Environmental Product Declaration

In accordance with ISO 14025 and EN 15804:2012+A2:2019 for:

Nautic Series 1500 Water Closet (WC)

from

Villeroy and Boch AG.
Saaruferstraße, 66693 Mettlach (Germany)

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General information

Programme information

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
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CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product category rules (PCR): *Construction products, 2019:14, version 1.0*
PCR review was conducted by: Martin Erlandsson, IVL Swedish Environmental Research Institute, martin.erlandsson@ivl.se
Independent third-party verification of the declaration and data, according to ISO 14025:2006: ☐ EPD process certification ☒ EPD verification
Third party verifier: *Manfred Russ* *Senior Sustainabilty Consultant Quantis* *Accredited Verifier* *International EPD® System* *E-Mail: Manfred.russ@quantis-intl.com*
Procedure for follow-up of data during EPD validity involves third party verifier: ☒ Yes ☐ No
Villeroy & Boch 1748 — Owner of the declaration Villeroy & Boch AG Saaruferstraße, 66693 Mettlach (Germany) https://www.villeroyboch-group.com/
ERM — EPD prepared by ERM LTD. Exchequer court, 33 St Mary Axe, Lime Street, London EC3A 8AA www.erm.com

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EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804. For further information about comparability, see EN 15804 and ISO 14025.

Company information

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Villeroy & Boch AG

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Description of the organisation:
This EPD study on 'Sanitary Ceramics,' specifically focussing on water closet products (hereafter referred to as 'WC") was commissioned by Villeroy & Boch (V&B), one of the largest providers of "Bathroom and Wellness and Tableware" related products in Europe. With its head office based in Germany (Saaruferstraße,66693 Mettlach) V&B is a major manufacturer of ceramics with 13 manufacturing facilities in Europe. Its products are sold in around 125 countries.

Product-related or management system-related certifications:
DIN EN ISO 9001:2015 – Quality Management System
DIN EN ISO 14001:2015 – Environmental Management System
DIN EN ISO 50001 :2015 – Energy Management System

Name and location of production sites:
Villeroy & Boch Magyarország Kft., Erzsébeti út. 7, HU-6800 Hódmezővásárhely
MONDIAL SA, Str. Timişorii, Nr. 149-151, RO-305500 Lugoj, Jud. Timiş
Villeroy & Boch Gustavsberg AB, Odelsberg väg 11, S-13440 Gustavsberg
Villeroy & Boch (Thailand) Co. Ltd., 58 Moo 6 Nogplamoe, Nongkhae, Saraburi, 18140, Thailand

Product information

Product name:
Nautic Series 1500 Water Closet (WC)

Product identification:
The WC assessed in this EPD is part of the Nautic series 1500 engineered ceramic sanitary ware products (see **Fehler! Verweisquelle konnte nicht gefunden werden.**). This includes an open edge flush for simplified cleaning, low flush button, clean-friendly and minimalist design as well as a soft close feature.

Figure 1: Nautic series 1500 WC

UN CPC Code:
37210 Ceramic sinks, baths, water closet pans, flushing cisterns and similar sanitary fixtures

Product description:
The product is a WC comprising several individual components namely: ceramic tank, under ceramic, flushing valve, push button, seat and fixings produced in manufacturing sites across Europe as well as Thailand. The majority of the material is comprised of ceramic (80 to 85%). Once individually produced, these components are transported to Gustavsberg (Sweden) for final assembly into a finished product. Table 1 indicates the material compostion of the Nautic series 1500 WC.

The ceramic tanks are supplied from two locations, with 60% coming from Thailand (7.30 kg) and 40% from Romania (7.20 kg). Thus an average mass of 7.26kg for ceramic tanks has been utilised.

Table 1: Typical material composition of the Nautic series 1500 WC

Country	Part	Mass	% (w/w)
Romania	Ceramic Tank	2.88 kg	8.92%
Thailand	Ceramic Tank	4.38 kg	13.57%
Hungary	Under Ceramic	22.6 kg	70.03%
Portugal	Flushing Valve (98% brass, 1% PP, 1% EPDM)	0.12 kg	0.38%
Estonia & Portugal	Push Button (40% POM, 2% stainless steel, 58% ABS)	0.05 kg	0.17%
Bulgaria	Seat (25% cellulose, 61% UF resin, 6% stainless steel, 8% others)	2.20 kg	6.82%
Luxembourg	Fixings (35% PA-6, 30% HDPE, 35% stainless steel)	0.03 kg	0.10%
Total		**32.27 kg**	**100.00%**

Packaging
No packaging has been modelled for the final product.

Recycled material:

No externally sourced recycled material is used in the final product.

LCA information

Functional unit / declared unit:
The declared unit for the WC is typically based on finished pieces, hence the declared unit for the water closet assembled at Gustavsberg is:

"One complete floorstanding Nautic series 1500 WC"

As this is a 'cradle-to-gate (A1-A3+C+D)' study and B1 – B7 steps are not included, the declaration of the reference service life (RSL) is not applicable.

Reference service life:
Not applicable

Time representativeness:
LCA calculations were subject to client-specific data from 2019 and based on one-year averaged data.

Geographic representativeness:
The upstream supply chain has been modelled based on production from the specific various V&B manufacturing sites and supplier locations used to make the Nautic product. It has been assumed that the product will be sold in the EU and the end of life stage will also take place in the EU.

Databases and LCA software used
All primary data used was based on the manufacturer's specific data inventory. Modelling was carried out using GaBi software (version 9.5.2.49). Background life cycle inventory data were primarily sourced from the GaBi 2020 databases, supplemented with data from ecoinvent v3.6, where this was deemed more representative. Country specific data forfuels and energy were used where possible. It was more challenging to find country-specific data for raw materials; if this could not be obtained, European average data were used where available. If the country specific data was not available, the most representative dataset from another location was used.

Description of system boundaries:
System boundary: cradle-to-gate study (A1-A3+C+D).

The LCA addresses the environmental aspects and potential environmental impacts from the point at which raw materials are extracted from the environmental through to final assembly of the finished product Gustasvberg. The end of life stage is also considered, from removal of the used WC a through to the final disposal along with and the benefits and loads beyond the system boundary.

Life cycle stage descriptions are shown below in Table 2 and Figure 2.

Table 2: Description of the system boundary according to the PCR

Life cycle stage	Individual stages	Module Code	Use
Product stage	Raw material	A1	X
	Transport	A2	X
	Manufacturing	A3	X
Construction process stage	Transport	A4	MND
	Construction Installation	A5	MND

Use stage	Use	B1	MND
	Maintenance	B2	MND
	Repair	B3	MND
	Replacement	B4	MND
	Refurbishment	B5	MND
	Operational energy use	B6	MND
	Operational water use	B7	MND
End of life stage	De-construction & demolition	C1	X
	Transport	C2	X
	Waste processing	C3	X
	Disposal	C4	X
Resource recovery stage	Reuse-Recovery-Recycling-potential	D	X

X = declared modules, MND = module not declared

The system boundaries considered in this study are presented in Figure 2 and include A1, A2, A3, C1, C2, C3, C4 and D from above:

Figure 2: System Diagram

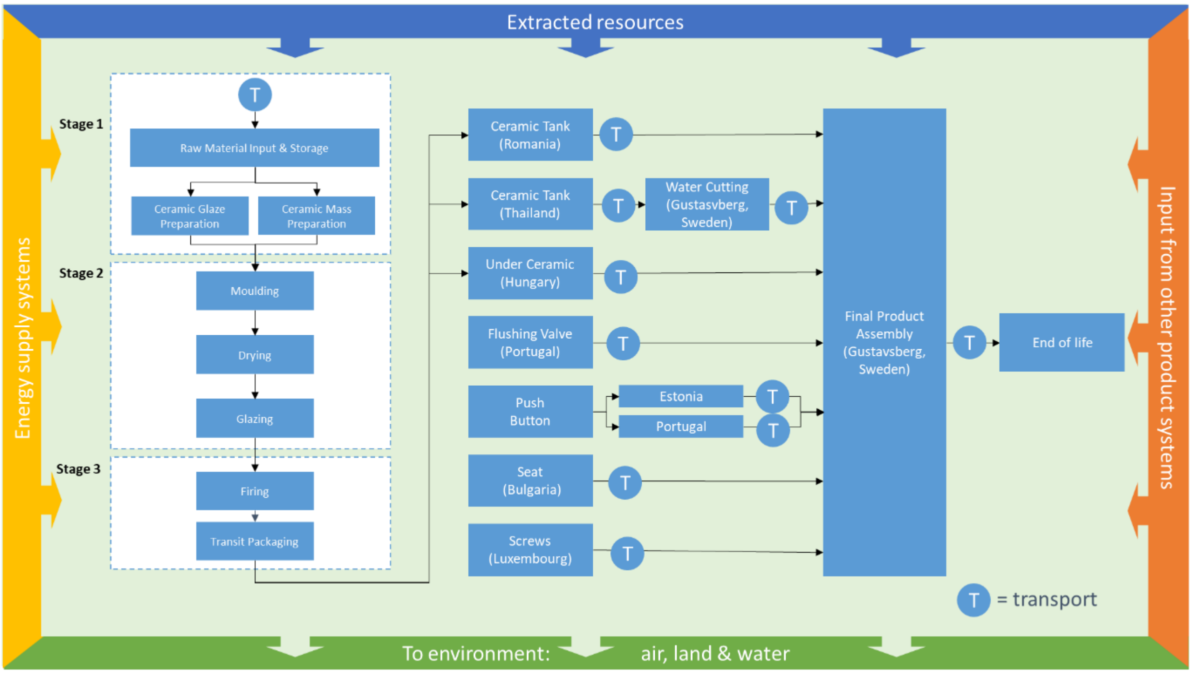


Table 3 summarises those life cycle aspects that have been included within and excluded from the study.

Table 3: Components inclusion/ exclusion

Included	Excluded
▪ Raw material acquisition ▪ Processing of raw materials ▪ Transport of raw materials to V&B manufacturing sites ▪ Energy used in production at manufacturing facilities ▪ Assembly of finished product ▪ Transport and disposal/recycling of wastes ▪ Transportation of components to assembly site	▪ Production, transportation and disposal of the packaging used for raw materials ▪ Construction activities, capital equipment and infrastructure ▪ Human labor, employee commute and business travel

Description of production process

The production process of ceramic parts includes the following steps:

Raw Material Preparation

For 'mass' preparation (comprising the material bulk of the ceramic product) the hard materials (feldspar, quartz and internally crushed, fired sanitary ware) are ground with water while the clays are separately dissolved in water with stirrers. Both suspensions are then mixed together with kaolin and conveyed through sieves and filters to a vessel, where the liquid fresh mass ('casting slip') is mixed with recycled mass from the production process. After a few days of rest the slip can be processed in the production facilities.

In case of glaze preparation (providing the surface coating of the product), the raw materials are ground together with water and, if necessary, desired colour bodies and mixed with recycled glaze from the production. After filtration and the addition of levelling agents, the glaze can be used in the glazing area.

Gypsum casting

In the plaster casting process, a plaster mould is filled with casting slip. Due to the capillary force of the absorbent material plaster, water is removed from the slurry to yield a thicker, more uniform, homogeneous material. This process can take 70-90 minutes depending on environmental conditions and the consistency of the casting compound. When the desired thickness is reached, the plaster mould is removed. The remaining slip is emptied and it is left to dry for approximately 60 minutes.

High pressure casting

During the moulding process, a high pressure system removes a large part of the water from the slurry in the porous plastic mould. After a certain amount of standing time, any residual slurry that is not required is returned to the working tank, then the blank of the sanitary article is released from the die-casting mould with the help of water and air. The moulds are then rinsed with water and air to prevent the capillaries from clogging.

After demoulding, the blanks ('green bodies') are processed by hand. The casting seams are deburred and the assembly, flushing and overflow holes are formed with special tools. Uneven areas are then smoothed out with the help of different sponges and water. Defective parts are removed from the process and made available to the mass preparation for recycling.

Drying

The blanks are dried before firing. During the drying process the moisture in the blank is reduced to a minimum. Integrated measuring and testing methods are used to detect defects in the articles at an early stage, to remove irreparable parts from the process and, if necessary, to recycle them back into the mass preparation stage.

Firing

The glazed blanks are placed on kiln cars with refractory base (fireclay). The supporting surface of the tunnel kiln car is coated with a release agent, which prevents the ceramic parts from sticking to the surface. The blanks are then fired in a gas-powered tunnel kiln.

Assembly

All ceramic parts along with the associated fixtures and fittings, from their respective manufacturing sites are then packaged and sent to the site based in Gustavsberg (Sweden) for final assembly.

Ceramic parts from Thailand undergo an additional process (water-cutting) onsite at Gustavsberg (Sweden) before final assembly.

End of life scenario

It has been assumed that, at end of life, the WC would be manually dismantled from where it has been installed during the use stage. Hence no burdens have been allocated to module C1.

It was considered that the most likely end of life route for the WC would be landfill and it has been assumed that this is 50 km from the location of the building where the product was installed.

Although some small components of the WC could potentially be recycled (eg steel fittings, some plastic components), it is considered very unlikely that this would occur in practice due to the small quantities involved and the difficulty of disassembling the product to get at these items. Therefore it has been assumed that no recycling or recovery takes place at end of life (no burdens associated with module C3)

The WC would be largely inert in landfill. There is a small amount of potentially biodegradable material in the seat (cellulose), but this is encased in a matrix of urea formaldehyde resin and so, in practice, it is unlikely to readily biodegrade (within a 100 year time horizon). Hence this will be a net 'sink' for biogenic carbon (taken up from the atmosphere but not re-emitted).

No externally sourced recycled content is used in manufacturing the WC and at end of life no materials from the WC are recycled or sent for energy recovery. The product is inert in landfill (not producing landfill gas that can be burnt to produce electricity). As such, no potential benefits or loads beyond the system boundary have been modelled in module D.

Data Quality

Data collection followed the guidance provided in ISO 14044:2006, clause 4.3.2. All producer-specific data are from 2019 and are based on one-year averaged data.

ERM collected site-specific data from V&B's operations using structured questionnaires. The data received were cross-checked for completeness and plausibility using mass balances and stoichiometry, as well as internal and external benchmarking.

All background data were obtained from the databases contained within the Gabi 9.5.2.49 software: most data were sourced from the Gabi 2020 database from Sphera, supplemented with data from ecoinvent v3.6 and Eurofer inventories. Datasets from these databases have been used worldwide for several years in LCA models of many critically reviewed studies in industrial and scientific applications.

The vast majority of data were sourced from 2016-2019, although a few datasets were older (dating back as far as 2014).

Cut-off criteria

EN 15804 requires that where there are data gaps or insufficient input data for a unit process, the cut-off criteria shall be 1% of renewable and non-renewable primary energy usage and 1% of the total mass of this unit process. The total neglected flows from a product stage must be no more than 5% of product inputs by mass or 5% of primary energy contribution.

All emissions and their environmental impact contributing greater than 1% to the total must be recorded.

In this assessment, all information gathered from data collection for the production of the WC has been modelled, i.e. all raw materials used, the electrical energy and other fuels used, use of ancillary materials and all direct production waste. Transport data on input and output flows have also considered.

Assumptions and Limitations

This EPD does not assess the installation and use stages associated with the WC life cycle. The end of life of the WC has been modelled based on what is currently the most likely scenario, but this may not be representative of the end of life of a newly installed product that would be disposed of some years in the future, eg if recycling of post-consumer ceramics were to become more widespread. Packaging of the finished product has also not been considered.

Allocation

Most scrap generated during production of the ceramic components is internally recycled. A small amount is sent for external recycling. No impacts have been allocated to this scrap, all burdens associated with the production process have been assigned to the main ceramic product.

LCA Additional Technical Information

Additional information from life cycle stages are provided above:

Components and fixtures

The ceramic components and associated fixtures used for the manufacture of the WC and their global locations are detailed below:

- Ceramic water tank – Romania (40%) and Thailand (60%)
- Under ceramics (bowl and support) – Hungary
- Flushing valve – Portugal
- Push button – Estonia (5%) & Portugal (95%)
- Seat – Bulgaria
- Screws – Luxemburg

Waste disposal:

The WC manufacturing processes generates process wastewater that is sent to a municipal waste water process alongside sludge. Additionally there is a minimal amount of scrap that is either internally or externally recycled or sent to landfill.

Assembly:

32.27 kg of individual components are required to produce a single unit of complete floor standing WC.

Further Information

Additional information on the Nautic Series 1500 Water Closet product can be found at www.gustavsberg.com

https://www.gustavsberg.com/en/products/toilet/toilets/product/GB111500201311/toilet-nautic-1500-hidden-s-trap-hygienic-flush-double-flush-24l-standard-seat/

Environmental Information

Potential environmental impact

	A1	A2	A3	C1	C2	C3	C4	D	TOTAL
GWP - total [kg CO2 eq.]	6.40E+01	9.96E+00	2.77E+00	0.00E+00	4.53E-01	0.00E+00	4.52E-01	0.00E+00	7.76E+01
GWP - fossil [kg CO2 eq.]	6.46E+01	9.82E+00	2.68E+00	0.00E+00	4.51E-01	0.00E+00	4.89E-01	0.00E+00	7.80E+01
GWP – biogenic [kg CO2 eq.]	-6.93E-01	7.86E-02	9.25E-02	0.00E+00	-7.74E-04	0.00E+00	-3.88E-02	0.00E+00	-5.61E-01
GWP - luluc [kg CO2 eq.]	4.44E-02	5.80E-02	6.84E-04	0.00E+00	3.67E-03	0.00E+00	1.41E-03	0.00E+00	1.08E-01
ODP [kg CFC-11 eq.]	9.66E-07	9.51E-16	3.28E-15	0.00E+00	5.45E-17	0.00E+00	1.81E-15	0.00E+00	9.66E-07
AP [Mole of H+ eq.]	1.28E-01	4.43E-02	1.34E-02	0.00E+00	4.42E-04	0.00E+00	3.51E-03	0.00E+00	1.90E-01
EP - freshwater [kg P eq.]	1.34E-03	2.20E-05	8.88E-05	0.00E+00	1.38E-06	0.00E+00	8.41E-07	0.00E+00	1.45E-03
EP - marine [kg N eq.]	3.27E-02	1.23E-02	6.98E-03	0.00E+00	1.20E-04	0.00E+00	9.04E-04	0.00E+00	5.30E-02
EP - terrestric [Mole of N eq.]	3.78E-01	1.37E-01	7.29E-02	0.00E+00	1.49E-03	0.00E+00	9.93E-03	0.00E+00	5.99E-01
POCP [kg NMVOC eq.]	9.31E-02	3.40E-02	1.72E-02	0.00E+00	3.45E-04	0.00E+00	2.74E-03	0.00E+00	1.47E-01
ADPF [MJ]	1.18E+03	1.07E+02	4.52E+00	0.00E+00	6.03E+00	0.00E+00	6.42E+00	0.00E+00	1.30E+03
ADPE [kg Sb eq.]	1.85E-04	5.38E-07	5.09E-08	0.00E+00	3.25E-08	0.00E+00	4.39E-08	0.00E+00	1.86E-04
WDP [m^3 world equiv.]	1.12E+01	6.57E-02	3.14E-01	0.00E+00	4.05E-03	0.00E+00	5.13E-02	0.00E+00	1.16E+01

Caption: GWP - total = global warming potential; GWP - fossil = global warming potential (fossil fuel only); GWP - biogenic = global warming potential (biogenic); GWP - luluc = global warming potential (land use only); ODP = ozone depletion; AP = acidification terrestrial and freshwater; EP - freshwater = eutrophication potential (freshwater); EP - marine = eutrophication potential (marine); EP- terrestric = eutrophication potential (terrestrial); POCP = photochemical ozone formation; ADPE = abiotic depletion potential (element), ADPF = abiotic depletion potential (fossil); WDP = water scarcity.

Use of resources

	A1	A2	A3	C1	C2	C3	C4	D	TOTAL
PERE [MJ]	2.04E+02	5.40E+00	1.08E+00	0.00E+00	3.39E-01	0.00E+00	8.41E-01	0.00E+00	2.12E+02
PERM [MJ]	1.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.05E+01
PERT [MJ]	2.15E+02	5.40E+00	1.08E+00	0.00E+00	3.39E-01	0.00E+00	8.41E-01	0.00E+00	2.23E+02
PENRE [MJ]	1.01E+03	1.07E+02	4.52E+00	0.00E+00	6.04E+00	0.00E+00	6.42E+00	0.00E+00	1.13E+03
PENRM [MJ]	1.78E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.78E+02
PENRT [MJ]	1.18E+03	1.07E+02	4.52E+00	0.00E+00	6.04E+00	0.00E+00	6.42E+00	0.00E+00	1.30E+03
SM [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
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
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
FW [m3]	5.01E-01	6.28E-03	7.92E-03	0.00E+00	3.93E-04	0.00E+00	1.62E-03	0.00E+00	5.17E-01

Caption: 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 net fresh water

Waste production and output flows

	A1	A2	A3	C1	C2	C3	C4	D	TOTAL
HWD [kg]	4.39E-05	4.44E-06	3.50E-08	0.00E+00	2.81E-07	0.00E+00	9.79E-08	0.00E+00	4.88E-05
NHWD [kg]	1.09E+00	1.58E-02	9.75E+00	0.00E+00	9.24E-04	0.00E+00	3.23E+01	0.00E+00	4.32E+01
RWD [kg]	8.26E-02	1.31E-04	2.44E-04	0.00E+00	7.48E-06	0.00E+00	7.30E-05	0.00E+00	8.31E-02
CRU [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
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
MFR [kg]	0.00E+00	0.00E+00	3.45E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.45E-01
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
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

Caption: HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy

Information on biogenic carbon content

	A1	A2	A3	C1	C2	C3	C4	D	TOTAL
Biogenic carbon content in product [kg]	2.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.44E-01
Biogenic carbon content in packaging [kg]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

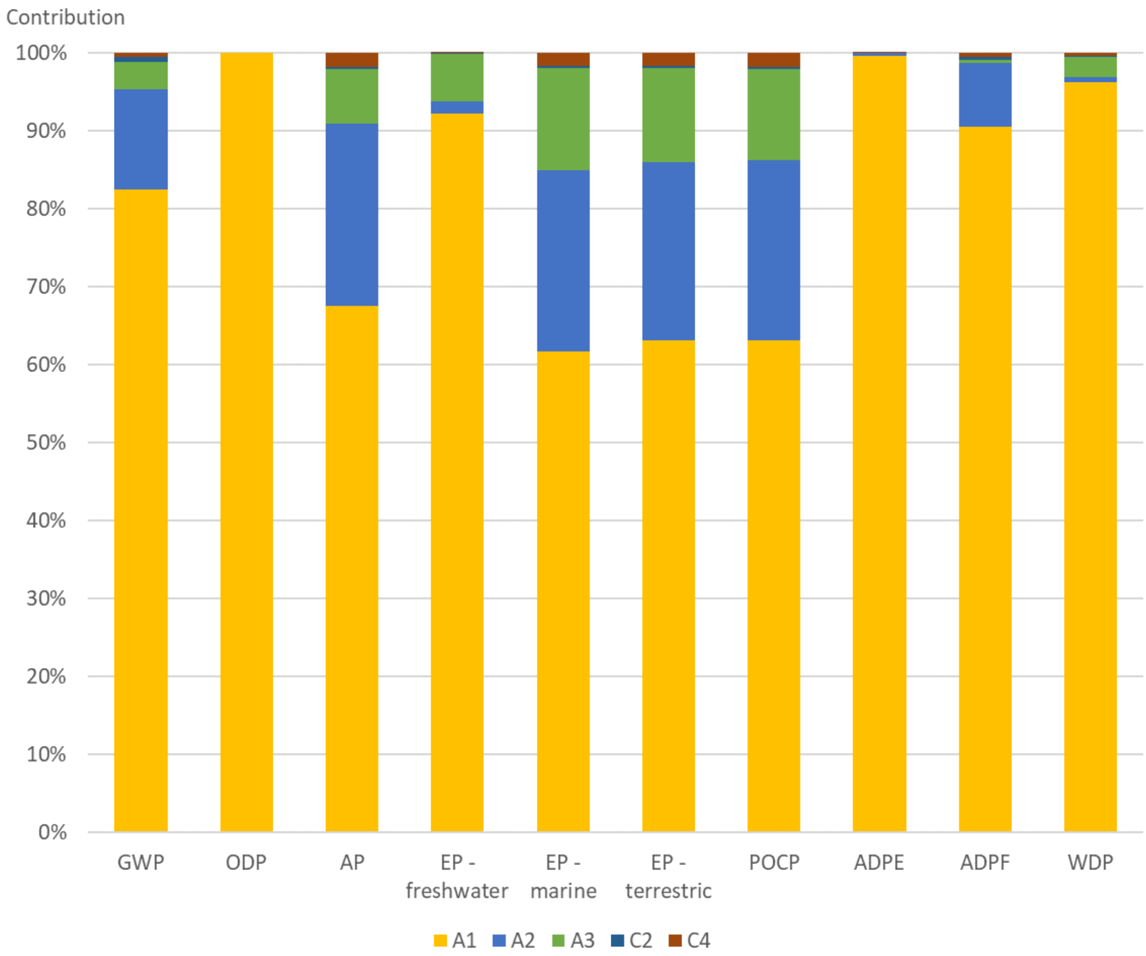
Other environmental indicators

	A1	A2	A3	C1	C2	C3	C4	D	TOTAL
PM [Disease incidences]	1.67E-06	6.58E-07	4.42E-08	0.00E+00	2.71E-09	0.00E+00	4.35E-08	0.00E+00	2.42E-06
IR [kBq U235 eq.]	8.43E+00	1.89E-02	3.55E-02	0.00E+00	1.08E-03	0.00E+00	7.50E-03	0.00E+00	8.49E+00
ETF-fw [CTUe]	2.98E+02	7.56E+01	7.40E+00	0.00E+00	4.26E+00	0.00E+00	3.67E+00	0.00E+00	3.89E+02
HTP-c [CTUh]	1.01E-07	1.57E-09	3.40E-10	0.00E+00	8.93E-11	0.00E+00	5.44E-10	0.00E+00	1.04E-07
HTP-nc [CTUh]	8.80E-07	8.07E-08	2.50E-08	0.00E+00	4.59E-09	0.00E+00	5.99E-08	0.00E+00	1.05E-06
SQP [Pt]	2.77E+02	3.35E+01	1.31E+00	0.00E+00	2.12E+00	0.00E+00	1.34E+00	0.00E+00	3.15E+02

Caption: PM = Particulate matter emissions; IR = Ionizing radiation, human health; ETF-fw = Eco-toxicity (freshwater); HTP-c = Human toxicity, cancer effects; HTP-nc = Human toxicity, non-cancer effects, SQP = Soil quality potential/ Land use related impacts

Interpretation

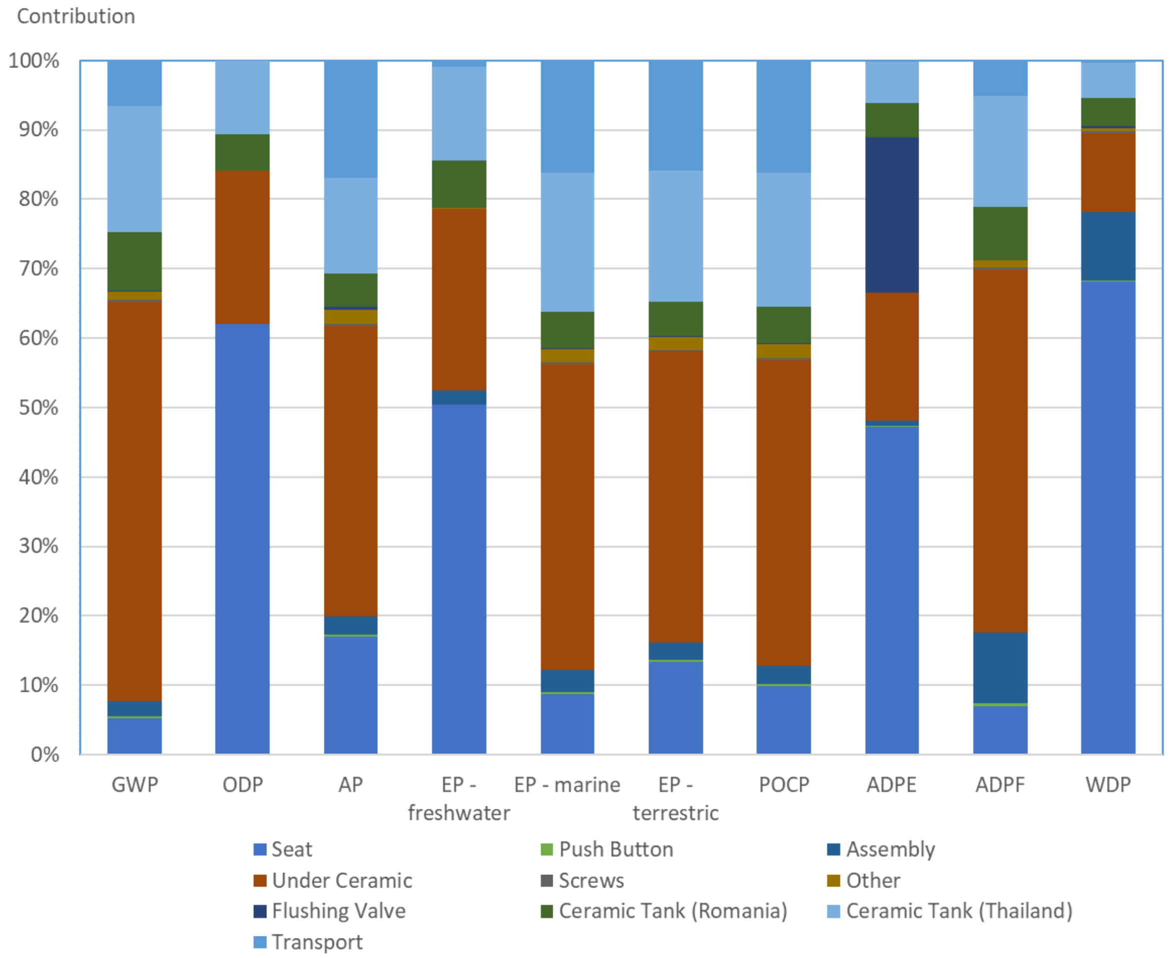
Figure 3: Contribution of modules (A1, A2, A3, C2 and C4) to environmental impact categories for WC



The results in Figure 3 show that module A1 (raw material supply) is the dominant contributor to the majority of environmental impact categories, accounting for more than 65% of burdens for every impact category. Burdens associated with module A2 are the next most significant, but to a much lesser extent than A1, and is negligible for several impact categories. Similarly, Module A3, also has a reasonable contribution to some impact categories but a minor contribution in others.

Modules associated with end of life have a negligible contribution to the overall life cycle burdens.

Figure 4: Contribution of individual components to environmental impact categories for WC



The results in Figure 4 show that the under ceramic from Hungary is the dominant contributor to eight out of the ten environmental impact categories (GWP, AP, EP freshwater, marine and terrestric),POCP, ADPE and ADPF. This is the largest individual component in the WC. Contributions from seat production are dominant for ODP and WDP environmental impact categories.

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