential
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
A1 A2 A3


Distribution of environmental impacts from module A1
Global warming potential - Fossil
Global warming potential - Biogenic
Global warming potential - Land use and LU…
Global warming potential - Total
Ozone depletion potential
Acidification potential
Eutrophication potential - Freshwater
Eutrophication potential - Marine
Eutrophication potential - Terrestrial
Photochemical ozone formation
Abiotic depletion potential - Minerals and metals
Abiotic depletion potential - Fossil fuels
Water deprevation potential
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Concrete Rubber Steel

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, and especially the steel production which has the highest impact on all of the categories expect for GWP-biogenic where the production of concrete has the highest impact. The high environmental impact from the steel production is mainly caused by the high content of pig iron as the steel only consist of 10% recycled input. The transportation of the barriers from Germany to Sweden (A3) also have a relatively high impact on ozone depletion potential. Compared to module A1-A3, the end-of-life modules C1-C4 does not have a very high impact on 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. The high impact mostly derives from the high content of pig iron, which could be reduced by using more scrap iron instead.

By using recycled steel for the barriers, an electric arc furnace can be used for the steel-making process instead of the basic oxygen blast furnaces, which would likely decrease the environmental impacts significantly, especially if renewable energy is used.

Appendix

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