Environmental Product Declaration

as per ISO 14025 and EN 15804

Owner of the declaration:	EEW Pipe Production Erndtebrück GmbH & Co.KG
Publisher:	Kiwa-Ecobility Experts
Programme operator:	Kiwa-Ecobility Experts
Registration number:	EPD-Kiwa-EE-000410-EN
Issue date:	21.10.2024
Valid to:	21.10.2029

Clad pipes

Ready-to-install and individually fabricated single pipes for pipelines (onshore and offshore) or process units containing high corrosive media such as sour gas or similar.

1. General information

Erntdebrücker Eisenwerk (EEW)

Programme operator
Kiwa GmbH, Ecobility Experts
Wattstraße 11-13
Haus 1, 3. OG, TH 1
13355, Berlin,
Germany

Registration number
EPD-Kiwa-EE-000410-EN

This declaration is based on the Product Category Rules
PCR A – General Program Category Rules for Construction Products, Kiwa-Ecobility Experts, Berlin, 2022

PCR B – construction steel products (Edition 2020-03-13 (draft))

Issue date
21.10.2024

Valid to
21.10.2029

Raoul Mancke
(Head of programme operations, Kiwa-Ecobility Experts)

Kripanshi Gupta
(Verification body, Kiwa-Ecobility Experts)

Clad pipes

Owner of the declaration
EEW Pipe Production Erndtebrück GmbH & Co.KG,
Im Grünewald 2
57339, Erndtebrück,
Germany

Declared product / declared unit
1 metric ton of clad pipes

Scope
The EPD is about ready to install and individually fabricated clad pipes, produced and distributed by EEW PPE, located in Erndtebrück, Germany. Clad pipes are used in pipelines (onshore and offshore) or process units containing high corrosive media such as sour gas or similar. The EPD refers to this specific kind of product concerning individual kinds of the clad pipe designs. The results of this EPD are representative for European Union.
EPD type: Cradle to gate, modules A1-A5, C1-C4, and module D.
Kiwa-Ecobility Experts assumes no liability for manufacturer's information, LCA data and evidence.

Verification
The European standard EN 15804+A2:2019 serves as the core PCR.

Independent verification of the declaration and data, according to EN ISO 14025:2010.

☐internal ☒external

Anne Kees Jeeninga
(Third party verifier)

2. Product

2.1 Product description

The clad pipes from EEW PPE are ready-to-install and individually prefabricated single pipes.

2.2 Application

The clad pipes are mainly used in pipelines (onshore and offshore) or process units containing high corrosive media such as sour gas or similar.

2.3 Reference Service Life (RSL)

The service life of the construction will limit the lifetime of the clad pipes, which is 30 years.

2.4 Technical data

The technical data is listed in the table below. The values for unit weight depend on the product type and its corresponding dimensions. For this reason, only the max. value is given here.

Table 1: Technical Data of clad pipes- EEW PPE

Characteristic	Value/Tolerance	Unit
Diameter range	300 – 2584	mm
Length range	Up to 13200	mm
Wall thickness range (Carbon steel)	12-75	mm
Weight Range	500-15000	kg
Wall thickness range (CRA or Ni-Alloyl)	3 (common)	mm

2.5 Substances of very high concern

The Product does not contain substances from the "Candidate list of substances of very high concern for authorisation" (SVHC).

2.6 Base materials / Ancillary materials

EEW Clad pipes are manufactured from steel heavy plate. The Material is low-carbon combined with an alloy steel for inside. The carbon steel from outside whose specifications offer high yield strength, the alloy steel inside is a high resistant material for special gases.

Table 2: Composition of clad pipes- EEW PPE

Raw material	value	unit
Backing (typically): API 5L / ISO 3183 – X52M or Q ~ X65M or Q (L360 ~ L450) PSL2 or DNV-ST-F101 – SAWL 360 – SAWL 450	89	%
Cladding (typically): Alloy 625 (N06625 / 2.4856) or Alloy 825 (N08825 / 2.4858) or 316L (1.4404) or 304L (1.4308)	9.9	%
Welding rod	1.1	%

There is no biogenic carbon in the products.

2.7 Manufacturing

The manufacturing is located at EEW Pipe Production Erndtebrück GmbH & Co. KG, im Grünewald 2, 57339, Erndtebrück, Germany.
The production of the clad pipes comprises the following process steps and is shown in the following figure:

1. Unloading of plate materials; incoming goods inspection; plate storage
2. Raw material storage and transport
3. Weld seam preparation
4. Pre-bending of prepared plates
5. JCO bending plate to pipe
6. Tack welding
7. Inside SAW welding
8. Back-milling of tack weld (optional)
9. Outside SAW welding
10. Cladding
11. Calibration / sizing
12. None destructive testing incl. hydrotesting
13. Pickling of CRA / alloy backing
14. Final inspection and marking
15. Pipe storage and loading for shipment

There is no packaging used for this product. Only load securing - square timbers, wooden wedges, rubber mats, and tension belts are used.

2.8 Other Information

For further information on clad pipe, please visit the official EEW PPE webpage under the following link:
(EEW PPE in Erndtebrück - Kompetenzzentrum für Clad Pipes (eew-group.com))

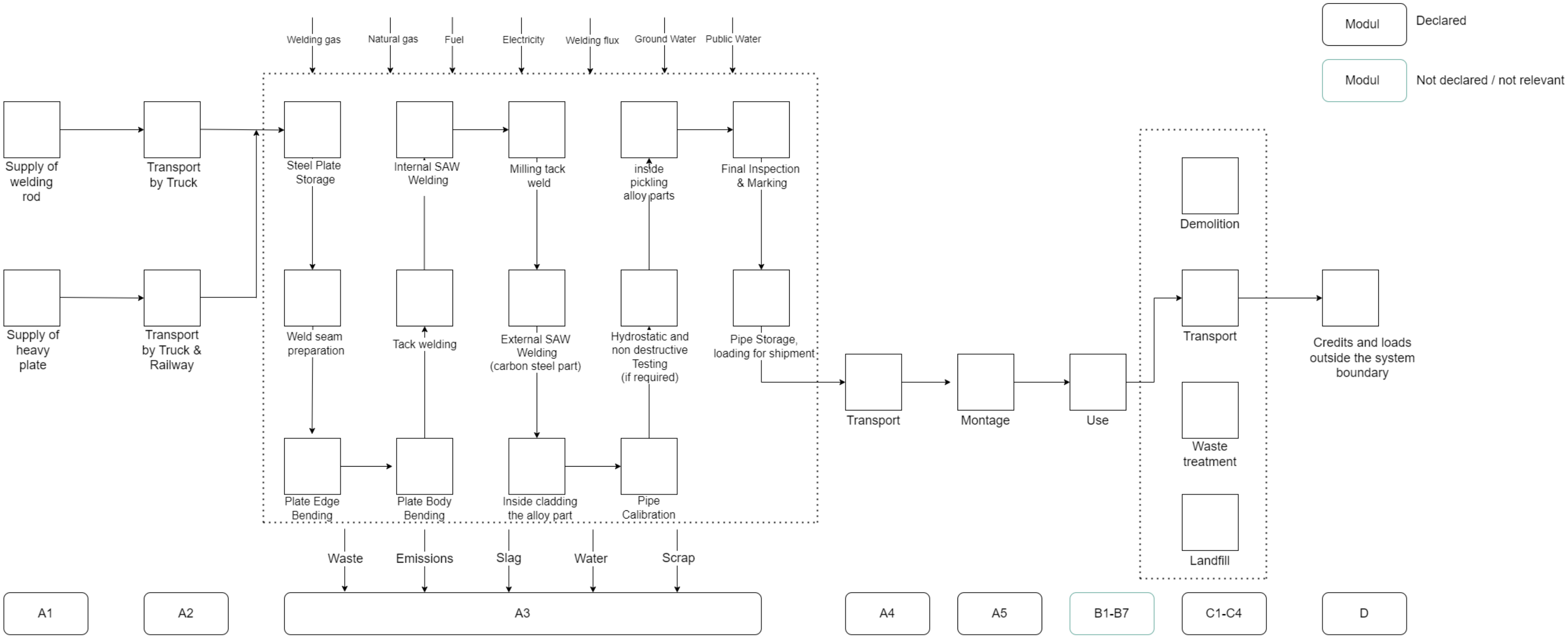

Figure 1: Process flow chart of the production of the clad pipes-EEW PPE

3. LCA: Calculation rules

3.1 Declared unit

In accordance with the PCR B – construction steel products (Edition 2020-03-13 (draft)), one metric ton of the clad pipes is chosen as the declared unit.

3.2 Conversion factors

Table 3: Conversion Factor

Product	Unit	Value
Declared Unit	metric ton of the clad pipes	1
Conversion factor to 1 kg	-	0.001

3.3 Scope of declaration and system boundaries

This EPD assesses all potential environmental impacts of the product from cradle to factory gate, with additional options. In addition to the production stages (modules A1-A3), the EPD also includes transport to the customer (module A4), installation (module A5), end-of-life stages (modules C1-C4), and the benefits and loads beyond the system boundaries (module D).

The manufacturing phase includes the production or extraction of the source materials, the transport to the respective production plant, and the production of the pipes. All inputs (raw materials, precursors, energy, and auxiliary materials), as well as the by-products and waste, are considered for all life cycle phases. The year 2022 represents the time reference for raw materials and electricity consumption. By defining the scenarios (transport from the production site and the end-of-life scenarios) according to specifications of the Dutch Environmental Database (Nationale Milieudatabase (NMD)), the Netherlands is the relevant geographical reference for the end-of-life scenario. Environmental effects such as the greenhouse effect can occur with a substantial spatial and temporal offset.

All benefits and loads beyond the system boundary (Module D) resulting from reusable products, recyclable materials and/or useful energy carriers leaving the product system are considered in this LCA.

The following production steps are considered during the production phase:

Table 4: Description of the system boundary

Description of the system boundary																
Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundaries
Raw material supply	Transport	Manufacturing	Transport from manufacturer to place of use	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishmen	Operational energy use	Operational water use	De-construction / demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
X	X	X	X	X	ND	ND	ND	ND	ND	ND	ND	X	X	X	X	X
X=Module declared | ND= Module not declared																

The waste materials and quantities produced are included in the respective modules.

3.4 Geographical reference area

The clad pipes are marketed worldwide. After the final inspection, the pipes are ready to be shipped. No average transport distances could be determined, as the logistics are sometimes organized by the customer and sometimes by EEW. A frequent shipment is transported by truck to Antwerp port and distributed world-wildly.

3.5 Cut-off criteria

All flows that influence is higher than 1% on the total mass, energy, or environmental impact are included in the LCA. All process-specific data could be determined and modelled by generic data (ecoinvent 3.6).

3.6 Allocation

Clad pipes account for 51% of total EEW PPE output by mass. As a result, all supplier contributions, energy usage, and additional materials were allocated proportionally according to the mass ratio.

During the production of the clad pipe, no co-products are generated.

3.7 Data collection and reference time period

For all processes, primary data was collected and provided by EEW PPE. The primary data refers to the year 2022.

Secondary data were taken from the ecoinvent 3.6 database, released in 2019. The database is regularly checked and thus complies with the requirements of ISO 14040/44 (background data not older than 10 years). The background data meets the requirements of EN 15804.

The quantities of raw materials, consumables and supplies used as well as the energy consumption have been recorded and averaged over the entire year of operation.

R<THINK EPD web application from the company NIBE was used to model the life cycle for the production and disposal of the declared product systems. To ensure that the results are comparable, consistent background data from the international database ecoinvent was used in the LCA (e.g., data records on energy, transport, auxiliary materials, and supplies). Almost all consistent data sets contained in the ecoinvent database are documented and can be viewed online.

The general rule that specific data from certain production processes or average data derived from certain processes must have priority when calculating an EPD or LCA was observed. Data for processes over which the manufacturer has no influence were assigned to generic data.

3.8 Estimates and assumptions

Transport distances for all raw materials (raw materials, operating materials, packaging) could be recorded. A payload factor of 50% was used for all truck transports (suppliers, disposal transports, and internal transports), which corresponds to a full delivery and empty return trip. A data set for a non-specific truck was used.

The energy and material consumptions are average values and refer to the year 2022.

The total amount of waste products generated, including slag, dust, and scrap, was reported at 10 kg per ton of product.

The proportions of the waste products are used as a reference value for calculating the raw material production waste amount.

$$p_{production\ waste\ amount}\ (\%) = \frac{m_{waste,raw\ material}}{m_{raw\ material}}$$

As a result, in the following report, overall 1%, of the steel raw material is considered waste during production.
The clad pipes are marketed worldwide. Precise transport distances vary, as logistics are managed either by the customer or EEW PPE. For transportation to the construction site (module A4), a common route involves shipping via truck to Antwerp port, covering an estimated distance of 340 km. From Antwerp port, distribution spans across the world.
EEW is not responsible for installing the clad pipes, so a fictive installation scenario (module A5) was assumed based on literature. This scenario includes the use of a self-propelled jack-up barge, 600 tons, with two engines consuming 310 liters/hr (while in operation) for a full day (24 hr), along with one generator consuming 88 liters/hr (while on standby) for 12 hours.

No CO2 certificates were considered.

3.9 Power mix

In general, a market-based approach was applied for electricity consumption in production (module A3). The electricity profile was modeled in SimaPro based on the provided Guarantees of Origin (GoO). This profile has a total Global Warming Potential (GWP) of 0.0459 kg CO_2-equivalent per kWh.

3.10 Comparability

In principle, a comparison or assessment of the environmental impacts of different products is only possible if they have been prepared in accordance with EN 15804.

For the evaluation of the comparability, the following aspects have to be considered in particular: PCR used, functional or declared unit, geographical reference, the definition of the system boundary, declared modules, data selection (primary or secondary data, background database, data quality), scenarios used for use and disposal phases, and the life cycle inventory (data collection, calculation methods, allocations, validity period). PCRs and general program instructions of different EPDs programs may differ. Comparability needs to be evaluated. For further guidance, see EN 15804+A2 (5.3 Comparability of EPD for construction products) and ISO 14025 (6.7.2 Requirements for comparability).

4. LCA: Scenarios and additional technical information

The distance to the construction site (module A4) was calculated according to the Dutch National Environmental Database (Nationale Milieu Database) method. Accordingly, the distance for transporting to the construction site was considered (340 km) by truck.
Due to a high life expectancy and the fact that EEW is not responsible for this, there is no company data available on the material recovery of the installed clad pipe. However, since there is a high potential for recycling and reusing steel pipe, this solution remains an attractive possibility. So, it is assumed that removal will be performed in the same manner as installation, a self-propelled jack-up barge, 600 ton, two engines 310 liters/hr (steaming) for one day (24 hr) with one generator 88 liters/hr (standby) for 12 hr, with the addition of an oxy-fuel cutting operation are stated for module C1 (demolition).
For the calculation of end-of-life, the standard waste scenario for steel, permanent (100yr) sheet piles placed in soil/marine water was followed based on the " Dutch National Milieudatabase" (NMD ID 90). This defines the waste scenario as 63.2% recycling and 36.8% to be left.

Note: The transport distances for waste are based on the standard waste scenarios outlined in the NMD Determination Method (SBK 2019). The distances represent the distance to the respective facilities: 150 km to an incineration plant, 50 km to a recycling facility, and 100 km to a landfill site. The transportation method used is a truck (unspecific). For energy recovery, it is assumed that only fossil raw materials are substituted, considering the calorific values of the raw materials of the declared product and energy and thermal efficiencies of 18% and 32%. According to EN 15804, loads are credited in A3 or C3 to C4, and benefits are credited in module D.

For all road transports, the environmental profile of a non-specific truck transport was used (conservative assumption): The vehicle operates with diesel and provides a fleet average that includes different lorry classes and EURO classes. This environmental profile contains data for transport, which is calculated for an average load factor, including empty return trips (Ecoinvent 3.6).

5. LCA: Results

5.1 Results of the LCA – Environmental Impact

The following tables show the results of the impact assessment indicators, resource use, waste, and other output streams. The results presented here refer to the declared specific product.

Disclaimer on ADP-e, ADP-f, WDP, ETP-fw, HTP-c, HTP-nc, SQP: The results of these environmental impact indicators must be used with caution, as the uncertainties in these results are high or as there is limited experience with the indicator.

Disclaimer on IR: This impact category mainly addresses the potential effect of low-dose ionizing radiation on human health in the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents and occupational exposures, nor does it consider radioactive waste disposal in underground facilities. Potential ionizing radiation from soil, radon, and some building materials are also not measured by this indicator.

Table 5: Results

Results of the LCA – Environmental impact: 1 ton clad pipes (EN 15804+A2)												
Parameter	**Unit**	**A1**	**A2**	**A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**	**Total A1-A3**
Core environmental impact indicators												
ADP-mm	kg Sb-eqv.	5.50E-01	1.39E-03	7.28E-03	1.15E-03	1.34E-04	1.37E-04	1.07E-04	0.00E+00	1.74E-05	-5.47E-04	5.59E-01
ADP-f	MJ	4.20E+04	8.95E+02	2.62E+03	6.85E+02	1.20E+03	1.21E+03	6.36E+01	0.00E+00	5.30E+01	-5.66E+03	4.56E+04
AP	mol H^+ eqv.	1.46E+02	3.64E-01	1.70E+00	2.63E-01	9.11E-01	9.14E-01	2.45E-02	0.00E+00	1.80E-02	-3.13E+00	1.48E+02
EP-fw	kg PO_4 eqv.	1.38E+00	8.14E-04	1.50E-02	4.58E-04	3.17E-04	3.79E-04	4.26E-05	0.00E+00	2.12E-05	-2.86E-02	1.40E+00
EP-m	kg N eqv.	1.04E+01	1.28E-01	1.56E-01	9.28E-02	4.02E-01	4.02E-01	8.62E-03	0.00E+00	6.19E-03	-5.80E-01	1.07E+01
EP-t	mol N eqv.	1.41E+02	1.41E+00	2.05E+00	1.02E+00	4.41E+00	4.42E+00	9.51E-02	0.00E+00	6.84E-02	-6.77E+00	1.45E+02
GWP-b	kg CO_2 eqv.	-2.11E+00	6.24E-02	1.21E+00	2.10E-02	2.42E-02	4.20E-02	1.95E-03	0.00E+00	3.74E-03	8.43E+00	-8.37E-01
GWP-f	kg CO_2 eqv.	3.97E+03	5.95E+01	1.42E+02	4.54E+01	8.71E+01	8.77E+01	4.22E+00	0.00E+00	1.90E+00	-8.10E+02	4.17E+03
GWP-luluc	kg CO_2 eqv.	2.88E+00	2.72E-02	1.30E-01	1.66E-02	6.86E-03	8.22E-03	1.55E-03	0.00E+00	5.29E-04	5.97E-01	3.04E+00
GWP-total	kg CO_2 eqv.	3.97E+03	5.96E+01	1.43E+02	4.54E+01	8.71E+01	8.77E+01	4.22E+00	0.00E+00	1.90E+00	-8.01E+02	4.17E+03
ODP	kg CFC 11 eqv.	2.58E-04	1.26E-05	1.79E-05	1.00E-05	1.88E-05	1.89E-05	9.31E-07	0.00E+00	7.81E-07	-1.98E-05	2.88E-04
POCP	kg NMVOC eqv.	4.17E+01	4.00E-01	5.45E-01	2.92E-01	1.21E+00	1.21E+00	2.71E-02	0.00E+00	1.98E-02	-4.60E+00	4.26E+01
WDP	m^3 world eqv.	1.80E+03	3.72E+00	3.45E+01	2.45E+00	1.61E+00	2.62E+00	2.28E-01	0.00E+00	2.38E+00	-1.54E+02	1.84E+03
Additional environmental impact indicators												
ETP-fw	CTUe	1.48E+06	8.16E+02	1.57E+04	6.10E+02	7.22E+02	7.30E+02	5.67E+01	0.00E+00	3.44E+01	-2.72E+04	1.50E+06
HTP-c	CTUh	3.03E-05	2.95E-08	3.44E-07	1.98E-08	2.52E-08	2.54E-08	1.84E-09	0.00E+00	7.96E-10	-1.05E-07	3.07E-05
HTP-nc	CTUh	2.76E-04	8.95E-07	9.63E-06	6.68E-07	6.20E-07	6.26E-07	6.21E-08	0.00E+00	2.44E-08	1.59E-04	2.86E-04
IRP	kBq U235 eqv.	1.11E+02	3.89E+00	3.46E+00	2.87E+00	5.14E+00	5.24E+00	2.67E-01	0.00E+00	2.17E-01	1.38E+01	1.19E+02
PM	disease incidence	5.22E-04	5.25E-06	6.79E-06	4.08E-06	2.41E-05	2.41E-05	3.80E-07	0.00E+00	3.50E-07	-4.69E-05	5.34E-04
SQP	-	3.36E+04	7.59E+02	2.15E+03	5.94E+02	1.53E+02	1.56E+02	5.52E+01	0.00E+00	1.11E+02	-1.25E+03	3.65E+04

ADP-mm= Abiotic depletion potential for non-fossil resources | **ADP-f**=Abiotic depletion for fossil resources potential | **AP**= Acidification potential, Accumulated Exceedance | **EP-fw** = Eutrophication potential, fraction of nutrients reaching freshwater end compartment | **EP-m**= Eutrophication potential, fraction of nutrients reaching marine end compartment| **EP-T**= Eutrophication potential, Accumulated Exceedance | **GWP-b**=Global Warming Potential biogenic | **GWP-f**=Global Warming Potential fossil fuels | **GWP-luluc**=Global Warming Potential land use and land use change |**GWP-total**=Global Warming Potential total| **ODP**=Depletion potential of the stratospheric ozone layer |**POCP**=Formation potential of tropospheric ozone | **WDP**=Water (user) deprivation potential, deprivation- weighted water consumption | **ETP-fw**=Potential Comparative Toxic Unit for ecosystems | **HTP-c**=Potential Toxic Unit for Humans toxicity, cancer | **HTP-nc**= Potential Toxic Unit for humans, non-cancer | **IRP**=Potential Human exposure efficiency relative to U235, human health | **PM**=Potential incidence of disease due to Particulate Matter emissions | **SQP**=Potential soil quality index

Table 5: Results (continued)

Results of the LCA – Environmental impact: 1 ton clad pipes (EN 15804+A2)												
Parameter	**Unit**	**A1**	**A2**	**A3**	**A4**	**A5**	**C1**	**C2**	**C3**	**C4**	**D**	**Total A1-A3**
PERE	MJ	7.50E+03	1.84E+01	1.07E+03	8.57E+00	6.48E+00	8.54E+00	7.97E-01	0.00E+00	4.28E-01	1.64E+02	8.59E+03
PERM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	7.50E+03	1.84E+01	1.07E+03	8.57E+00	6.48E+00	8.54E+00	7.97E-01	0.00E+00	4.28E-01	1.64E+02	8.59E+03
PENRE	MJ	4.46E+04	9.50E+02	2.82E+03	7.27E+02	1.27E+03	1.28E+03	6.76E+01	0.00E+00	5.63E+01	-5.87E+03	4.84E+04
PENRM	MJ	0.00E+00	0.00E+00	4.95E+01	0.00E+00	0.00E+00	4.76E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.95E+01
PENRT	MJ	4.46E+04	9.50E+02	2.87E+03	7.27E+02	1.27E+03	1.29E+03	6.76E+01	0.00E+00	5.63E+01	-5.87E+03	4.85E+04
SM	kg	1.00E+02	0.00E+00	1.15E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.01E+02
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m^3	4.78E+01	1.43E-01	9.69E-01	8.34E-02	6.17E-02	9.23E-02	7.75E-03	0.00E+00	5.65E-02	-2.93E+00	4.89E+01
HWD	kg	1.87E-01	2.21E-03	2.32E-03	1.73E-03	3.26E-03	3.27E-03	1.61E-04	0.00E+00	7.92E-05	-9.72E-02	1.92E-01
NHWD	kg	1.94E+03	5.19E+01	2.59E+01	4.34E+01	1.42E+00	1.46E+00	4.04E+00	0.00E+00	3.60E+02	-7.93E+01	2.02E+03
RWD	kg	1.17E-01	5.84E-03	3.66E-03	4.50E-03	8.32E-03	8.41E-03	4.18E-04	0.00E+00	3.48E-04	4.78E-03	1.26E-01
CRU	kg	0.00E+00	0.00E+00	5.39E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.39E-01
MFR	kg	0.00E+00	0.00E+00	2.15E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.32E+02	0.00E+00	0.00E+00	2.15E+01
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EET	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PERE=Use of renewable primary energy excluding renewable primary energy resources used as raw materials | **PERM**= Use of renewable primary energy resources used as raw materials | **PERT**=Total use of renewable primary energy resources | **PENRE**= Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials | **PENRM**= Use of non-renewable primary energy resources used as raw materials | **PENRT**= Total use of non-renewable primary energy resources | **SM**=Use of secondary material | **RSF**=Use of renewable secondary fuels | **NRSF**=Use of non-renewable secondary fuels | **FW**=Use of fresh water | **HWD**=Hazardous waste disposed | **NHWD**=Non-hazardous waste disposed | **RWD**=Radioactive waste disposed | **CRU**=Components for reuse | **MFR**=Materials for recycling | **MER**=Materials for energy recovery | **EE**=Exported energy | **EET**= Exported Energy Thermic | **EEE**= Exported Energy Electric

Table 6: Biogenic Carbon Content

LCA results- information on biogenic carbon content:1 ton clad pipes/ (EN15804+A2)		
Parameters	**Unit**	**Value**
Biogenic carbon content in the product	kg C	0
Biogenic carbon content in the associated packaging	kg C	0
Note: 1 kg of biogenic carbon corresponds to 44/12 kg of CO2		

5.2 Calculation of the MKI value (Dutch: Milieukostenindicator; English: Environmental Cost Indicator, ECI)

The results are aggregated to a single-point score using the shadow price method, which is presented in the SBK Determination Method (2009) and NMD Environmental Performance Assessment Method for Construction (2022). The ECI is a suitable valuation method, especially in the Dutch construction sector. In the Netherlands, it is a prerequisite for public tenders. The indicator aims to show the shadow price for the environmental impacts of a product or project. The following weighting is used for aggregation:

Table 7: Weighting factors (for the environmental impact categories) (NMD 2022)

Impact	Equivalent Unit	Weighting [€/ Equivalent Unit]
Depletion of abiotic raw materials (excluding fossil energy carriers) - ADP	kg Sb eq.	0.16
Depletion of fossil energy carriers - ADP	kg Sb eq.	0.16
Global warming - GWP 100 years	kg CO_2 Eq	0.05
Ozone layer depletion - ODP	kg CFC-11 Eq	30
Photochemical oxidant-formation - POCP	kg C_2H_4 eq	2
Acidification - AP	kg SO_2 Eq	4
Eutrophication - EP	kg PO_4^{3-} Eq	9
Human toxicity - HTP	1,4-DCB eq	0.09
Freshwater aquatic ecotoxicity - FAETP	1,4-DCB eq	0.03
Marine aquatic ecotoxicity - MAETP	1,4-DCB eq	0.0001
Terrestrial ecotoxicity - TETP	1,4-DCB eq	0.06

Due to its weighting, the impact category GWP has the greatest influence on the indicator score. The application of single-point scores is an additional assessment tool for eco-balance results. However, it must be pointed out that weightings are always based on value maintenance and not on a scientific basis (EN 14040). The ECI results are shown in the following tables.

Table 8: Results - MKI value (1-point evaluation) per 1 ton clad pipe

Module EN15804	ECI NL (€)per module	Share in total (%)
A1 Raw Materials Supply	2817.5	100.8
A2 Transport	7.2	0.3
A3 Manufacturing	35.9	1.3
A4 Transport from the gate to the site	5.4	0.2
A5 Construction - Installation process	11.5	0.4
C1 Demolition	11.6	0.4
C2 Transport	0.5	0.0
C3 Waste processing	0.0	0.0
C4 Final disposal	0.3	0.0
D Benefits and loads beyond the product system boundary	-94.2	-3.4
ECI NL per functional unit	2795.65	

Note: Users of weighting factors should be aware that there is less consensus on weighting and weighting factors than, for example, on characterization factors and that the method is also subject to uncertainties (NMD 2022).

6. LCA: Interpretation

The following figure shows the impact categories for 1 ton of the clad pipe.

Clad pipes account for 51% of total EEW PPE output by mass and all supplier contributions, energy usage, and additional materials were allocated proportionally according to the 51% mass ratio.

All input values (raw and ancillary materials , energy) were calculated considering 1 ton of product (clad pipe) as the reference point.

As shown in the Figure, A1 (raw material supply) shows the most significant influence on environmental core indicators. This is primarily due to the use of heavy plate, which notably impacts the environmental life cycle of the product. In general, clad pipes have the potential for recycling. As a result, D has a credit outside of the production system based on the waste scenario.

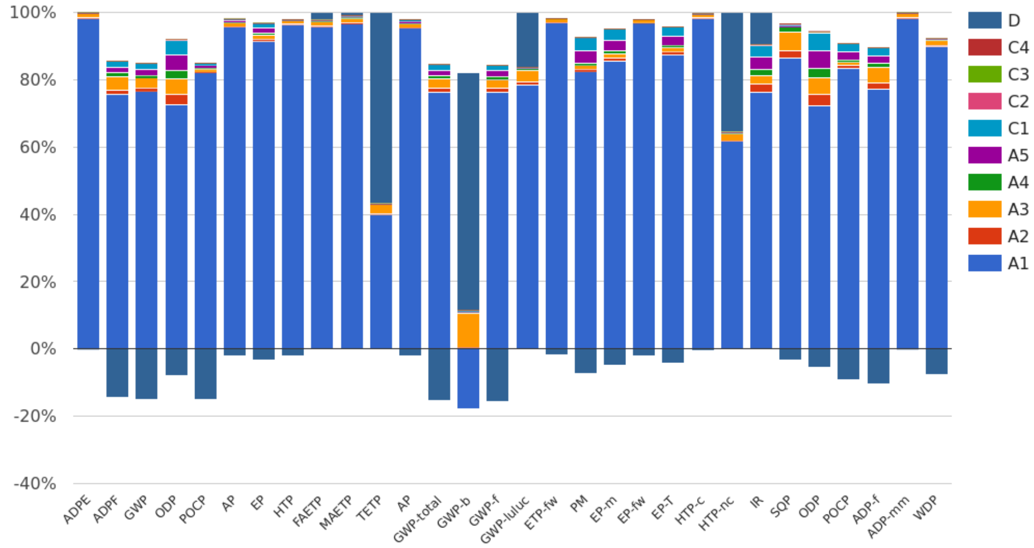

Figure 2: Clad pipes- Impact of the individual modules on the environmental core indicators (NMD set 1+2)

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