ENVIRONMENTAL AND HEALTH DECLARATION DATASHEET

Techno Metal Post™ – P4-16 model, galvanized metal posts

In accordance with NF EN ISO 14025, NF EN 15804+A1 and companion standard NF EN 15804/CN

Techno Pieux
1700 Setlakwe St.
Thetford Mines QC G6G 8B2
Canada

May 1st, 2020

Foreword

The information contained in this declaration are provided under the responsibility of Techno Pieux. This environmental production declaration is in accordance with NF EN ISO 14025, NF EN 15804+A1 and associated standard NF EN 15804/CN. Techno Pieux commissioned Charles Thibodeau and Julien Walzberg of CT Consultant to carry out this FDES (Environmental and Health Declaration Datasheet).

Techno Pieux and CT Consultant do not accept any responsibility to any party to which the study results have been communicated or any party having otherwise obtained the results. The use of the results falls under the responsibility of the user.

Any use, in whole or in part, of the information provided in this document must at a minimum be accompanied by the complete reference to the original FDES as well as its producer who could provide a complete copy.

We recall the study results are based only on facts, circumstances and assumptions that have been submitted us over the course of the study. If these facts, circumstances and assumptions differ, the results are subject to change. Furthermore, the study results should be considered as a whole with regard to the assumptions and should be considered in isolation.

The CEN standard EN 15804+A1 utilises the product category rules (PCR).

Throughout the text, the term *metal post* or *galvanized metal post* covers a “galvanized metal post manufactured by Techno Pieux ™, model P4-16”.

Reader’s guide

The presentation of the inventory data meets the requirements of standard NF EN 15804+A1.

Some information on data formatting

Certain values are provided in scientific notation such as the example below:

4,0E+01 = $4{,}0 \times 10^{1}$

Data format guidelines

In the rest of the document

- When the result of a calculation is zero, the value zero is written
- All non-zero values are expressed with 3 significant digits.

Abbreviations

ELCD: European reference Life Cycle Database

EPD: Environmental Product Declaration

FDES: Environmental and Health Declaration Datasheet (Fiche de Déclaration Environnementale et Sanitaire)

FU: Functional Unit

HDPE: High Density Polyethylene

LCA: Life Cycle Assessment

LHV: Lower Heating Value

RSL: Reference Service Life

Caution in using FDES for product comparison

Construction product FDES can be incomparable if they do follow the guidelines of the NF EN15804+A1 standard.

The NF EN 15804+A1 standard defines in article *5.3 Comparability of FDES** *for construction production, conditions in which construction products can be compared on the basis of information provided in the FDES:*

"A comparison of construction production environmental performance using information from EPD must be based on the usage of the products and their impacts on the building and must take in account the entire life cycle (all information modules)."

*Note 1 of the foreward of the national supplementary information defines *"…in France, the term FDES (Environmental and Health Declaration Datasheet or Fiche de Déclaration Environnementale et Sanitaire) is used that combines Environmental Declaration and Health Information of the products covered under a given FDES. As such, FDES is an EPD with additional health information."*

General information

1. Producer of the FDES

The information contained in this declaration are provided under the responsibility of Techno Pieux.

Techno Pieux https://www.technopieux.com
1700 Setlakwe street
Thetford Mines QC G6G 8B2
Canada

info@technopieux.com

2. Representativeness of the FDES

The producer of the metal post is:

- Techno Pieux https://www.technopieux.com
  1700 Setlakwe Street, Thetford Mines, Quebec, G6G 8B2, Canada

The regions and countries within which the FDES is application are the following:

- Europe, the United States of America and Canada.

3. Type of FDES

This individual FDES covers the product life cycle from cradle-to-grave.

4. Validity of the FDES

This FDES is an individual declaration. It is only applicable for galvanized metal posts produced by Techno Pieux. It includes all types of galvanized metal posts (e.g. wall thickness, length of tubes and length of helixes) produced by Techno Pieux. Non-galvanized metal posts produced by Techno Pieux are covered under a separate FDES.

The FDES was carried out within the framework of the environmental and health declaration programme for construction products, or Programme FDES – INIES managed by INIES (www.inies.fr).

5. Review of the FDES

This FDES was subject to a peer review conducted by Naeem Adibi (WeLOOP), authorised reviewer of Environmental and Health Declaration in the construction sector by INIES (in France). The review report and certification are available from Techno Pieux on demand.

The CEN EN 15804 standard uses PCR[a]	
External independent review of the declaration and data, in compliance with EN ISO 14025:2010.	
Third party review[b]:	
Dr. Naeem Adibi WeLOOP Base 11/19, pépinière d'éco-entreprises, rue Léon Blum 62750 Loos-en-Gohelle, France	T : +33 6 45403877 Email: n.adibi@weloop.org Website : www.weloop.org
[a] Product category rules. [b] Optional for business-to-business communication, mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4).	

6. Publication date and expiry date

This FDES was published in May 2020 and will be valid for a period of 5 years.

7. Products covered by FDES

This FDES covers the galvanized model P4-16 metal post produced by Techno Pieux™ in Canada and sold to consumers in North America and Europe through a network of dealers.

• Description of the functional unit (or declared unit) and the product

1. Functional unit (FU)

Using a galvanized model P4-16 metal post (44.8 kg), in achieving a specific load-bearing capacity (compression, shear, flexion), for a reference lifetime of 100 years.

2. Product description

Techno Pieux galvanized metal posts with high density polyethylene (HDPE) sheathing are screwed metal posts allowing for a desired load-bearing capacity for a given construction project. They also allow for the establishment of necessary foundations for construction work. One galvanized metal post consists of 89% steel, 10% zinc and 1% HDPE on a mass basis.

One metal post consists of a steel tube equipped with one or more steel spiral helixes (adapted from Techno Pieux, 2018). A steel plate and other accessories are also used to affix the metal post. A galvanisation process is subsequently applied. When the depth required to achieve the desired load-bearing capacity is greater than the length of the metal post, one or more extensions can be used. An extension consists of a tube without a helix and with HDPE sheathing.

Techno Pieux manufactures several models and dimensions of galvanized metal posts and extensions. The length of one metal post or extension is 2-3 metres, with the diameter varying between 48.3-168.3 mm. The reference flow considered for this FDES is a 2 m-long galvanized metal post with a diameter of 101.6 mm with a total mass of 44.8 kg.

3. Description of product use

The metal posts can form part of the necessary foundations for many types of construction projects. The supported structures can be residential (house, cottage, etc.), touristic (flags, insignia, etc.), in the energy sector (solar panel structures), infrastructure projects (footbridge) or industrial and commercial (machinery, offices).

4. Main performance of the FU

The galvanized model P4-16 metal post allows for up to load-bearing capacities of 200 kN of compression, 100 kN of tension and 12 kN of lateral capacity.

5. Other technical characteristics not included in the functional unit

A secondary function of the product is to contribute to the aesthetic of the supported structure.

6. Description of the main components and/or product materials

- Main product:
  -44.2 kg galvanized steel
  -0.6 kg HDPE
- Additional products for installation (at reference flow scale):
  -Welding rod: 0.02 m
- Distribution packaging (at reference flow scale):
  -Wooden cases: 2,0E-03 kg
  -Steel barrels: 5.1E-02 kg
  -Steel racks: 6.0E-01 kg

7. REACH regulation

This product does not contain any substances on the REACH regulation candidate list of substances that have concentrations greater than 0.1% by mass.

8. Description of the reference lifetime

The reference service life (RSL) is 100 years. The RSL of metal posts is based on the ICC-ES AC-358 evaluation criteria (International Council Code) and on a corrosion thickness of 1.5 mm.

Parameter	Value
Reference service life	100 years
Product declared properties (at factory gate), finishings, etc.	The galvanized model P4-16 metal post allows for up to load-bearing capacities of 200 kN of compression, 100 kN of tension and 12 kN of lateral capacity.
Theoretical application parameters (if imposed by the manufacturer), including references to appropriate practices.	Not applicable
Presumed quality of work, when installation conforms to manufacturer instructions	No product loss during installation in compliance with manufacturer instructions
Outdoor environment (for outdoor applications), for example, inclement weather, pollutants, exposure to UV and wind, building orientation, shade, temperature	Not applicable
Indoor environment (for indoor applications), for example, temperature, humidity, exposure to chemical products	Not applicable
Conditions of use, for example, frequency of use, mechanical exposure	Not applicable
Maintenance, for example, required frequency, type and quality and replacement of replaceable components	Not applicable

• Life cycle modules

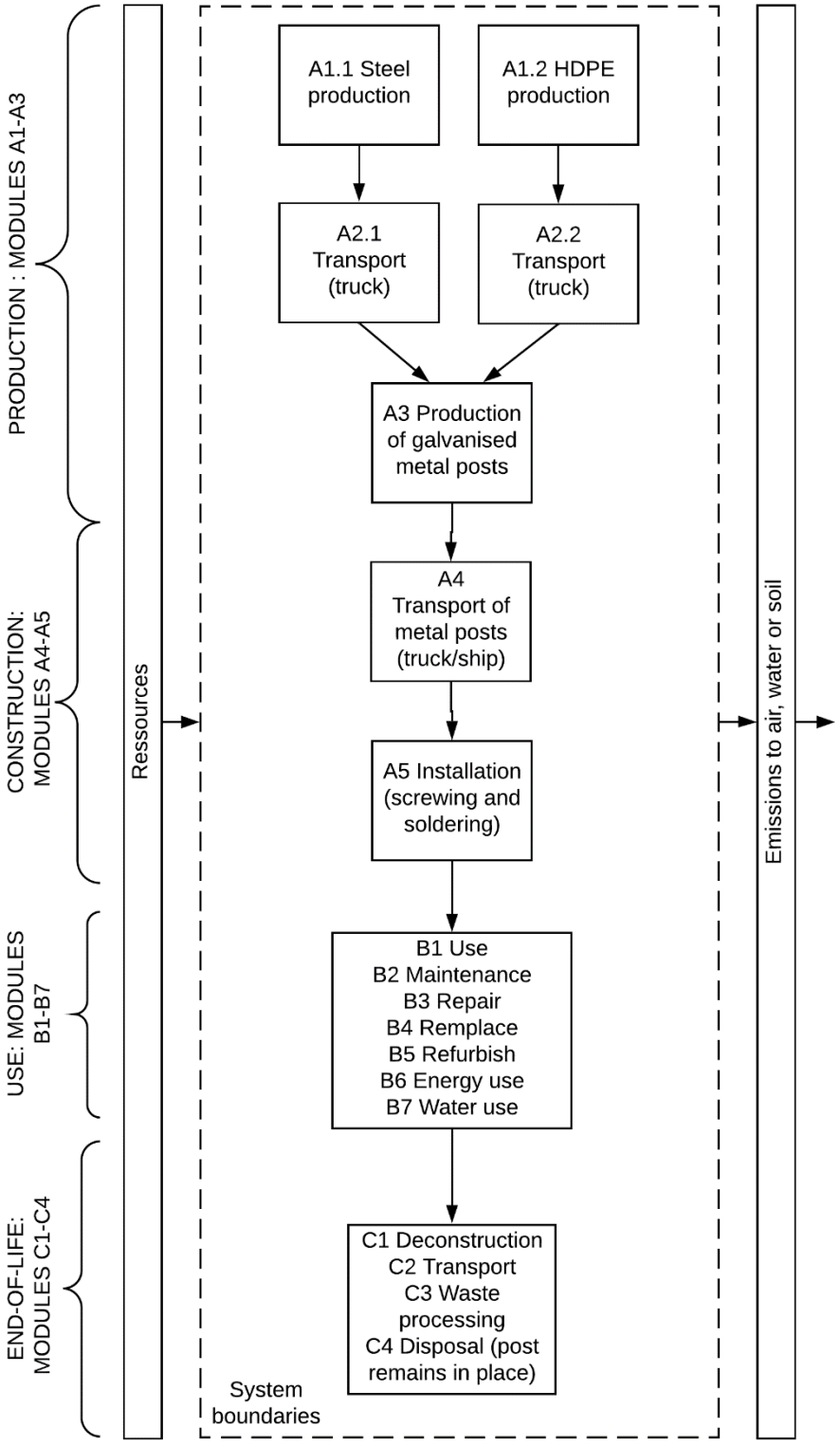

Figure 1 – Life cycle of Techno Pieux P3-P10 galvanized metal post

- **Product stage, A1-A3**

  - Production module A1 covers raw material sourcing. For the P4-16 metal post, this consists of steel production (for metal post tube and helix) and the production of high-density polyethylene (HDPE) for the post sheathing.

    The steel used is certified ASTM A500C, CAN/CSA-G40.21-98 and CSA W47. It is produced using a mix of primary steel (52%) and secondary steel (48%). Primary steel is sourced from mills using Blast Oxygen Furnace (BOF) or Linz-Donawitz processes and is produced using iron ore and coke. The extraction of the raw materials (iron ore, coke, etc.), their transport and the production of steel are considered. Secondary steel is sourced from mills using electric arc furnaces (EAF) and is mostly produced using steel scrap. The average proportions of recycled content pre- and post-consumption is 29% and 89% for the BOF and EAF processes, respectively.

  - Transport module A2 consists of raw material transport. The means of transport, quantities transported, the distances and the loads for road transport are provided by Techno Pieux. According to the company, HDPE is transported from Mississauga, Ontario to Thetford Mines, Quebec by tractor trailer. The steel originates from Canadian mills, situated in Ontario and is transported by tractor trailer to the metal posts production plant in Thetford Mines. A weighted average of the steel provided by each mill was used to calculate the transport distance for the steel.

  - Manufacturing module A3 consists of the production of the tube (sub-contractor to Techno Pieux), the production and positioning of the helix and the cutting and assembly of the metal post in the Techno Pieux plants in Thetford Mines. At this stage, the steel racks and accessories (e.g. fixing plate) are produced. This module includes the return transport to the galvanisation plant by transport truck, as well as the galvanization process itself. This module includes the emissions to air related to the combustion of fuel (natural gas for heating facilities, oxyfuel for cutting and welding for post production), and waste generation. The production of fuels and consumed electricity for manufacturing the posts is also included in this module. Steel scrap produced during product manufacturing account for an average of 0.11kg/kg finish product (metal post, rack, accessories), which is covered for recycling. Furthermore, manufacturing requires the use of a liquid coolant whose fate is the sewage system. These emissions are considered within the framework of this FDES.

- **Construction process stage, A4-A5**

  - Transport module A4 corresponds to the transport of metal posts from the manufacturing site to the construction site. The modelling takes into account the fuel production and combustion for transport, as well as the construction of the road. No product loss (post) takes place during transport.

    For metal post distribution, the scenario used is based on actual company sales for the year 2017 in North America and Europe. The distances provided in the table below represent the weighted average of distances to the final customer, in terms of mass sold.

Transport to the construction site:

Parameter	Value
Type of vehicle used for transport	The vehicles concerned are 16-32 tonne Euro 5 trucks, 3.5-7.5 tonne Euro 5 trucks and container ships.
Distance to construction site	1125 km by truck and 4880 km by ship
Loading capacity	50% for 16-32 tonne Euro 5 trucks and 33% 3.5-7.5 tonne Euro 5 trucks
Volumetric mass of transported products	397 kg/m^3
Use coefficient for volumetric capacity	NA

- Installation module A5 considers the installation of the metal post in the ground ready to build on. The modelling considers the manufacturing as well as the consumption of energy resources used by the installation machine for affixing the post to the ground. Diesel consumption for the installation machine was obtained from Techno Pieux, which was 3.3 litres per FU. A solder with accessories and optional post extensions has been considered. The average amounts of solders and electricity used are 2.47E-02 kg and 1.27E-02 kWh, respectively. As such, there is no gas used during welding. There is no product loss associated with installation.

Installation of metal post :

Parameter	Value
Auxiliary inputs for installation	2.47E-02 kg solder
Water use	0 m^3
Use of other resources	0 kg
Quantitative description of energy type and consumption during installation process.	1.27E-02 kWh electricity et 3.3 litres diesel consumed
Waste produced on construction site before treatment of waste generated by product installation	0 kg
End-of-life packaging	100% packaging is recycled
Direct emissions to air, soil and water	0 kg

- **Use stage, B1-B7**
  - During the use stage, the metal post does not require any interventions. Modules B1 to B7 are assigned values of zero in the results tables for the life cycle assessment.
- **End-of-life stage, C1-C4**
  - During the end of life, the metal post remains in place in the ground. This procedure corresponds to the disposal module C4. During the end-of-life of the post, no energy or material inputs are

required. However, the post will be subjected to a leaching process during this life cycle stage, releasing metals (mostly ionic iron and zinc) and particles of HDPE in the ground. These emissions are similar to those occurring when metals and plastics are disposed in landfills and were modelled accordingly.

- Other than the fact that the metal post remains in the ground, the metal post does not require any other processes during the end-of-life. Modules C1 to C3 are assigned values of zero in the results tables for the life cycle assessment.

- **Reuse, recovery and/or recycling potential, D**
  - During end-of-life, the metal post remains in place in the ground. It is therefore not possible to reuse, recover or recycle the metal post and as such Module D is assigned a value of zero in the results tables for the life cycle assessment.

Life cycle stage

Information for calculating the life cycle assessment

PCR used	ISO 14040:2006 ISO 14044:2006 ISO 14025 standard NF EN 15804+A1 et associated national standard NF EN 15 804/CN
System boundaries	The life cycle assessment is from cradle-to-grave. The system boundaries are from the production of raw materials and energy to the end-of-life of the product. Module D (optional according to NF EN 15804) is not included in the assessment. In compliance with the NF EN 15804+A1 standard, all processes where the mass or the energy flow accounts for more than 1% of the cumulative total of mass and/or energy of the posts are included. In addition, at least 95% of the mass and energy flows from each life cycle module (A1-A3, A4-A5, B1-B7, C1-C4) has been considered. However, due to their marginal contributions to the results, the following processes have been excluded: - Manufacturing process materials - Maintenance of manufacturing processes (consumption of oil, water, etc.) - General maintenance of production plants (water and detergent consumption) - Plant administration (paper use, electronics, etc.) - Employee transport to plants - Materials used within galvanisation plant - Storage of posts (mostly stored outdoors) - Transport of packaging at end-of-life
Allocation	No multifunctional processes were considered throughout the life cycle of Techno Pieux.

Geographical and temporal representativeness of primary data	The primary data used in this LCA correspond to the data collected from Techno Pieux. These primary data were collected by way of an Excel questionnaire, a visit of the plant in Thetford Mines and several discussions with the director general of Techno Pieux. **Product stage – Modules A1-A3** - Year: 2017 - Geographical representativeness: Quebec, Canada - Technological representativeness: data corresponds to technologies used by Techno Pieux and its suppliers (Canadian steel) - Source: Techno Pieux **Construction process stage – Modules A4-A5** - Year: 2017 - Geographical representativeness: North America and Europe - Source: Techno Pieux **Use stage – Modules B1-B7** - Not applicable **End-of-life stage – Module C4** - Year: 2017 - Geographical representativeness: North America and Europe - Source: Techno Pieux, based on the assumption that all metal posts remain in the ground at their end-of-life
Secondary data sources	Secondary data are the data obtained from other sources than those collected from Techno Pieux. **Secondary database:** - Year: 2017 - Geographical representativeness: Canada, Quebec, Europe, United States - Source: Ecoinvent v3.4 (ecoinvent center) **Main data records used:** - *Steel production in an electric arc furnace (A1)*: 2009, steel production, electric, low-alloyed | steel, low-alloyed | Cutoff, U – and adaptation of energy consumption to correspond to rate of 89% recycled content (case of steel tubes) according to Yellishetty et al., 2011. - *Production of steel with Linz-Donawitz process (blast furnace) (A1):* 2009, steel production, converter, unalloyed | steel, unalloyed | Cutoff, S – and adaptation of emissions related to climate change and photochemical ozone formation impacts to correspond to the 29% recycled content rate (case of steel tubes) according to WorldSteel, 2017.

	- *Quebec electricity grid mix (powering Techno Pieux plant – A3)*: 2014, market for electricity, low voltage | electricity, low voltage | Cutoff, U - CA-QC - *Ontario electricity grid mix (steel production) (A1)*: 2014, market for electricity, low voltage | electricity, low voltage | Cutoff, U - CA-ON
Variability of results	The variability (uncertainty) of the results is between 10 and 30% depending on the indicator.
Reproducibility of results	The openLCA software version 1.8.0 developed by GreenDelta was used to carry out the modelling of the elementary processes included in the life cycle of the metal post (life cycle inventory stage) OpenLCA and the method EN 15804 2012 English (based on the CML (baseline) v4.4 (2015) method and available on the openLCA site) were used to calculate the impacts and the inventory indicators (life cycle impact assessment stage) The indicators air pollution and water and soil pollution were calculated in an Excel spreadsheet using elementary flows scaled to the FU and the characterisation factors and the conversion of the associated national standard NF EN 15804/CN (Annexes C and J).

• Life cycle assessment results

Table 1 below presents the modules that are declared and non-declared in the FDES: life cycle assessment of galvanized metal post, from cradle-to-grave, all modules (A1 to C4) are declared in the FDES.

Table 1

Product stage			Construction process stage		Use stage							End-of-life stage				Total life cycle	D Benefits and loads beyond the system boundary
A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Remplacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal		
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

X = life cycle modules included in LCA

Table 2 presents environmental indicator results for all the modules considered in the life cycle of the galvanized P4-16 metal post. The results are also shown for the functional unit: *Using a galvanized model P4-16 metal post (44.8 kg), in achieving a specific load-bearing capacity (compression, shear, flexion), for a reference lifetime of 100 years.*

Table 2

Environmental impacts	Product stage				Construction process stage			Use stage								End-of-life stage					Total life cycle	D Benefits and loads beyond the system boundary
	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**		
Abiotic resource depletion (fossil fuels) MJ/FU	7.70E+02	1.27E+02	2.67E+02	1.16E+03	1.88E+02	1.71E+02	3.59E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.03E+00	7.03E+00	1.53E+03	NA
Abiotic resource depletion (elements) kg Sb eq/FU	6.28E-05	2.51E-05	3.82E-03	3.91E-03	4.61E-05	4.70E-06	5.08E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.12E-08	7.12E-08	3.96E-03	NA
Soil and water acidification kg SO_2 eq/FU	2.81E-01	2.77E-02	1.33E-01	4.42E-01	5.06E-02	8.87E-02	1.39E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.30E-03	2.30E-03	5.83E-01	NA
Ozone layer depletion CFC 11 eq/FU	4.02E-06	1.52E-06	2.27E-06	7.81E-06	2.24E-06	2.11E-06	4.35E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.56E-08	1.56E-08	1.22E-05	NA
Global warming kg CO_2 eq/FU	6.77E+01	8.51E+00	2.92E+01	1.05E+02	1.27E+01	1.18E+01	2.45E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.85E-01	6.85E-01	1.30E+02	NA
Eutrophication kg PO_4^{3-} eq/FU	1.21E-01	6.27E-03	6.09E-02	1.88E-01	1.03E-02	2.07E-02	3.10E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.80E-02	1.80E-02	2.37E-01	NA
Photochemical ozone formation kg C_2H_4 eq/FU	4.14E-02	1.41E-03	8.96E-03	5.18E-02	2.41E-03	2.37E-03	4.78E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.11E-04	2.11E-04	5.68E-02	NA
Air pollution m^3/FU	3.62E+03	6.50E+02	2.51E+03	6.78E+03	1.01E+03	6.36E+02	1.64E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.35E-04	7.35E-04	8.43E+03	NA
Water and soil pollution m^3/FU	1.13E-01	2.69E-02	2.76E+00	2.90E+00	4.30E-02	2.19E-02	6.48E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.23E-02	6.23E-02	3.03E+00	NA

Resource use	Product stage				Construction process stage			Use stage								End-of-life stage					Total life cycle	D Benefits and loads beyond the system boundary
	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**		
Primary renewable energy use, excluding primary renewable energy resources used as primary materials MJ LHV/FU	4.30E+01	1.52E+00	7.44E+01	1.19E+02	2.76E+00	1.09E+00	3.85E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E+02	NA
Primary renewable energy use used as primary materials MJ LHV/FU	0.00E+00	0.00E+00	3.04E-05	3.04E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.04E-05	NA
Total primary renewable energy use MJ LHV/FU	4.30E+01	1.52E+00	7.44E+01	1.19E+02	2.76E+00	1.09E+00	3.85E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.23E+02	NA
Primary non-renewable energy use, excluding primary non-renewable energy resources used as primary materials MJ LHV/FU	9.50E+02	1.36E+02	3.10E+02	1.40E+03	2.02E+02	1.82E+02	3.85E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.78E+03	NA
Primary non-renewable energy use used as primary materials MJ LHV/FU	2.47E+01	0.00E+00	0.00E+00	2.47E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.47E+01	NA
Total primary non-renewable energy use MJ LHV/FU	9.74E+02	1.36E+02	3.10E+02	1.42E+03	2.02E+02	1.82E+02	3.85E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E+03	NA
Utilisation de matière secondaire kg/UF	2.56E+01	0.00E+00	0.00E+00	2.56E+01	0.00E+00	3.08E-01	3.08E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.59E+01	NA
Secondary renewable fuel use MJ LHV/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA

Resource use	Product stage				Construction process stage			Use stage								End-of-life stage					Total life cycle	D Benefits and loads beyond the system boundary
	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**		
Secondary non-renewable fuel use MJ LHV/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Net freshwater use m^3/FU	7.37E-01	2.21E-02	2.20E-01	9.79E-01	3.22E-02	1.55E-02	4.77E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.87E-04	5.87E-04	1.03E+00	NA

Waste	Product stage				Construction process stage			Use stage								End-of-life stage					Total life cycle	D Benefits and loads beyond the system boundary
	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**		
Hazardous waste disposal kg/FU	7.81E+00	8.24E-02	5.33E+00	1.32E+01	1.34E-01	1.13E-01	2.47E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.35E+01	NA
Non-hazardous waste disposal kg/FU	5.41E+01	6.81E+00	1.84E+01	7.94E+01	8.78E+00	7.97E-01	9.58E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E-02	1.91E-02	8.89E+01	NA
Radioactive waste disposal kg/FU	4.85E-03	8.56E-04	9.27E-04	6.63E-03	1.27E-03	1.18E-03	2.45E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.01E-06	2.01E-06	9.08E-03	NA

Output flows	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**	**Total life cycle**	**D Benefits and loads beyond the system boundary**
Reused components kg/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.48E-02	4.48E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.48E-02	NA
Recycled materials kg/FU	0.00E+00	0.00E+00	6.08E+00	6.08E+00	0.00E+00	6.81E-01	6.81E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.76E+00	NA
Materials used in energy recovery kg/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Energy supplied externally MJ LHV/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA

• Additional information on the discharge of hazardous substances to indoor air, soil and water during use stage

Indoor air

Galvanized P4-16 metal posts do not contribute to indoor air pollution of the construction project, as they do not emit any substances inside the building during the use phase.

Soil and water

Galvanized P4-16 metal posts contribute to soil and water pollution around the construction project site in so far as the exterior surface of the metal post corrodes and degrades via acidity, water and other chemical compounds in the soil. In addition, during its lifetime the galvanized metal posts discharges hydroxides, iron oxides, zinc oxides and other compounds present in low concentrations in the steel (phosphorus, sulphur and manganese) and in the HDPE.

• Product contribution to quality of life inside buildings

Characteristics of participating product in the creation of hygrothermal comfort conditions in the building

Galvanized P4-16 metal posts, such as defined by the functional unit do not contribute directly to hygrothermal comfort.

Characteristics of participating product in the creation of acoustic comfort conditions in the building

Galvanized P4-16 metal posts, such as defined by the functional unit do not contribute directly to acoustic comfort.

Characteristics of participating product in the creation of visual comfort in the building

Galvanized P4-16 metal posts, such as defined by the functional unit do not contribute directly to visual comfort.

Characteristics of participating product in the creation of olfactory comfort in the building

Galvanized P4-16 metal posts, such as defined by the functional unit do not contribute directly to olfactory comfort.

• Positive environmental contribution

Construction site

Galvanized P4-16 metal posts allow for achieving a desired load-bearing capacity for all types of residential, commercial and light to heavy industrial projects. It is a flexible product that allows for construction on all types of terrain, including unstable or weak terrain.

Energy management

Galvanized P4-16 metal posts, such as defined by the functional unit do not contribute directly to an improvement in project energy management.

Management of products deconstruction and recycling

At the end-of-life, the galvanized metal post remains in place. In addition, no products of deconstruction are used, and recycling is not possible.

References

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3. World Steel Association (2017) Life Cycle Inventory Methodology Report for steel products. Available at: https://www.worldsteel.org/en/dam/jcr:6eefabf4-f562-4868-b919-f232280fd8b9/LCI+methodology+report_2017_vfinal.pdf.

4. Yellishetty, M. et al. (2011) 'Environmental life-cycle comparisons of steel production and recycling: sustainability issues, problems and prospects', Environmental Science & Policy, 14(6), pp. 650–663. doi: https://doi.org/10.1016/j.envsci.2011.04.008.

Annexe 1

To calculate the environmental impact or a given inventory indicator score for the different models of metal posts manufactured by Techno Pieux, a mass chart corresponding to the types of posts and helixes can be consulted (Table 3). Environmental impacts and inventory indicators for 1 kg of galvanized metal post can be found in Table 4. By multiplying the given galvanized post mass by the impact per kg of post, total impacts of metal posts can be calculated.

Table 3 shows the mass chart for different Techno Pieux galvanized posts.

Table 3

GALVANIZED METAL POSTS FOR 2 METRE SECTIONS

	Type of posts			
	P1	**P2**	**P3**	**P4**
TYPE OF HELIX (ϕ IN INCHES)	**kg**			
6	10.8	14.0	N/A	N/A
8	11.9	15.1	29.3	34.4
10	13.4	16.6	31.2	36.4
12	15.2	18.4	33.6	38.8
16	19.8	23.0	39.7	44.8

Table 4 presents environmental indicator results for all the modules considered in the life cycle of: *1 kg of galvanized P4-16 metal post, in achieving a specific load-bearing capacity (compression, shear, flexion), for a reference lifetime of 100 years.*

Table 4

Environmental impacts	Product stage				Construction process stage			Use stage								End-of-life stage					Total life cycle	D Benefits and loads beyond the system boundary
	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Remplacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**		
Abiotic resource depletion (fossil fuels) MJ/FU	1.72E+01	2.84E+00	5.96E+00	2.60E+01	4.20E+00	3.81E+00	8.01E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.57E-01	1.57E-01	3.42E+01	NA
Abiotic resource depletion (elements) kg Sb eq/FU	1.40E-06	5.61E-07	8.53E-05	8.73E-05	1.03E-06	1.05E-07	1.14E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.59E-09	1.59E-09	8.84E-05	NA
Soil and water acidification kg SO_2 eq/FU	6.27E-03	6.19E-04	2.97E-03	9.86E-03	1.13E-03	1.98E-03	3.11E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.13E-05	5.13E-05	1.30E-02	NA
Ozone layer depletion CFC 11 eq/FU	8.97E-08	3.40E-08	5.06E-08	1.74E-07	5.00E-08	4.71E-08	9.71E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.49E-10	3.49E-10	2.72E-07	NA
Global warming kg CO_2 eq/FU	1.51E+00	1.90E-01	6.51E-01	2.35E+00	2.83E-01	2.63E-01	5.46E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.53E-02	1.53E-02	2.91E+00	NA
Eutrophication kg PO_4^{3-} eq/FU	2.70E-03	1.40E-04	1.36E-03	4.20E-03	2.30E-04	4.62E-04	6.92E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.01E-04	4.01E-04	5.29E-03	NA
Photochemical ozone formation kg C_2H_4 eq/FU	9.24E-04	3.15E-05	2.00E-04	1.16E-03	5.38E-05	5.29E-05	1.07E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.71E-06	4.71E-06	1.27E-03	NA
Air pollution m^3/FU	8.08E+01	1.45E+01	5.61E+01	1.51E+02	2.25E+01	1.42E+01	3.67E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.64E-05	1.64E-05	1.88E+02	NA
Water and soil pollution m^3/FU	2.53E-03	6.00E-04	6.17E-02	6.48E-02	9.59E-04	4.88E-04	1.45E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.39E-03	1.39E-03	6.77E-02	NA

Resource use	Product stage				Construction process stage			Use stage								End-of-life stage					Total life cycle	D Benefits and loads beyond the system boundary
	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Remplacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**		
Primary renewable energy use, excluding primary renewable energy resources used as primary materials MJ LHV/FU	9.59E-01	3.40E-02	1.66E+00	2.65E+00	6.15E-02	2.44E-02	8.59E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.74E+00	NA
Primary renewable energy use used as primary materials MJ LHV/FU	0.00E+00	0.00E+00	6.79E-07	6.79E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.79E-07	NA
Total primary renewable energy use MJ LHV/FU	9.59E-01	3.40E-02	1.66E+00	2.65E+00	6.15E-02	2.44E-02	8.59E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.74E+00	NA
Primary non-renewable energy use, excluding primary non-renewable energy resources used as primary materials MJ LHV/FU	2.12E+01	3.04E+00	6.92E+00	3.12E+01	4.52E+00	4.07E+00	8.59E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.97E+01	NA
Primary non-renewable energy use used as primary materials MJ LHV/FU	5.51E-01	0.00E+00	0.00E+00	5.51E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.51E-01	NA
Total primary non-renewable energy use MJ LHV/FU	2.17E+01	3.04E+00	6.92E+00	3.17E+01	4.52E+00	4.07E+00	8.59E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.03E+01	NA
Secondary material use kg/FU	5.71E-01	0.00E+00	0.00E+00	5.71E-01	0.00E+00	6.88E-03	6.88E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.77E-01	NA
Secondary renewable fuel use MJ LHV/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA

Secondary non-renewable fuel use MJ LHV/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Net freshwater use m^3/FU	1.64E-02	4.94E-04	4.90E-03	2.18E-02	7.18E-04	3.46E-04	1.06E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-05	1.31E-05	2.29E-02	NA

Waste	**Product stage**				**Construction process stage**			**Use stage**								**End-of-life stage**					**Total life cycle**	**D Benefits and loads beyond the system boundary**
	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Remplacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**		
Hazardous waste disposal kg/FU	1.74E-01	1.84E-03	1.19E-01	2.95E-01	2.99E-03	2.52E-03	5.51E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.01E-01	NA
Non-hazardous waste disposal kg/FU	1.21E+00	1.52E-01	4.11E-01	1.77E+00	1.96E-01	1.78E-02	2.14E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.26E-04	4.26E-04	1.99E+00	NA
Radioactive waste disposal kg/FU	1.08E-04	1.91E-05	2.07E-05	1.48E-04	2.83E-05	2.64E-05	5.47E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.48E-08	4.48E-08	2.03E-04	NA

Output flows	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Remplacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**	**Total life cycle**	**D Benefits and loads beyond the system boundary**
Components for reuse kg/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-03	1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-03	NA
Materials for recycling kg/FU	0.00E+00	0.00E+00	1.36E-01	1.36E-01	0.00E+00	1.52E-02	1.52E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E-01	NA
Materials for energy recovery kg/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Energy supplied MJ LHV/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA

ENVIRONMENTAL AND HEALTH DECLARATION DATASHEET

Techno Metal Post™ – P4-16 model, non-galvanized metal posts

In accordance with NF EN ISO 14025, NF EN 15804+A1 and companion standard NF EN 15804/CN

Techno Pieux
1700 Setlakwe St.
Thetford Mines QC G6G 8B2
Canada

May 1st, 2020

Foreword

The information contained in this declaration are provided under the responsibility of Techno Pieux. This environmental production declaration is in accordance with NF EN ISO 14025, NF EN 15804+A1 and associated standard NF EN 15804/CN. Techno Pieux commissioned Charles Thibodeau and Julien Walzberg of CT Consultant to carry out this FDES (Environmental and Health Declaration Datasheet).

Techno Pieux and CT Consultant do not accept any responsibility to any party to which the study results have been communicated or any party having otherwise obtained the results. The use of the results falls under the responsibility of the user.

Any use, in whole or in part, of the information provided in this document must at a minimum be accompanied by the complete reference to the original FDES as well as its producer who could provide a complete copy.

We recall the study results are based only on facts, circumstances and assumptions that have been submitted us over the course of the study. If these facts, circumstances and assumptions differ, the results are subject to change. Furthermore, the study results should be considered as a whole with regard to the assumptions and should be considered in isolation.

The CEN standard EN 15804+A1 utilises the product category rules (PCR).

Throughout the text, the term *metal post* or *non-galvanized metal post* covers a “non-galvanized post manufactured by Techno Pieux ™, model P4-16”.

Reader’s guide

The presentation of the inventory data meets the requirements of standard NF EN 15804+A1.

Some information on data formatting

Certain values are provided in scientific notation such as the example below:

4,0E+01 = $4{,}0 \times 10^{1}$

Data format guidelines

In the rest of the document

- When the result of a calculation is zero, the value zero is written
- All non-zero values are expressed with 3 significant digits.

Abbreviations

ELCD: European reference Life Cycle Database

EPD: Environmental Product Declaration

FDES: Environmental and Health Declaration Datasheet (Fiche de Déclaration Environnementale et Sanitaire)

FU: Functional Unit

HDPE: High Density Polyethylene

LCA: Life Cycle Assessment

LHV: Lower Heating Value

RSL: Reference Service Life

Caution in using FDES for product comparison

Construction product FDES can be incomparable if they do follow the guidelines of the NF EN15804+A1 standard.

The NF EN 15804+A1 standard defines in article *5.3 Comparability of FDES* for construction production, conditions in which construction products can be compared on the basis of information provided in the FDES:*

"A comparison of construction production environmental performance using information from EPD must be based on the usage of the products and their impacts on the building and must take in account the entire life cycle (all information modules)."

*Note 1 of the foreword of the national supplementary information defines *"…in France, the term FDES (Environmental and Health Declaration Datasheet or Fiche de Déclaration Environnementale et Sanitaire) is used that combines Environmental Declaration and Health Information of the products covered under a given FDES. As such, FDES is an EPD with additional health information."*

General information

1. Producer of the FDES

The information contained in this declaration are provided under the responsibility of Techno Pieux.

Techno Pieux https://www.technopieux.com
1700 Setlakwe Street
Thetford Mines QC G6G 8B2
Canada

info@technopieux.com

2. Representativeness of the FDES

The producer of the metal post is:

- Techno Pieux https://www.technopieux.com
  1700 Setlakwe Street, Thetford Mines, Quebec, G6G 8B2, Canada

The regions and countries within which the FDES is application are the following:

- Europe, the United States of America and Canada.

3. Type of FDES

This individual FDES covers the product life cycle from cradle-to-grave.

4. Validity of the FDES

This FDES is an individual declaration. It is only applicable for non-galvanized metal posts produced by Techno Pieux. It includes all types of non-galvanized metal posts (e.g. wall thickness, length of tubes and length of helixes) produced by Techno Pieux. Galvanized metal posts produced by Techno Pieux are covered under a separate FDES.

The FDES was carried out within the framework of the environmental and health declaration programme for construction products, or Programme FDES – INIES managed by INIES (www.inies.fr).

5. Review of the FDES

This FDES was subject to a peer review conducted by Naeem Adibi (WeLOOP), authorised reviewer of Environmental and Health Declaration in the construction sector by INIES (in France). The review report and certification are available from Techno Pieux on demand.

The CEN EN 15804 standard uses PCR[a]
External independent review of the declaration and data, in compliance with EN ISO 14025:2010.
Third party review[b]: **Dr. Naeem Adibi** T: +33 6 45403877 WeLOOP Email: n.adibi@weloop.org Base 11/19, pépinière d'éco-entreprises, rue Léon Blum Website: www.weloop.org 62750 Loos-en-Gohelle, France
[a] Product category rules. [b] Optional for business-to-business communication, mandatory for business-to-consumer communication (see EN ISO 14025:2010, 9.4).

6. Publication date and expiry date

This FDES was published in May 2020 and will be valid for a period of 5 years.

7. Products covered by FDES

This FDES covers the non-galvanized model P4-16 metal post produced by Techno Pieux™ in Canada and sold to consumers in North America and Europe through a network of dealers.

• Description of the functional unit (or declared unit) and the product

1. Functional unit (FU)

Using a non-galvanized model P4-16 metal post (40.8 kg), in achieving a specific load-bearing capacity (compression, shear, flexion), for a reference service life of 90 years.

2. Product description

Techno Pieux metal posts with high density polyethylene (HDPE) sheathing are screwed steel posts allowing for a desired load-bearing capacity for a given construction project. They also allow for the establishment of necessary foundations for construction work. One metal post consists of 99% steel and 1% HDPE on a mass basis.

One metal post consists of a steel tube equipped with one or more steel spiral helixes (adapted from Techno Pieux, 2018). A steel plate and other accessories are also used to affix the metal post. When the depth required to achieve the desired load-bearing capacity is greater than the length of the post, one or more extensions can be used. An extension consists of a tube without a helix and with HDPE sheathing.

Techno Pieux manufactures several models and dimensions of metal posts and extensions. The length of one metal post or extension is 2-3 metres, with the diameter varying between 48.3-168.3 mm. The reference flow considered for this FDES is a 2 m-long metal post with a diameter of 101.6 mm with a total mass of 40.8 kg.

3. Description of product use

The metal posts can form part of the necessary foundations for many types of construction projects. The supported structures can be residential (house, cottage, etc.), touristic (flags, insignia, etc.), in the energy sector (solar panel structures), infrastructure projects (footbridge) or industrial and commercial (machinery, offices).

4. Main performance of the FU

The non-galvanized model P4-16 metal post allows for up to load-bearing capacities of 200 kN of compression, 100 kN of tension and 12 kN of lateral capacity.

5. Other technical characteristics not included in the functional unit

A secondary function of the product is to contribute to the aesthetic of the supported structure.

6. Description of the main components and/or product materials

- Main product:
  -40.25 kg steel
  -0.55 kg HDPE
- Additional products for installation (at reference flow scale):
  -Welding rod: 0.02 kg
- Distribution packaging (at reference flow scale):
  -Wooden cases: 1,8E-03 kg
  -Steel barrels: 4.6E-02 kg
  -Steel racks: 5.5E-01 kg

7. REACH regulation

This product does not contain any substances on the REACH regulation candidate list of substances that have concentrations greater than 0.1% by mass.

8. Description of the reference service life

The reference service life (RSL) is 90 years. The RSL of metal posts is based on the ICC-ES AC-358 evaluation criteria (International Council Code) and on a corrosion thickness of 1.5 mm.

Parameter	Value
Reference service life	90 years
Product declared properties (at factory gate), finishings, etc.	The non-galvanized model P4-16 metal post allows for up to load-bearing capacities of 200 kN of compression, 100 kN of tension and 12 kN of lateral capacity.
Theoretical application parameters (if imposed by the manufacturer), including references to appropriate practices.	Not applicable
Presumed quality of work, when installation conforms to manufacturer instructions	No product loss during installation in compliance with manufacturer instructions
Outdoor environment (for outdoor applications), for example, inclement weather, pollutants, exposure to UV and wind, building orientation, shade, temperature	Not applicable
Indoor environment (for indoor applications), for example, temperature, humidity, exposure to chemical products	Not applicable
Conditions of use, for example, frequency of use, mechanical exposure	Not applicable
Maintenance, for example, required frequency, type and quality and replacement of replaceable components	Not applicable

• Life cycle modules

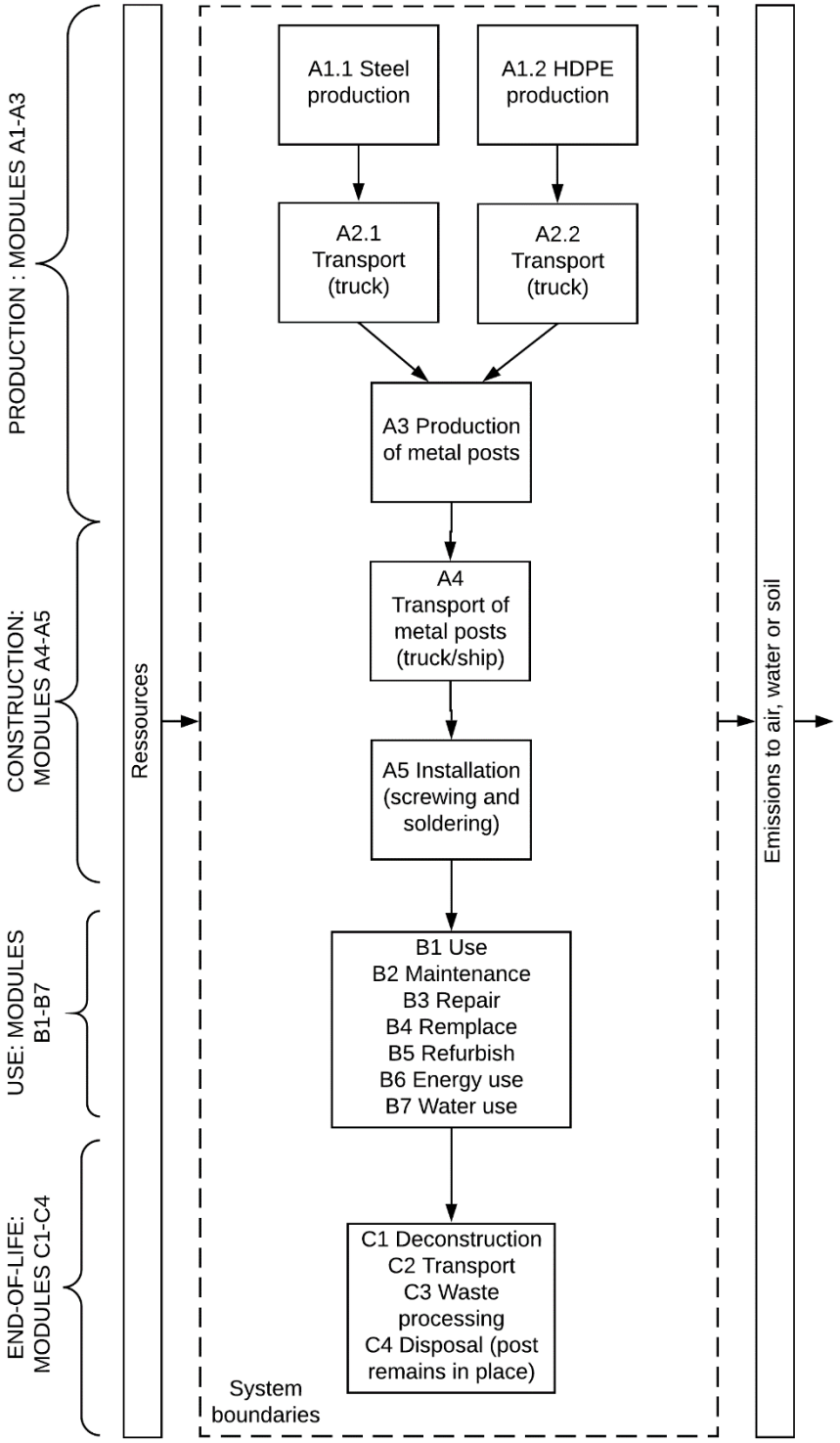

Figure 1 – Life cycle of Techno Pieux P4-16 non-galvanized metal post

- **Product stage, A1-A3**

  - Production module A1 covers raw material sourcing. For the P4-16 non-galvanized metal post, this consists of steel production (for metal post tube and helix) and the production of high-density polyethylene (HDPE) for the post sheathing.

    The steel used is certified ASTM A500C, CAN/CSA-G40.21-98 and CSA W47. It is produced using a mix of primary steel (52%) and secondary steel (48%). Primary steel is sourced from mills using Blast Oxygen Furnace (BOF) or Linz-Donawitz processes and is produced using iron ore and coke. The extraction of the raw materials (iron ore, coke, etc.), their transport and the production of steel are considered. Secondary steel is sourced from mills using electric arc furnaces (EAF) and is mostly produced using steel scrap. The average proportions of recycled content pre- and post-consumption is 29% and 89% for the BOF and EAF processes, respectively.

  - Transport module A2 consists of raw material transport. The means of transport, quantities transported, the distances and the loads for road transport are provided by Techno Pieux. According to the company, HDPE is transported from Mississauga, Ontario to Thetford Mines, Quebec by tractor trailer. The steel originates from Canadian mills, situated in Ontario and is transported by tractor trailer to the metal posts production plant in Thetford Mines. A weighted average of the steel provided by each mill was used to calculate the transport distance for the steel.

  - Manufacturing module A3 consists of the production of the tube (sub-contractor to Techno Pieux), the production and positioning of the helix and the cutting and assembly of the metal post in the Techno Pieux plants in Thetford Mines. At this stage, the steel racks and accessories (e.g. fixing plate) are produced. This module includes the emissions to air related to the combustion of fuel (natural gas for heating facilities, oxyfuel for cutting and welding for post production), and waste generation. The production of fuels and consumed electricity for manufacturing the posts is also included in this module. Steel scrap produced during product manufacturing account for an average of 0.11kg/kg finish product (metal post, extension, rack, accessories), which is covered for recycling. Furthermore, manufacturing requires the use of a liquid coolant whose fate is the sewage system. These emissions are considered within the framework of this FDES.

- **Construction process stage, A4-A5**

  - Transport module A4 corresponds to the transport of posts from the manufacturing site to the construction site. The modelling takes into account the fuel production and combustion for transport, as well as the construction of the road. No product loss (post) takes place during transport.

    For metal post distribution, the scenario used is based on actual company sales for the year 2017 in North America and Europe. The distances provided in the table below represent the weighted average of distances to the final customer, in terms of mass sold.

Transport to the construction site:

Parameter	Value
Type of vehicle used for transport	The vehicles concerned are 16-32 tonne Euro 5 trucks, 3.5-7.5 tonne Euro 5 trucks and container ships.
Distance to construction site	1125 km by truck and 4880 km by ship
Loading capacity	50% for 16-32 tonne Euro 5 trucks and 33% 3.5-7.5 tonne Euro 5 trucks
Volumetric mass of transported products	363 kg/m^3
Use coefficient for volumetric capacity	NA

- Installation module A5 considers the installation of the metal post in the ground ready to build on. The modelling considers the manufacturing as well as the consumption of energy resources used by the installation machine for affixing the post to the ground. Diesel consumption for the installation machine was obtained from Techno Pieux, which was 3.0 litres per FU. A solder with accessories and optional post extensions has been considered. The average amounts of solders and electricity used are 2.25E-02 kg and 1.15E-02 kWh, respectively. As such, there is no gas used during welding. There is no product loss associated with installation.

Installation of metal post:

Parameter	Value
Auxiliary inputs for installation	2.25E-02 kg solder
Water use	0 m^3
Use of other resources	0 kg
Quantitative description of energy type and consumption during installation process.	1.15E-02 kWh electricity and 3.0 litres diesel consumed
Waste produced on construction site before treatment of waste generated by product installation	0 kg
End-of-life packaging	100% packaging is recycled
Direct emissions to air, soil and water	0 kg

- **Use stage, B1-B7**
  - During the use stage, the metal post does not require any interventions. Modules B1 to B7 are assigned values of zero in the results tables for the life cycle assessment.
- **End-of-life stage, C1-C4**
  - During the end of life, the metal post remains in place in the ground. This procedure corresponds to the disposal module C4. During the end-of-life of the post, no energy or material inputs are

required. However, the post will be subjected to a leaching process during this life cycle stage, releasing metals (mostly ionic iron) and particles of HDPE in the ground. These emissions are similar to those occurring when metals and plastics are disposed in landfills and were modelled accordingly.

- Other than the fact that the metal post remains in the ground, the metal post does not require any other processes during the end-of-life. Modules C1 to C3 are assigned values of zero in the results tables for the life cycle assessment.

- **Reuse, recovery and/or recycling potential, D**
  - During end-of-life, the metal post remains in place in the ground. It is therefore not possible to reuse, recover or recycle the metal post and as such Module D is assigned a value of zero in the results tables for the life cycle assessment.

Life cycle stages

Information for calculating the life cycle assessment

PCR used	ISO 14040:2006 ISO 14044:2006 ISO 14025 standard NF EN 15804+A1 et associated national standard NF EN 15 804/CN
System boundaries	The life cycle assessment is from cradle-to-grave. The system boundaries are from the production of raw materials and energy to the end-of-life of the product. Module D (optional according to NF EN 15804) is not included in the assessment. In compliance with the NF EN 15804+A1 standard, all processes where the mass or the energy flow accounts for more than 1% of the cumulative total of mass and/or energy of the metal posts are included. In addition, at least 95% of the mass and energy flows from each life cycle module (A1-A3, A4-A5, B1-B7, C1-C4) has been considered. However, due to their marginal contributions to the results, the following processes have been excluded: - Manufacturing process materials - Maintenance of manufacturing processes (consumption of oil, water, etc.) - General maintenance of production plants (water and detergent consumption) - Plant administration (paper use, electronics, etc.) - Employee transport to plants - Materials used within galvanisation plant - Storage of posts (mostly stored outdoors) - Transport of packaging at end-of-life
Allocation	No multifunctional processes were considered throughout the life cycle of Techno Pieux.

Geographical and temporal representativeness of primary data	The primary data used in this LCA correspond to the data collected from Techno Pieux. These primary data were collected by way of an Excel questionnaire, a visit of the plant in Thetford Mines and several discussions with the director general of Techno Pieux. **Product stage – Modules A1-A3** - Year: 2017 - Geographical representativeness: Quebec, Canada - Technological representativeness: data corresponds to technologies used by Techno Pieux and its suppliers (Canadian steel) - Source: Techno Pieux **Construction process stage – Modules A4-A5** - Year: 2017 - Geographical representativeness: North America and Europe - Source: Techno Pieux **Use stage – Modules B1-B7** - Not applicable **End-of-life stage – Module C4** - Year: 2017 - Geographical representativeness: North America and Europe - Source: Techno Pieux, based on the assumption that all posts remain in the ground at their end-of-life
Secondary data sources	Secondary data are the data obtained from other sources than those collected from Techno Pieux. **Secondary database:** - Year: 2017 - Geographical representativeness: Canada, Quebec, Europe, United States - Source: Ecoinvent v3.4 (ecoinvent center) **Main data records used:** - *Steel production in an electric arc furnace (A1)*: 2009, steel production, electric, low-alloyed | steel, low-alloyed | Cutoff, U – and adaptation of energy consumption to correspond to rate of 89% recycled content (case of steel tubes) according to Yellishetty et al., 2011. - *Production of steel with Linz-Donawitz process (blast furnace) (A1)*: 2009, steel production, converter, unalloyed | steel, unalloyed | Cutoff, S – and adaptation of emissions related to climate change and photochemical ozone formation impacts to correspond to the 29% recycled content rate (case of steel tubes) according to WorldSteel, 2017.

	- *Quebec electricity grid mix (powering Techno Pieux plant – A3)*: 2014, market for electricity, low voltage | electricity, low voltage | Cutoff, U - CA-QC - *Ontario electricity grid mix (steel production) (A1)*: 2014, market for electricity, low voltage | electricity, low voltage | Cutoff, U - CA-ON
Variability of results	The variability (uncertainty) of the results is between 10 and 30% depending on the indicator.
Reproducibility of results	The openLCA software version 1.8.0 developed by GreenDelta was used to carry out the modelling of the elementary processes included in the life cycle of the metal post (life cycle inventory stage) OpenLCA and the method EN 15804 2012 English (based on the CML (baseline) v4.4 (2015) method and available on the openLCA site) were used to calculate the impacts and the inventory indicators (life cycle impact assessment stage) The indicators air pollution and water and soil pollution were calculated in an Excel spreadsheet using elementary flows scaled to the FU and the characterisation factors and the conversion of the associated national standard NF EN 15804/CN (Annexes C and J).

• Life cycle assessment results

Table 1 below presents the modules that are declared and non-declared in the FDES: life cycle assessment of non-galvanized metal post, from cradle-to-grave, all modules (A1 to C4) are declared in the FDES.

Table 1

Product stage			Construction process stage		Use stage							End-of-life stage				Total life cycle	D Benefits and loads beyond the system boundary
A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	A4 Transport	A5 Installation	B1 Use	B2 Maintenance	B3 Repair	B4 Remplacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal		
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

X = life cycle modules included in LCA

Table 2 presents environmental indicator results for all the modules considered in the life cycle of the non-galvanized P4-16 metal post. The results are also shown for the functional unit: *Using a non-galvanized model P4-16 metal post (40.8 kg), in achieving a specific load-bearing capacity (compression, shear, flexion), for a reference lifetime of 90 years.*

Table 2

Environmental impacts	Product stage				Construction process stage			Use stage								End-of-life stage					Total life cycle	D Benefits and loads beyond the system boundary
	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**		
Abiotic resource depletion (fossil fuels) MJ/FU	7.70E+02	1.27E+02	2.12E+02	1.11E+03	1.79E+02	1.46E+02	3.26E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.41E+00	6.41E+00	1.44E+03	NA
Abiotic resource depletion (éléments) kg Sb eq/FU	6.27E-05	2.52E-05	4.24E-04	5.12E-04	4.37E-05	4.02E-06	4.77E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.45E-08	6.45E-08	5.60E-04	NA
Soil and water acidification kg SO_2 eq/FU	2.81E-01	2.78E-02	9.67E-02	4.06E-01	4.90E-02	7.63E-02	1.25E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.08E-03	2.08E-03	5.33E-01	NA
Ozone layer depletion CFC 11 eq/FU	4.01E-06	1.53E-06	1.84E-06	7.38E-06	2.14E-06	1.81E-06	3.95E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.41E-08	1.41E-08	1.13E-05	NA
Global warming kg CO_2 eq/FU	6.77E+01	8.57E+00	2.40E+01	1.00E+02	1.22E+01	1.01E+01	2.22E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.20E-01	6.20E-01	1.23E+02	NA
Eutrophication kg PO_4^{3-} eq/FU	1.21E-01	6.28E-03	4.73E-02	1.75E-01	9.91E-03	1.77E-02	2.77E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.66E-02	1.66E-02	2.19E-01	NA
Photochemical ozone formation kg C_2H_4 eq/FU	4.15E-02	1.42E-03	7.26E-03	5.01E-02	2.33E-03	2.03E-03	4.36E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.92E-04	1.92E-04	5.47E-02	NA
Air pollution m^3/FU	3.62E+03	6.28E+02	1.91E+03	6.15E+03	9.18E+02	5.79E+02	1.50E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.34E-03	1.34E-03	7.65E+03	NA
Water and soil pollution m^3/FU	1.13E-01	2.60E-02	2.66E+00	2.80E+00	3.91E-02	1.99E-02	5.90E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.14E-01	1.14E-01	2.97E+00	NA

Resource use	Product stage				Construction process stage			Use stage								End-of-life stage					Total life cycle	D Benefits and loads beyond the system boundary
	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**		
Primary renewable energy use, excluding primary renewable energy resources used as primary materials MJ LHV/FU	4.28E+01	1.53E+00	7.02E+01	1.14E+02	2.44E+00	9.34E-01	3.37E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.18E+02	NA
Primary renewable energy use used as primary materials MJ LHV/FU	0.00E+00	0.00E+00	2.77E-05	2.77E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.77E-05	NA
Total primary renewable energy use MJ LHV/FU	4.28E+01	1.53E+00	7.02E+01	1.14E+02	2.44E+00	9.34E-01	3.37E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.18E+02	NA
Primary non-renewable energy use, excluding primary non-renewable energy resources used as primary materials MJ LHV/FU	9.47E+02	1.36E+02	2.49E+02	1.33E+03	1.93E+02	1.56E+02	3.49E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.68E+03	NA
Primary non-renewable energy use used as primary materials MJ LHV/FU	2.25E+01	0.00E+00	0.00E+00	2.25E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.25E+01	NA
Total primary non-renewable energy use MJ LHV/FU	9.69E+02	1.36E+02	2.49E+02	1.35E+03	1.93E+02	1.56E+02	3.49E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.70E+03	NA
Utilisation de matière secondaire kg/UF	2.33E+01	0.00E+00	0.00E+00	2.33E+01	0.00E+00	2.81E-01	2.81E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.36E+01	NA
Secondary renewable fuel use MJ LHV/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Secondary non-renewable fuel use MJ LHV/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Net freshwater use m^3/FU	4.92E-01	2.22E-02	1.72E-01	6.87E-01	3.09E-02	1.32E-02	4.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.34E-04	5.34E-04	7.31E-01	NA

Waste	Product stage				Construction process stage			Use stage								End-of-life stage					Total life cycle	D Benefits and loads beyond the system boundary
	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**		
Hazardous waste disposal kg/FU	7.82E+00	8.24E-02	5.10E+00	1.30E+01	1.32E-01	9.67E-02	2.28E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.32E+01	NA
Non-hazardous waste disposal kg/FU	5.42E+01	6.81E+00	1.43E+01	7.53E+01	8.45E+00	6.85E-01	9.13E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.73E-02	1.73E-02	8.44E+01	NA
Radioactive waste disposal kg/FU	5.06E-03	8.57E-04	7.38E-04	6.65E-03	1.20E-03	1.01E-03	2.21E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.82E-06	1.82E-06	8.87E-03	NA

Output flows	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**	**Total life cycle**	**D Benefits and loads beyond the system boundary**
Reused components kg/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.08E-02	4.08E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.08E-02	NA
Recycled materials kg/FU	0.00E+00	0.00E+00	5.54E+00	5.54E+00	0.00E+00	6.20E-01	6.20E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.16E+00	NA
Materials used in energy recovery kg/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Energy supplied externally MJ LHV/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA

• Additional information on the discharge of hazardous substances to indoor air, soil and water during use stage

Indoor air

Non-galvanized P4-16 metal posts do not contribute to indoor air pollution of the construction project, as they do not emit any substances inside the building during the use phase.

Soil and water

Non-galvanized P4-16 metal posts contribute to soil and water pollution around the construction project site in so far as the exterior surface of the metal post corrodes and degrades via acidity, water and other chemical compounds in the soil. In addition, during its lifetime the non-galvanized metal posts discharges hydroxides, iron oxides and other compounds present in low concentrations in the steel (phosphorus, sulphur and manganese) and in the HDPE.

• Product contribution to quality of life inside buildings

Characteristics of participating product in the creation of hygrothermal comfort conditions in the building

Non-galvanized P4-16 metal posts, such as defined by the functional unit do not contribute directly to hygrothermal comfort.

Characteristics of participating product in the creation of acoustic comfort conditions in the building

Non-galvanized P4-16 metal posts, such as defined by the functional unit do not contribute directly to acoustic comfort.

Characteristics of participating product in the creation of visual comfort in the building

Non-galvanized P4-16 metal posts, such as defined by the functional unit do not contribute directly to visual comfort.

Characteristics of participating product in the creation of olfactory comfort in the building

Non-galvanized P4-16 metal posts, such as defined by the functional unit do not contribute directly to olfactory comfort.

• Positive environmental contribution

Construction site

Non-galvanized P4-16 metal posts allow for achieving a desired load-bearing capacity for all types of residential, commercial and light to heavy industrial projects. It is a flexible product that allows for construction on all types of terrain, including unstable or weak terrain.

Energy management

Non-galvanized P4-16 metal posts, such as defined by the functional unit do not contribute directly to an improvement in project energy management.

Management of products deconstruction and recycling

At the end-of-life, the non-galvanized metal post remains in place. In addition, no products of deconstruction are used, and recycling is not possible.

References

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3. World Steel Association (2017) Life Cycle Inventory Methodology Report for steel products. Available at: https://www.worldsteel.org/en/dam/jcr:6eefabf4-f562-4868-b919-f232280fd8b9/LCI+methodology+report_2017_vfinal.pdf.
4. Yellishetty, M. et al. (2011) 'Environmental life-cycle comparisons of steel production and recycling: sustainability issues, problems and prospects', Environmental Science & Policy, 14(6), pp. 650–663. doi: https://doi.org/10.1016/j.envsci.2011.04.008.

Annexe 1

To calculate the environmental impact or a given inventory indicator score for the different models of metal posts manufactured by Techno Pieux, a mass chart corresponding to the types of metal posts and helixes can be consulted (Table 3). Environmental impacts and inventory indicators for 1 kg of non-galvanized metal post can be found in Table 4. By multiplying the given non-galvanized metal post mass by the impact per kg of post, total impacts of metal posts can be calculated.

Table 3 shows the mass chart for different Techno Pieux non-galvanized metal posts.

Table 3

NON-GALVANIZED METAL POSTS FOR 2 METRE SECTIONS

	Type of posts			
	P1	**P2**	**P3**	**P4**
TYPE OF HELIX (ϕ IN INCHES)	**kg**			
6	9.8	12.7	N/A	N/A
8	10.9	13.8	26.6	31.2
10	12.2	15.1	28.4	33.1
12	13.8	16.7	30.6	35.2
16	18.0	20.9	36.1	40.8

Table 4 presents environmental indicator results for all the modules considered in the life cycle of: *1 kg of non-galvanized metal post, in achieving a specific load-bearing capacity (compression, shear, flexion), for a reference lifetime of 90 years.*

Table 4

Environmental impacts	Product stage				Construction process stage			Use stage								End-of-life stage					Total life cycle	D Benefits and loads beyond the system boundary
	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Remplacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**		
Abiotic resource depletion (fossil fuels) MJ/FU	1.89E+01	3.12E+00	5.20E+00	2.72E+01	4.39E+00	3.59E+00	7.98E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.57E-01	1.57E-01	3.53E+01	NA
Abiotic resource depletion (elements) kg Sb eq/FU	1.54E-06	6.18E-07	1.04E-05	1.26E-05	1.07E-06	9.86E-08	1.17E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E-09	1.58E-09	1.37E-05	NA
Soil and water acidification kg SO_2 eq/FU	6.89E-03	6.82E-04	2.37E-03	9.95E-03	1.20E-03	1.87E-03	3.07E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.10E-05	5.10E-05	1.31E-02	NA
Ozone layer depletion CFC 11 eq/FU	9.84E-08	3.75E-08	4.51E-08	1.81E-07	5.24E-08	4.43E-08	9.67E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.45E-10	3.45E-10	2.78E-07	NA
Global warming kg CO_2 eq/FU	1.66E+00	2.10E-01	5.88E-01	2.46E+00	2.98E-01	2.47E-01	5.45E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.52E-02	1.52E-02	3.02E+00	NA
Eutrophication kg PO_4^{3-} eq/FU	2.97E-03	1.54E-04	1.16E-03	4.28E-03	2.43E-04	4.35E-04	6.78E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.06E-04	4.06E-04	5.37E-03	NA
Photochemical ozone formation kg C_2H_4 eq/FU	1.02E-03	3.47E-05	1.78E-04	1.23E-03	5.71E-05	4.98E-05	1.07E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.71E-06	4.71E-06	1.34E-03	NA
Air pollution m^3/FU	8.87E+01	1.54E+01	4.67E+01	1.51E+02	2.25E+01	1.42E+01	3.67E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.28E-05	3.28E-05	1.88E+02	NA
Water and soil pollution m^3/FU	2.78E-03	6.38E-04	6.52E-02	6.86E-02	9.59E-04	4.88E-04	1.45E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.79E-03	2.79E-03	7.29E-02	NA

Resource use	Product stage				Construction process stage			Use stage								End-of-life stage					Total life cycle	D Benefits and loads beyond the system boundary
	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Remplacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**		
Primary renewable energy use, excluding primary renewable energy resources used as primary materials MJ LHV/FU	1.05E+00	3.75E-02	1.72E+00	2.81E+00	5.98E-02	2.29E-02	8.27E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.89E+00	NA
Primary renewable energy use used as primary materials MJ LHV/FU	0.00E+00	0.00E+00	6.80E-07	6.80E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.80E-07	NA
Total primary renewable energy use MJ LHV/FU	1.05E+00	3.75E-02	1.72E+00	2.81E+00	5.98E-02	2.29E-02	8.27E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.89E+00	NA
Primary non-renewable energy use, excluding primary non-renewable energy resources used as primary materials MJ LHV/FU	2.32E+01	3.33E+00	6.10E+00	3.26E+01	4.73E+00	3.82E+00	8.55E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.12E+01	NA
Primary non-renewable energy use used as primary materials MJ LHV/FU	5.51E-01	0.00E+00	0.00E+00	5.51E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.51E-01	NA
Total primary non-renewable energy use MJ LHV/FU	2.38E+01	3.33E+00	6.10E+00	3.32E+01	4.73E+00	3.82E+00	8.55E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.17E+01	NA
Secondary material use kg/FU	5.71E-01	0.00E+00	0.00E+00	5.71E-01	0.00E+00	6.88E-03	6.88E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.77E-01	NA
Secondary renewable fuel use MJ LHV/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Secondary non-renewable fuel use MJ LHV/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Net freshwater use m^3/FU	1.21E-02	5.43E-04	4.22E-03	1.68E-02	7.57E-04	3.24E-04	1.08E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.31E-05	1.31E-05	1.79E-02	NA

Waste	Product stage				Construction process stage			Use stage								End-of-life stage					Total life cycle	D Benefits and loads beyond the system boundary
	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Remplacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**		
Hazardous waste disposal kg/FU	1.92E-01	2.02E-03	1.25E-01	3.19E-01	3.23E-03	2.37E-03	5.60E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.24E-01	NA
Non-hazardous waste disposal kg/FU	1.33E+00	1.67E-01	3.50E-01	1.85E+00	2.07E-01	1.68E-02	2.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.24E-04	4.24E-04	2.07E+00	NA
Radioactive waste disposal kg/FU	1.24E-04	2.10E-05	1.81E-05	1.63E-04	2.94E-05	2.48E-05	5.42E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.45E-08	4.45E-08	2.17E-04	NA

Output flows	A1 Raw material supply and processing	A2 Transport	A3 Manufacturing	**Total A1-A3**	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Remplacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste treatment	C4 Disposal	**Total C1-C4**	Total life cycle	D Benefits and loads beyond the system boundary
Components for reuse kg/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-03	1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-03	NA
Materials for recycling kg/FU	0.00E+00	0.00E+00	1.36E-01	1.36E-01	0.00E+00	1.52E-02	1.52E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.51E-01	NA
Materials for energy recovery kg/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA
Energy supplied MJ LHV/FU	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA