# Environmental Product Declaration

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

## Average Ceramic Product

from


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




| | |
|---|---|
| Programme: | The International EPD® System, www.environdec.com |
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| | *An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com* |



# General information

## Programme information

| | |
|---|---|
| **Programme:** | The International EPD® System |
| **Address:** | EPD International AB<br>Box 210 60<br>SE-100 31 Stockholm<br>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:<br><br>☐ EPD process certification ☒ EPD verification |
| Third party verifier:<br>*Manfred Russ*<br>*Senior Sustainabilty Consultant Quantis*<br>*Accredited Verifier*<br>*International EPD® System*<br>*E-Mail: Manfred.russ@quantis-intl.com* |
| Procedure for follow-up of data during EPD validity involves third party verifier:<br><br>☒ Yes ☐ No |

| | |
|---|---|
| Villeroy & Boch 1748 | Owner of the declaration<br>Villeroy & Boch AG<br>Saaruferstraße, 66693 Mettlach (Germany)<br>https://www.villeroyboch-group.com/ |
| ERM | EPD prepared by<br><br>ERM LTD.<br>Exchequer court, 33 St Mary Axe, Lime Street, London EC3A 8AA<br>www.erm.com |

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

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

Owner of the EPD:
Villeroy & Boch AG

Contact:
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Description of the organisation:
This EPD study on 'Sanitary Ceramics,' specifically focussing on average ceramic sanitary products 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 site(s):
Villeroy & Boch S.A.S., Avenue du 11 Novembre, F-82400 Valence d`Agen, France
Villeroy & Boch AG sanitary factory Mettlach, Britterstraße 1, 66689 Mettlach, Germany
Villeroy & Boch Magyarország Kft., Erzsébeti út. 7, HU-6800 Hódmezővásárhely, Hungary
Mondial SA, Str. Timişorii, Nr. 149-151, RO-305500 Lugoj, Jud. Timiş, Romania
Villeroy & Boch (Thailand) Co. Ltd., 58 Moo 6 Nogplamoe, Nongkhae, Saraburi, 18140, Thailand

## Product information

Product name:
**Average sanitary ceramic product**

Product identification:
*Table 1: Technical construction data – representative dimensions for each product category*

| Category | Dimension | Unit |
|---|---|---|
| Washbasins | 800*450*170 | mm |
| Bidets | 540*360*400 | mm |
| Toilets | 600*360*400 | mm |
| Urinals | 600*300*350 | mm |
| Kitchen Sinks | 1000*510*225 | mm |
| Cisterns | 390*165*300 | mm |

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

Product description:
This report describes the environmental impact of the ceramic component of a range of products, including baths, wash basins, WCs, urinals, etc made by Villeroy & Boch ('V&B'). These products all undergo the same manufacturing process and will therefore have equivalent impacts per kg of product, regardless of the actual end-use application.

V&B manufacture sanitary ceramic products at five locations as noted in name and locations of production sites. All these sites are used to supply products for the European market. The results presented in this report are the weighted average products from these five production locations.

Table 2 shows the weighted production volumes from each manufacturing site for 2019.

*Table 2: Weighted contribution of ceramic from the 5 production sites.*

| Country | Total Production (Tonnes) | Weighted Contribution (%) |
|---|---|---|
| France | 5,526 | 8.87 |
| Germany | 10,436 | 16.75 |
| Hungary | 18,353 | 29.45 |
| Romania | 15,884 | 25.49 |
| Thailand | 12,124 | 19.45 |
| **Total** | 62,323 | 100.00 |

Table 3 indicates the typical composition of sanitary ceramic products made by V&B.

*Table 3: Typical composition of sanitary ceramic products*

| Material | Content |
|---|---|
| Clay and Chamotte | 48% |
| Kaolin | 14% |
| Feldspar | 24% |
| Quartz | 4% |
| Zirconia | 2% |
| Chalk/ limestone | 2% |
| Others | 1% |
| Recycling (internally recycled fired scrap) | 5% |

Packaging
No packaging has been modelled for the final product.

Recycled material:
The production site in Valence d`Agen, France, uses some scrap material sourced from V&B's other operations in Chateauroux.

## LCA information

Functional unit / declared unit:

The declared unit quantifies and describes the product and is used as the basis for reporting results. This EPD relates to an average sanitary ceramic product sold in the European market.

The declared unit for the study is:

**"1 kg average sanitary ceramic product, excluding packaging and additional fittings (eg valves, screws, taps, etc)."**

Reference service life:

This is a 'cradle-to-gate study with modules C and D (A1-A3+C+D)' study so steps A4-5 and B1 – B7 are not included. As such, declaration of the reference service life (RSL) is not applicable.

Time representativeness:

LCA calculations were subject to client-specific data from 2019 and based on one-year averaged data. Supply of products from each V&B manufacturing site is relatively stable, there are no large scale changes in supply location from year to year.

Geographic representativeness:

The upstream supply chain has been modelled based on production from the specific various V&B manufacturing sites used to manufacture ceramic sanitary ware products for the EU market. 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 for fuels and energy were used where possible. For raw materials it was more challenging to find country-specific data; 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 production of the ceramic product. The end of life stage is also considered, from removal of the used ceramic product through to the final disposal along with and the benefits and loads beyond the system boundary.

Life cycle stage descriptions are shown in Table 4 and Figure 1.

*Table 4*: Description of the system boundary according to the PCR

| Life cycle stage | Individual stages | Module | Use | Geography | Specific data | Variation – sites |
|---|---|---|---|---|---|---|
| Product stage | Raw material | A1 | X | DE,FR,HU, RO,TH | V&B manufacturing data (accounting for raw materials, energy and waste which is >90% of total) | GWP-GHG Min: -25% Max: +29% compared to average |
| | Transport | A2 | X | GLO | | |
| | Manufacturing | A3 | X | EU-28 | | |
| Construction process stage | Transport | A4 | MND | EU-28 | | |
| | Construction Installation | A5 | MND | EU-28 | | |
| Use stage | Use | B1 | MND | EU-28 | - | - |
| | Maintenance | B2 | MND | EU-28 | - | - |
| | Repair | B3 | MND | EU-28 | - | - |
| | Replacement | B4 | MND | EU-28 | - | - |
| | Refurbishment | B5 | MND | EU-28 | - | - |
| | Operational energy use | B6 | MND | EU-28 | - | - |
| | Operational water use | B7 | MND | EU-28 | - | - |
| End of life stage | De-construction & demolition | C1 | X | GLO | - | - |
| | Transport | C2 | X | GLO | - | - |
| | Waste processing | C3 | X | GLO | - | - |
| | Disposal | C4 | X | EU-28 | - | - |
| Resource recovery stage | Reuse-Recovery-Recycling-potential | D | X | GLO | - | - |

*X = declared modules, MND = module not declared, Note country abbreviations: DE (Germany), FR (France), GLO (Global), HU (Hungary), RO (Romania) & TH (Thailand)*

The system boundaries considered in this study are presented in Figure 1 and include A1, A2, A3, C1, C2, C3, C4 and D from above:

*Figure 1: System Diagram*

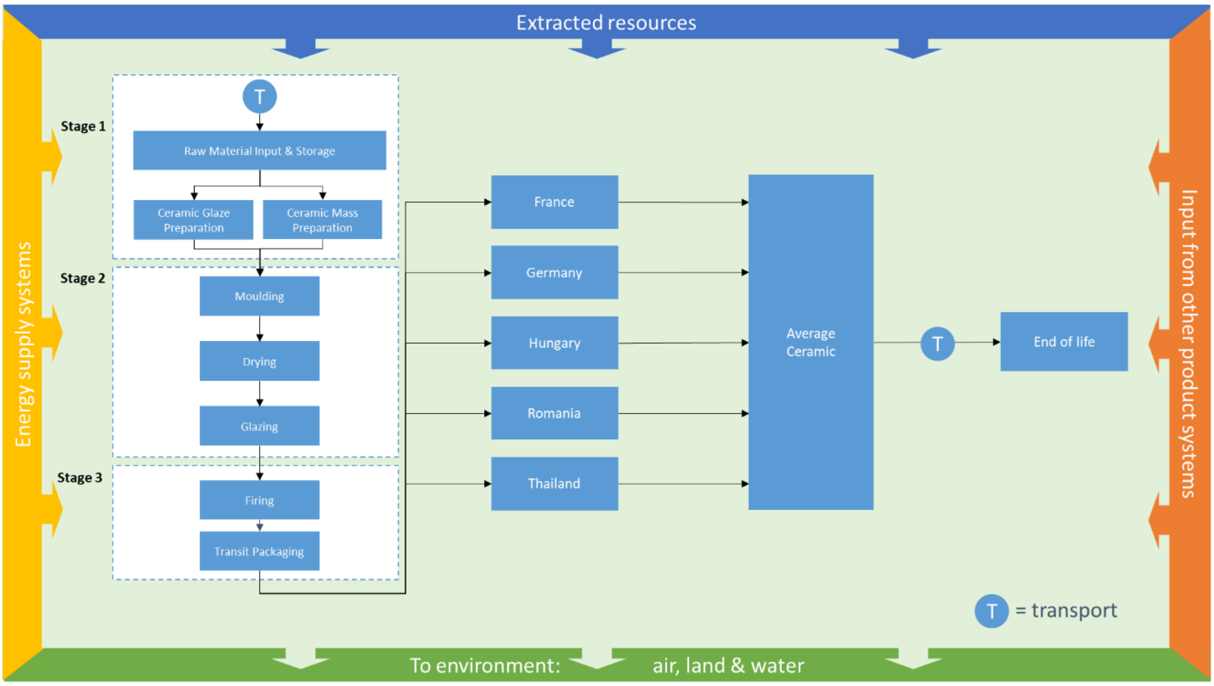



Table 5 summarises those life cycle aspects that have been included within and excluded from the study.

*Table 5: Components inclusion/ exclusion*

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

## Description of production process

The production process 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.

**Waste disposal:**

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

## End of life scenario

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

It is considered very unlikely that post-consumer ceramic ware would be recycled due to the low value and high mass of the product, and to the limited locations where recycling could actually take place.  Therefore it has been assumed that no recycling takes place at end of life but that the ceramic product is all sent to landfill, 50 km from where the product was installed.

Ceramic 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. Datasets from these databases have been used worldwide for several years in LCA models of many critically reviewed studies in industrial and scientific applications. All data were sourced from 2016-2019.

## 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 life cycle of the ceramic product. The end of life 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

The results shown in this EPD are an average across five different production locations, which all produce ceramic sanitary ware for the European market. Each production location was assessed individually and the weighted average resuilts are presented. The environmental impact results table includes the co-efficient of variation (CV)—the ratio of the standard deviation to the mean—which is a measure of the dispersion of results among each site. The CV has been calculated based on 1 kg ceramic production from each site (ie not weighted by production volume). The higher the CV the greater the variation in results observed across the different production locations.

## Further Information

Additional information on sanitary ware ceramic products can be found at www.villeroy-boch.com

## Environmental Information

### Potential environmental impact

| | A1 | A2 | A3 | C1 | C2 | C3 | C4 | D | TOTAL | Co-efficient of variation |
|---|---|---|---|---|---|---|---|---|---|---|
| GWP - total [kg CO2 eq.] | 2.22E+00 | 1.96E-01 | 1.17E-01 | 0.00E+00 | 1.41E-02 | 0.00E+00 | 1.47E-02 | 0.00E+00 | 2.57E+00 | 0.28 |
| GWP - fossil [kg CO2 eq.] | 2.21E+00 | 1.94E-01 | 1.08E-01 | 0.00E+00 | 1.40E-02 | 0.00E+00 | 1.51E-02 | 0.00E+00 | 2.54E+00 | 0.28 |
| GWP – biogenic [kg CO2 eq.] | 8.76E-03 | 9.56E-04 | 9.32E-03 | 0.00E+00 | -1.80E-05 | 0.00E+00 | -4.39E-04 | 0.00E+00 | 1.86E-02 | 0.46 |
| GWP - luluc [kg CO2 eq.] | 1.33E-03 | 1.38E-03 | 4.22E-05 | 0.00E+00 | 1.15E-04 | 0.00E+00 | 4.44E-05 | 0.00E+00 | 2.92E-03 | 0.50 |
| ODP [kg CFC-11 eq.] | 1.99E-08 | 2.19E-17 | 2.59E-16 | 0.00E+00 | 1.80E-18 | 0.00E+00 | 5.87E-17 | 0.00E+00 | 1.99E-08 | 0.67 |
| AP [Mole of H+ eq.] | 2.95E-03 | 3.16E-04 | 2.48E-04 | 0.00E+00 | 1.26E-05 | 0.00E+00 | 1.08E-04 | 0.00E+00 | 3.63E-03 | 0.43 |
| EP - freshwater [kg P eq.] | 3.33E-05 | 5.02E-07 | 8.07E-06 | 0.00E+00 | 4.18E-08 | 0.00E+00 | 2.54E-08 | 0.00E+00 | 4.19E-05 | 0.66 |
| EP - marine [kg N eq.] | 1.07E-03 | 1.05E-04 | 1.38E-04 | 0.00E+00 | 3.64E-06 | 0.00E+00 | 2.80E-05 | 0.00E+00 | 1.34E-03 | 0.48 |
| EP - terrestric [Mole of N eq.] | 1.16E-02 | 1.20E-03 | 1.18E-03 | 0.00E+00 | 4.50E-05 | 0.00E+00 | 3.07E-04 | 0.00E+00 | 1.43E-02 | 0.49 |
| POCP [kg NMVOC eq.] | 2.94E-03 | 2.87E-04 | 2.85E-04 | 0.00E+00 | 1.05E-05 | 0.00E+00 | 8.47E-05 | 0.00E+00 | 3.61E-03 | 0.48 |
| ADPF [MJ] | 3.75E+01 | 2.28E+00 | 3.09E-01 | 0.00E+00 | 1.87E-01 | 0.00E+00 | 2.01E-01 | 0.00E+00 | 4.05E+01 | 0.24 |
| ADPE [kg Sb eq.] | 2.32E-06 | 1.29E-08 | 3.77E-09 | 0.00E+00 | 1.07E-09 | 0.00E+00 | 1.43E-09 | 0.00E+00 | 2.34E-06 | 0.55 |
| WDP [$m^3$ world equiv.] | 1.08E-01 | 1.47E-03 | 1.21E-02 | 0.00E+00 | 1.22E-04 | 0.00E+00 | 1.62E-03 | 0.00E+00 | 1.23E-01 | 0.53 |

***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.***

### Potential environmental impact – GWP-GHG based on EN 15804:2012+A1:2013 (previous version of the standard)

| | A1 | A2 | A3 | C1 | C2 | C3 | C4 | D | Total |
|---|---|---|---|---|---|---|---|---|---|
| GWP-GHG | 2.17E+00 | 1.92E-01 | 1.16E-01 | 0.00E+00 | 1.37E-02 | 0.00E+00 | 1.43E-02 | 0.00E+00 | 2.51E+00 |

## Use of resources

| | A1 | A2 | A3 | C1 | C2 | C3 | C4 | D | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| PERE [MJ] | 2.80E+00 | 1.26E-01 | 8.24E-02 | 0.00E+00 | 1.05E-02 | 0.00E+00 | 2.70E-02 | 0.00E+00 | 3.05E+00 |
| 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 |
| PERT [MJ] | 2.80E+00 | 1.26E-01 | 8.24E-02 | 0.00E+00 | 1.05E-02 | 0.00E+00 | 2.70E-02 | 0.00E+00 | 3.05E+00 |
| PENRE [MJ] | 3.75E+01 | 2.29E+00 | 3.09E-01 | 0.00E+00 | 1.88E-01 | 0.00E+00 | 2.01E-01 | 0.00E+00 | 4.05E+01 |
| PENRM [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 |
| PENRT [MJ] | 3.75E+01 | 2.29E+00 | 3.09E-01 | 0.00E+00 | 1.88E-01 | 0.00E+00 | 2.01E-01 | 0.00E+00 | 4.05E+01 |
| SM [kg] | 1.17E-02 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 1.17E-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 |
| 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] | 5.05E-03 | 1.44E-04 | 3.25E-04 | 0.00E+00 | 1.20E-05 | 0.00E+00 | 4.95E-05 | 0.00E+00 | 5.58E-03 |

***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] | 7.39E-09 | 1.14E-10 | 5.91E-11 | 0.00E+00 | 9.45E-12 | 0.00E+00 | 2.13E-11 | 0.00E+00 | 7.59E-09 |
| NHWD [kg] | 2.04E-02 | 3.38E-04 | 5.05E-01 | 0.00E+00 | 2.79E-05 | 0.00E+00 | 1.00E+00 | 0.00E+00 | 1.53E+00 |
| RWD [kg] | 8.69E-04 | 2.77E-06 | 1.81E-05 | 0.00E+00 | 2.27E-07 | 0.00E+00 | 2.10E-06 | 0.00E+00 | 8.92E-04 |
| 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 | 4.18E-02 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 4.18E-02 |
| 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] | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Biogenic carbon content in packaging [kg] | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |

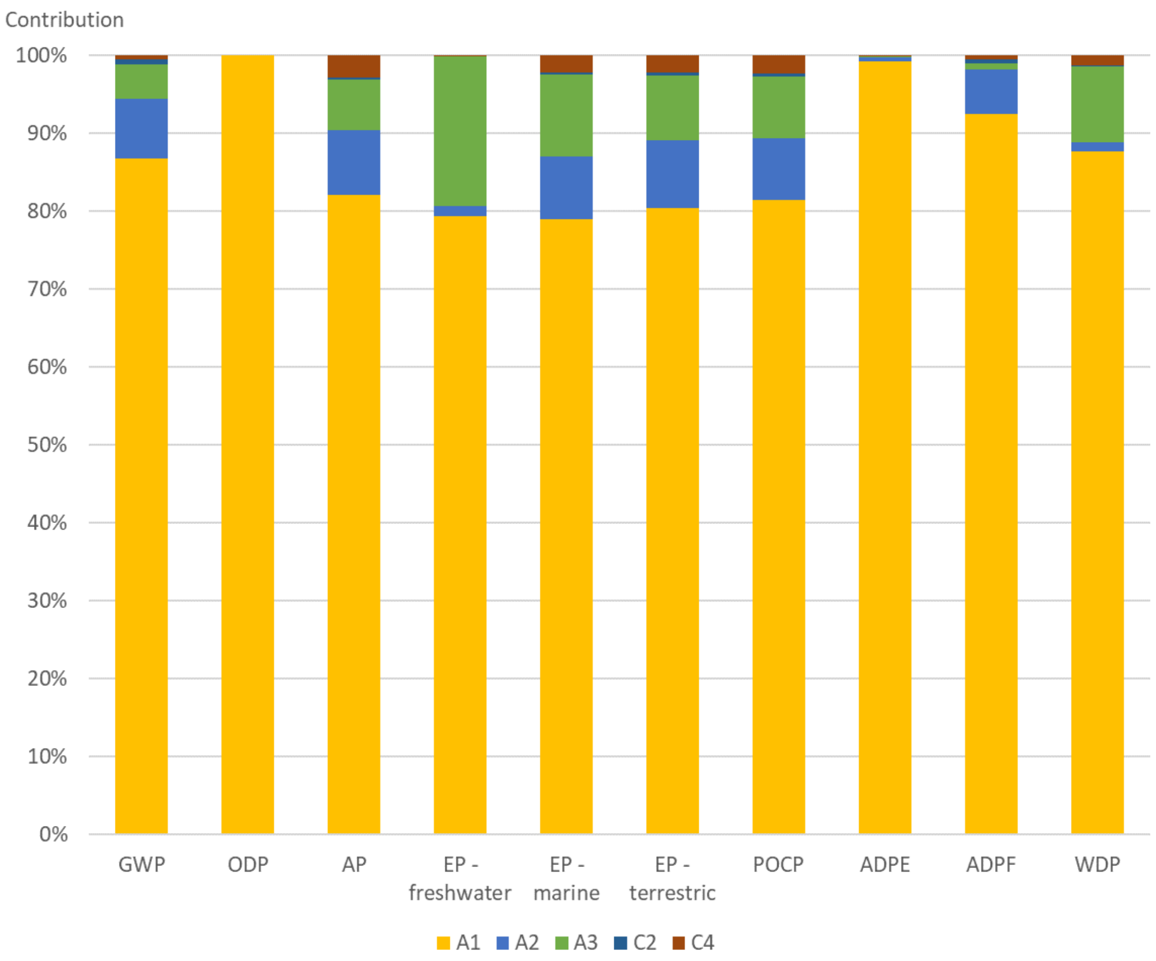
## Other environmental indicators

| | A1 | A2 | A3 | C1 | C2 | C3 | C4 | D | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| PM [Disease incidences] | 3.69E-08 | 3.21E-09 | 1.44E-09 | 0.00E+00 | 7.95E-11 | 0.00E+00 | 1.34E-09 | 0.00E+00 | 4.30E-08 |
| IR [kBq U235 eq.] | 1.23E-01 | 3.96E-04 | 2.69E-03 | 0.00E+00 | 3.25E-05 | 0.00E+00 | 2.21E-04 | 0.00E+00 | 1.27E-01 |
| ETF-fw [CTUe] | 1.37E+02 | 1.65E+00 | 6.04E-01 | 0.00E+00 | 1.35E-01 | 0.00E+00 | 1.14E-01 | 0.00E+00 | 1.40E+02 |
| HTP-c [CTUh] | 3.81E-10 | 3.33E-11 | 2.38E-11 | 0.00E+00 | 2.73E-12 | 0.00E+00 | 1.69E-11 | 0.00E+00 | 4.57E-10 |
| HTP-nc [CTUh] | 2.12E-08 | 1.74E-09 | 1.50E-09 | 0.00E+00 | 1.41E-10 | 0.00E+00 | 1.86E-09 | 0.00E+00 | 2.65E-08 |
| SQP [Pt] | 3.22E+00 | 7.72E-01 | 9.39E-02 | 0.00E+00 | 6.43E-02 | 0.00E+00 | 4.05E-02 | 0.00E+00 | 2.35E+00 |

***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

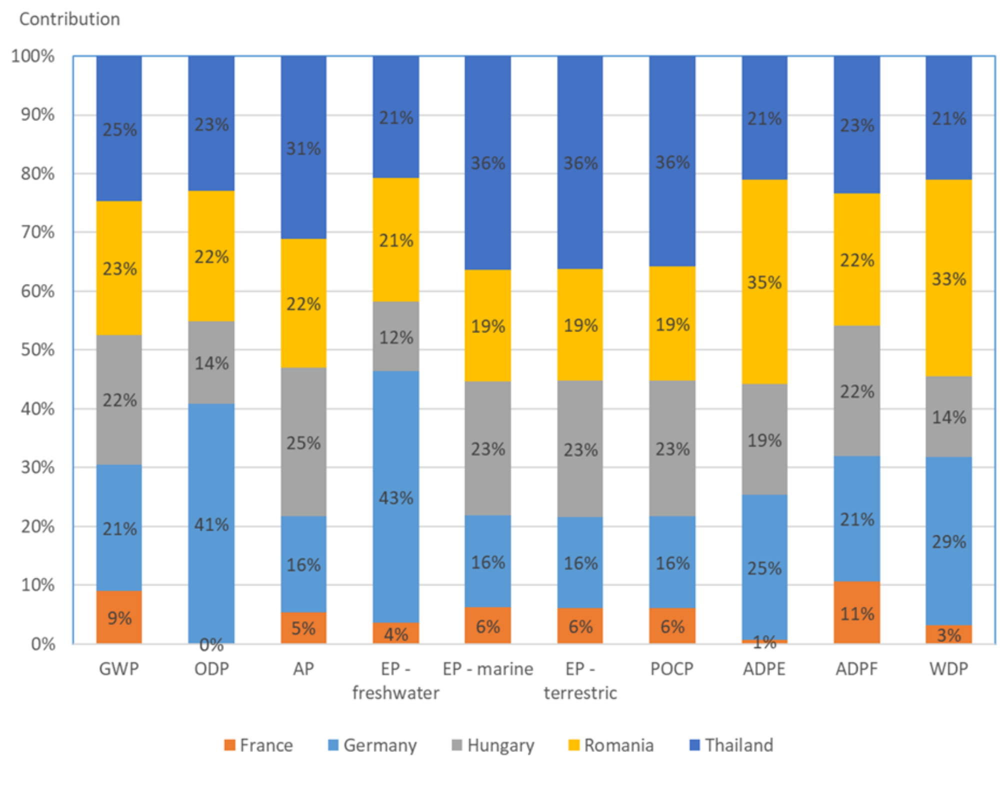
*Figure 2: Contribution of modules (A1, A2, A3, C2 and C4) to environmental impact categories for sanitary ceramic products*




The results in Figure 2 show that module A1 (raw material supply) is the dominant contributor to the majority of environmental impact categories, accounting for almost more than 80% 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 3: Contribution of individual manufacturing facilities to environmental impact categories for sanitary ceramic products*




The results from Figure 3 show that Hungary and Thailand tend to account for the largest contributions to the total impact. This is due to a combination of factors including production volume (Hungary is the biggest producer), production efficiency (significantly more waste is generated in Thailand than in other locations), raw material and fuel mix.

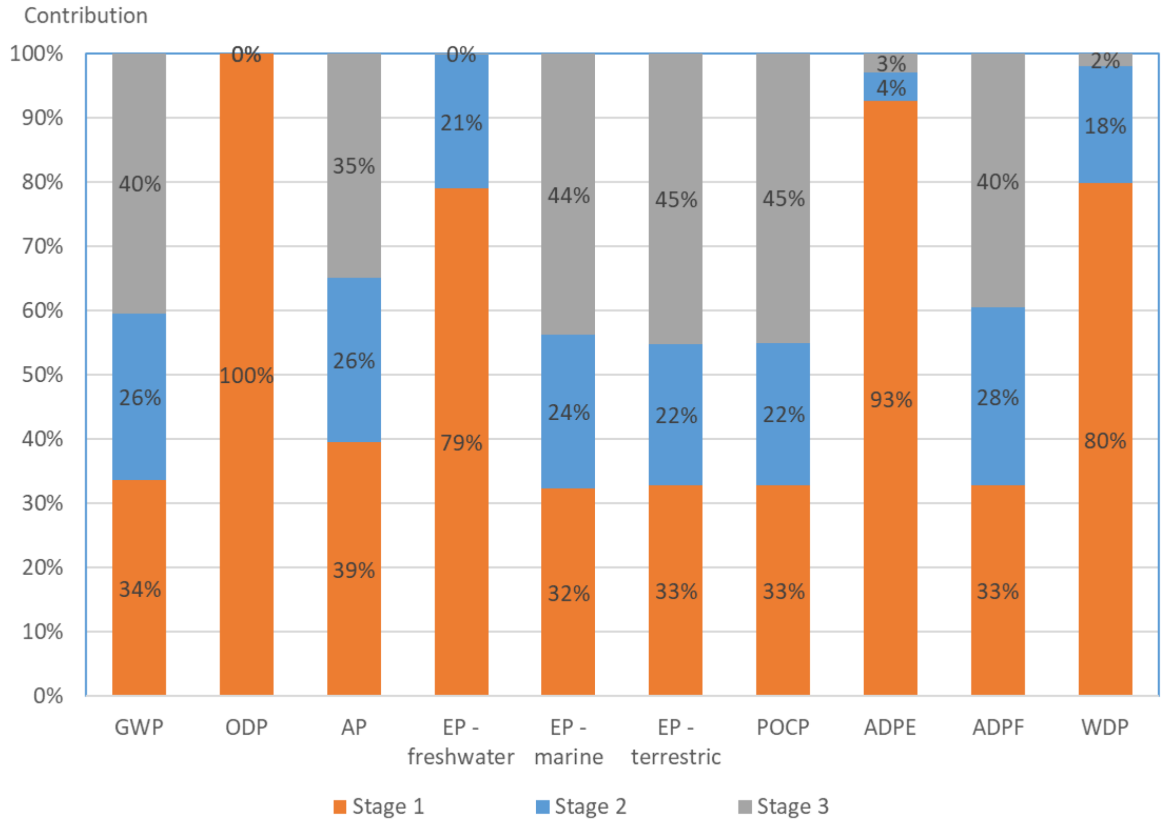
The co-efficient of variation has been reported alongside the EPD results for the environmental impact categories. The degree of difference in co-efficient of variation varies greatly depending on the metric assessed. For some, such as climate change and use of fossil resources, the different production sites are reasonably well-aligned, while for others, such as freshwater eutrophication and use of metal and mineral resources, the differences are much greater. These differences are due to a number of factors including fuel mix, country-specific electricity grid mix, particular selection of raw materials, loss rates during manufacturing, etc.

The high relative burdens associated with ozone depletion, freshwater eutrophication and water scarcity in Germany are due to outsized contributions from production of zirconium silicate and barium carbonate minerals. The larger than expected burdens for marine and terrestrial eutrophication and photochemical ozone formation in Thailand is mainly due to the high electricity usage and the specific grid mix in this region. The high contribution to mineral and metal resource depletion in Romania is mostly due to burdens associated with frit production.

Overall, compared to production volumes from each site, it can be seen that ceramic manufactured in Thailand generally has proportionally higher burdens than expected for most impact categories. German production also has higher burdens for some indicators. In contrast, production in Romania and France shows lower relative impacts for most categories.

Figure 4 shows the contribution to the total impact from A1-3 from each production stage (stage 1 = raw materials preparation, stage 2 = casting and drying, stage 3 = firing). For most impact categories there is a relatively even split between each stage, but ODP, EP (freshwater), ADPE and WDP are all dominated by impacts associated with raw material acquisition).

*Figure 4: Contribution of individual processing stages to environmental impact categories for sanitary ceramic products*



# References


General Programme Instructions of the International EPD® System. Version 3.01.

BS EN 15804:2012+A2:2019 - Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products

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GaBi dataset documentation https://gabi.sphera.com/support/gabi/

Hauschild M, G. M. (2011). Recommendations for Life Cycle Impact Assessment in the European context - based on existing environmental impact assessment models and factors. Luxembourg: European Commission.

NBR ISO 14020 - Environmental labels and declarations - General Principles, 2002

ISO 14025 - Environmental labels and declarations - Type III environmental declarations - Principles and procedures, 2006

NBR ISO 14040 - Environmental management - Life cycle assessment - Principles and framework, 2009

NBR ISO 14044 - Environmental management – Life cycle assessment – Requirements and guidelines, 2009

Product Category Rule (PCR 2019:14): “Construction products”, International EPD® System, 2019

EPD®

www.environdec.com

# Environmental Product Declaration

Of multiple products based on average results
In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019/AC:2021 for:

# Villeroy & Boch / Gustavsberg Duroplast Toilet Seats

from

## Villeroy & Boch AG

| | |
|---|---|
| Programme: | The International EPD® System, www.environdec.com |
| Programme operator: | EPD International AB |
| EPD registration number: | EPD-IES-0007705:001 |
| Publication date: | 2025-06-02 |
| Valid until: | 2028-06-21 |
| | *An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com* |

# General information

## Programme information

| | |
|---|---|
| **Programme:** | The International EPD® System |
| **Address:** | EPD International AB<br>Box 210 60<br>SE-100 31 Stockholm<br>Sweden |
| **Website:** | www.environdec.com |
| **E-mail:** | info@environdec.com |

| **Accountabilities for PCR, LCA and independent, third-party verification** |
|---|
| **Product Category Rules (PCR)** |
| CEN standard EN 15804 serves as the Core Product Category Rules (PCR)<br>Product Category Rules (PCR): PCR 2019:14 Construction products (EN 15804:A2) (version 1.3.4) |
| Product Category Rules (PCR): Construction Products 2019:14, Version 1.3.4 and EN 15804:2012+A2:2019 Sustainability of Construction Works |
| PCR review was conducted by: The Technical Committee on the International EPD ® System. Contact via www.environdec.com info@environdec.com |
| **Life Cycle Assessment (LCA)** |
| LCA accountability: Alexander Kyriakidis, AFRY, www.afry.com |
| **Third-party verification** |
| Independent third-party verification of the declaration and data, according to ISO 14025:2006, via:<br><br>☒ EPD verification by individual verifier<br><br>Third-party verifier: Katrin Molina-Besch, Miljögiraff<br><br>Approved by: The International EPD® System |
| Procedure for follow-up of data during EPD validity involves third party verifier:<br><br>☐ Yes ☒ No |

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but registered in different EPD programmes, or not compliant with EN 15804, may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see EN 15804 and ISO 14025.

## Company information

Owner of the EPD:
Villeroy & Boch AG
Saaruferstraße
66693 Mettlach (Germany)
https://www.villeroyboch-group.com/ [villeroyboch-group.com]

Contact:
Mattias Virsgård

Description of the organisation:
Since its foundation in 1748, the ceramic producer has developed into an international lifestyle brand. Like very few other premium brands, Villeroy & Boch is deeply rooted in European culture. And, in the way that only a great brand can do, it has understood how to preserve its identity while still moving with the times.
Villeroy & Boch produces innovative and stylish products to enhance people's lives, provide continuous inspiration and open up new horizons for truly personalised interior design.

Product-related or management system-related certifications:
Production facilities:
DIN EN ISO 9001

Villeroy & Boch Gustavsberg organization:
SS-EN ISO 9001:2015 – Quality Management System
SS-EN ISO 14001:2015 – Environmental Management System
SS-EN ISO 45001:2018 – Occupational Health and Safety Management Systems
SS-EN ISO 50001:2018 – Energy Management System

Location of production site(s):
Rohrdorf, Germany
Sevlievo, Bulgaria
Kunshan, China

## Product information

Product name:
Duroplast Toilet Seats

Product list

*Villeroy & Boch brand*
8M67S1R1 Antao
8M67S1RW Antao
8M67S1R7 Antao
8M67S1AM Antao
8M67S1R8 Antao
98M9C101 Architectura
98M9C109 Architectura
98M9C201 Architectura
98M9D101 Architectura

98M9D109 Architectura
98M96101 Architectura
98M96109 Architectura
9M58S101 Architectura
9M606101 Architectura
9M83S101 Architectura
9M836101 Architectura
8M79S1T1 Architectura K
8M79S101 Architectura K
8M70S101 Architectura Slim
8M706101 Architectura Slim
9M77C101 Avento
9M77C1RW Avento
9M61D101 Avento
8M78S1T1 Avento K
8M78S101 Avento K
8M78S138 Avento K
991CS101 Castorama
990CS101 Collection V&B
8M57S101 Embrace
8M57S1RW Embrace
8M57S1R7 Embrace
9E396101 Metro
9EM9C101 Metro
9E38S101 Metro V&B
9EM9D101 Metro V&B
8M59S101 NeWo
8M596101 NeWo
8M58S101 NeWo
8M586101 NeWo
9M38S101 O.novo
8M16S101 O.novo
9M716101 O.novo
8M43S101 O.novo
8M436101 O.novo
9M406101 O.novo
9M396101 O.novo
8M36S101 O.novo compact
8M80S1T1 O.novo K
8M80S101 O.novo K
9955C101 Subway
9955C1R3 Subway
9M556101 Subway
9955C201 Subway 2.0
9955C301 Subway 2.0
9955C3RW Subway 2.0
9M686101 Subway 2.0
8M34S101 Subway 2.0 Komfort
8M77S1T1 Subway K
8M77S101 Subway K

8M77S138 Subway K
8M31S101 V&B Exclusive
8M88S1R7 V&B Exclusive
8M37S101 V&B Exclusive
8M83S101 Verity
9M559101 Verity Design
8M54S101 Verity Design 2.0
9M67S1T1 ViCare
9M67S1P1 ViCare
9M7261T1 ViCare
9M7261P1 ViCare
9M9761T1 ViCare
9M676101 ViCare
9M86S101 Vivia

*Gustavsberg brand*
8780S801 Saval
8780G801 Saval
8780S101 Saval
8780G101 Saval
8780G109 Saval
9M169901 Artic
9M16S101 Artic
9M16S136 Artic
98895101 Artic
98895136 Artic
9M09S101 Estetic
9M09S138 Estetic
9M09S1RW Estetic
9M10S101 Estetic
9M10S138 Estetic
9M10S1RW Estetic
9M10S901 Estetic
9M256101 Nautic
9M26S101 Nautic
9M26S136 Nautic
9M26S901 Nautic
8M45S101 Nautic Slim
8M45S901 Nautic Slim
8M56S101 Nordic

And others for Villeroy & Boch group, produced in the same material in the same production site.

Product identification:
Toilet seat set made of thermoset material (urea)

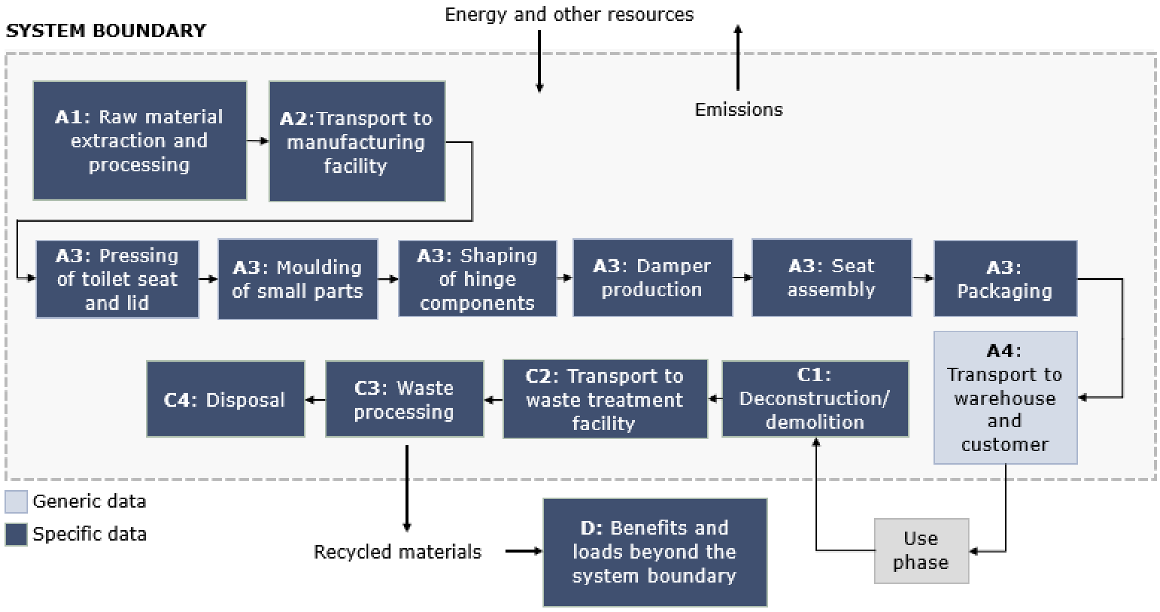
Product description:

Villeroy & Boch & Gustavsberg toilet seats are the perfect, custom-fit solution for each toilet. Their clever features, quick assembly and easy-clean benefits speak for themselves, and their beautiful designs create a harmonic unit with the ceramic bowl.

Available in different categories as Slim Seat and Slim Seat Line, or the wider Comfort Seat.
-Custom fit to match the shape, color and measurements of each toilet.
-Designed with visual appeal and comfort in mind
-Easy cleaning thanks to hidden hinges and Quick Release technology
-High-quality Duroplast and stainless steel hinges for increased hygiene
-Polished surfaces for exceptional shine
All seats comply with DIN standard 19516 (175 kg) as well as our corporate quality standard and are stable to at least 240 kg.

UN CPC code:
3693 - Baths, wash-basins, lavatory pans and covers, flushing cisterns and similar sanitary ware, of plastics.

Production diagram:




## LCA information

Declared unit:
1 piece average Duroplast Toilet Seat (2.03 kg)

Reference service life:
Urea WC seats have an average lifespan of 7-10 years.

Time representativeness:
Production data was collected for the year 2022.

Database(s) and LCA software used:
LCA for Experts (Version 10.7) and Sphera LCA content (Content Version 2023.1).

For module A4 only: SimaPro 9.6.1 and Ecoinvent 3.10.
Environmental impact was assessed according to EN 15804:2012+A2:2019 using EF 3.1 characterization factors

LCA scenarios:
In module A5, the waste treatment of the packaging materials is modelled. Cardboard is recycled and polyethylene foil is incinerated. For waste treatment in module C3, incineration is modelled for plastic components and recycling for metal components. Loads and benefits resulting from recycling and incineration in modules A5 and C3 are assigned to module D. For transports to waste treatment, a distance of 100 km is assumed.

Description of system boundaries:
Cradle to gate with options, modules A1–A5, C1–C4 and module D.

Cut-off criteria:
Infrastructure, capital goods and personnel-related processes were excluded. Silicone oil was cut-off (0.2% of mass of product). It is assumed that the cut-off criterion on mass inputs and primary energy at the unit process level (1%) and at the information module level (5%) are met.

Allocation:
Energy was allocated between Duroplast and Thermoplast toilet seats based on the number of seats produced at each site.

Assumptions:
Shares of secondary material input for steel components was used from the LCA datasets. A steel hinge was modelled as a worst-case approach.

Modules declared, geographical scope, share of specific data (in GWP-GHG results) and data variation (in GWP-GHG results):

| | Product stage | | | Construction process stage | | Use stage | | | | | | | End of life stage | | | | Resource recovery stage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Raw material supply | Transport | Manufacturing | Transport | Construction installation | Use | Maintenance | Repair | Replacement | Refurbishment | Operational | Operational | De- | Transport | Waste | Disposal | Reuse-Recovery-Recycling |
| **Module** | **A1** | **A2** | **A3** | **A4** | **A5** | **B1** | **B2** | **B3** | **B4** | **B5** | **B6** | **B7** | **C1** | **C2** | **C3** | **C4** | **D** |
| Modules declared | X | X | X | X | X | ND | ND | ND | ND | ND | ND | ND | X | X | X | X | X |
| Geography | DE, BG, CN | DE, BG, CN | DE, BG, CN | EUR | EUR | | | | | | | | EUR | EUR | EUR | EUR | EUR |
| Specific data used | > 90% | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Variation – products | - 17% to +38% for GWP-GHG indicator | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Variation – sites | 19% to +38% for GWP-GHG indicator compared to declared average | | | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Variability in the LCIA results is mainly due to the different weights of the products. In general, the lighter the product, the lower the LCIA results. The weight of the unpackaged product varies between 1.4 and 3.5 kg.

**A1: Raw Material**
This stage includes raw material extraction and production of bought components.

**A2: Transport**
This stage includes transportation of raw materials to production sites and of components to final site of assembly.

**A3: Manufacturing**
This stage includes resource use in the manufacturing facility, such as use of energy. It also includes treatment of waste generated from the manufacturing processes. The manufacturing includes casting, chrome plating, assembling, and packing. Data from the full year of 2022 have been used in the calculations.

Site electricity mixes were the following (GWP-GHG/kWh):

- Germany: Green electricity (3 g)
- Bulgaria: Residual electricity mix (441 g)
- China: Electricity mix (811 g)

**A4**
This stage includes the transportation of the finished product to its installation location. 1000 km transportation is assumed.

**A5**

This stage includes the installation of the product, materials needed and waste generated as an result of installation.

**C1: Deconstruction**
No impacts are assumed to be associated with the deconstruction phase.

**C2: Waste Transport**
Includes the transportation of the discarded product to a waste treatment facility. 100 km transportation is assumed.

**C3: Waste Processing**
This stage includes sorting of waste.

**C4: Waste disposal**
This stage includes waste disposal processes, such as landfill or incineration. Incineration is assumed for plastics, with metals assumed to have a recycling rate of 90%

**D: Benefits and loads outside the system boundary**
This stage includes benefits and burdens associated with recovery/recycling that affects future life cycles. For this product it includes benefits from the recycling of brass and metals, as well as energy recovery from waste incineration

# Content information

| Product components | Weight, kg / piece | Post-consumer material, weight-% | Biogenic carbon, kg / declared unit |
|---|---|---|---|
| Duroplast (Urea resin, 30% cellulose) | 1.828 | 0% | 0.228 |
| Injection Molding (polyethylene, ethylene vinyl acetate, polypropylene, polyamide, polyethylene, pigment) | 0.057 | 0% | 0 |
| Metal (stainless steel, steel) | 0.106 | 58% | 0 |
| Other (polyamide) | 0.038 | 0% | 0 |
| TOTAL | 2.03 | 3% | 0.228 |
| **Packaging materials** | **Weight, kg** | **Weight-% (versus the product)** | **Weight biogenic carbon, kg C/kg** |
| Polyethylene foil | 0.017 | 0.8% | - |
| Cardboard box | 0.272 | 13.4% | 0.112 |
| TOTAL | 0.29 | 14.2% | 0.112 |

Note: 1 kg biogenic carbon is equivalent to 44/12 kg CO2.

| Dangerous substances from the candidate list of SVHC for Authorisation | EC No. | CAS No. | Weight-% per functional or declared unit |
|---|---|---|---|
| Molding compound | | | None |
| Stainless steel | | | None |
| Other plastics (dampers, buffers) | | | None |
| Silicone oil | | | None |

No substances that appear in the REACH Candidate List of Substances of Very High Concern (SVHC) are present or used in the product.

# Results of the environmental performance indicators

## Mandatory impact category indicators according to EN 15804

| Results per functional or declared unit | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Indicator** | **Unit** | **A1-A3** | **A4** | **A5** | **C1** | **C2** | **C3** | **C4** | **D** |
| GWP-fossil | kg $CO_2$ eq. | 4.72E+00 | 2.10E+00 | 5.61E-02 | 0.00E+00 | 1.87E-02 | 4.38E+00 | 0.00E+00 | -1.48E+00 |
| GWP-biogenic | kg $CO_2$ eq. | -1.25E+0 | 1.56E-03 | 4.11E-01 | 0.00E+00 | 0.00E+00 | 8.37E-01 | 0.00E+00 | 0.00E+00 |
| GWP-luluc | kg $CO_2$ eq. | 3.65E-03 | 6.85E-04 | 2.63E-05 | 0.00E+00 | 1.70E-04 | 7.28E-06 | 0.00E+00 | -9.14E-05 |
| GWP-total | kg $CO_2$ eq. | 3.48E+00 | 2.10E+00 | 4.67E-01 | 0.00E+00 | 1.89E-02 | 5.22E+00 | 0.00E+00 | -1.48E+0 |
| ODP | kg CFC 11 eq. | 4.06E-11 | 4.07E-08 | 2.89E-15 | 0.00E+00 | 2.40E-15 | 3.00E-13 | 0.00E+00 | -1.08E-11 |
| AP | mol $H^+$ eq. | 1.91E-02 | 4.26E-03 | 1.74E-05 | 0.00E+00 | 7.29E-05 | 4.70E-04 | 0.00E+00 | -1.92E-03 |
| EP-freshwater | kg P eq. | 3.25E-05 | 1.38E-04 | 1.10E-08 | 0.00E+00 | 6.73E-08 | 7.63E-08 | 0.00E+00 | -2.24E-06 |
| EP-marine | kg N eq. | 5.14E-03 | 1.02E-03 | 6.81E-06 | 0.00E+00 | 3.39E-05 | 1.42E-04 | 0.00E+00 | -5.38E-04 |
| EP-terrestrial | mol N eq. | 5.55E-02 | 1.10E-02 | 8.86E-05 | 0.00E+00 | 3.80E-04 | 2.29E-03 | 0.00E+00 | -5.69E-03 |
| POCP | kg NMVOC eq. | 7.06E-03 | 7.08E-03 | 1.43E-05 | 0.00E+00 | 3.79E-05 | 3.74E-04 | 0.00E+00 | -1.55E-03 |
| ADP-minerals&metals* | kg Sb eq. | 1.43E-05 | 6.65E-06 | 0.00E+00 | 6.61E-05 | 3.91E-04 | 0.00E+00 | -1.55E-03 | -1.09E-07 |
| ADP-fossil* | MJ | 1.06E+02 | 2.39E+00 | 4.49E-02 | 0.00E+00 | 2.51E-01 | 7.50E-01 | 0.00E+00 | -2.62E+01 |
| WDP* | $m^3$ | 1.60E+00 | 1.21E-01 | 4.94E-03 | 0.00E+00 | 2.22E-04 | 3.94E-01 | 0.00E+00 | -1.49E-01 |
| Acronyms | GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption | | | | | | | | |

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

## Additional mandatory and voluntary impact category indicators

| Results per functional or declared unit | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Indicator** | **Unit** | **A1-A3** | **A4** | **A5** | **C1** | **C2** | **C3** | **C4** | **D** |
| GWP-GHG[1] | kg $CO_2$ eq. | 4.73E+00 | 2.10E+00 | 5.61E-02 | 0.00E+00 | 1.87E-02 | 3.34E+00 | 0.00E+00 | 1.49E+00 |

*In order to calculate the results for module A1-A3 for a toilet seat with another weight, the following formula can be applied: Average Duroplast toilet seat GWP-GHG emissions in kg CO2e = 2.20 + Product weight (without packaging) in kg * 1.25*

## Resource use indicators

| Results per functional or declared unit | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Indicator** | **Unit** | **A1-A3** | **A4** | **A5** | **C1** | **C2** | **C3** | **C4** | **D** |
| PERE | MJ | 3.79E+01 | 1.96E+00 | 4.57E+00 | 0.00E+00 | 1.82E-02 | 9.42E+00 | 0.00E+00 | -7.31E+00 |
| PERM | MJ | 1.38E+01 | 0.00E+00 | -4.57E+00 | 0.00E+00 | 0.00E+00 | -9.23E+00 | 0.00E+00 | 0.00E+00 |
| PERT | MJ | 5.17E+01 | 1.96E+00 | 4.42E-03 | 0.00E+00 | 1.82E-02 | 1.92E-01 | 0.00E+00 | -7.31E+00 |
| PENRE | MJ | 8.12E+01 | 2.71E+01 | 7.91E-01 | 0.00E+00 | 2.52E-01 | 2.49E+01 | 0.00E+00 | -2.62E+01 |
| PENRM | MJ | 2.49E+01 | 0.00E+00 | -7.46E-01 | 0.00E+00 | 0.00E+00 | -2.41E+01 | 0.00E+00 | 0.00E+00 |
| PENRT | MJ | 1.06E+02 | 2.71E+01 | 4.51E-02 | 0.00E+00 | 2.52E-01 | 7.50E-01 | 0.00E+00 | -2.62E+01 |
| SM | kg | 3.22E-01 | 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 |
| 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 |
| FW | $m^3$ | 3.32E-02 | 2.15E-03 | 1.18E-04 | 0.00E+00 | 2.00E-05 | 9.26E-03 | 0.00E+00 | -6.37E-03 |
| Acronyms | 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 re-sources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water | | | | | | | | |

[1] This indicator accounts for all greenhouse gases except biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. As such, the indicator is identical to GWP-total except that the CF for biogenic $CO_2$ is set to zero.

## Waste indicators

| Results per functional or declared unit | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Indicator** | **Unit** | **A1-A3** | **A4** | **A5** | **C1** | **C2** | **C3** | **C4** | **D** |
| Hazardous waste disposed | kg | 8.86E-08 | 0.00E+00 | 2.62E-13 | 0.00E+00 | 7.79E-13 | 1.83E-11 | 0.00E+00 | -1.35E-09 |
| Non-hazardous waste disposed | kg | 1.37E-01 | 0.00E+00 | 2.17E-04 | 0.00E+00 | 3.84E-05 | 3.06E-02 | 0.00E+00 | 1.01E-03 |
| Radioactive waste disposed | kg | 4.84E-03 | 0.00E+00 | 4.53E-07 | 0.00E+00 | 4.71E-07 | 4.48E-05 | 0.00E+00 | -1.95E-03 |

## Output flow indicators

| Results per functional or declared unit | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Indicator** | **Unit** | **A1-A3** | **A4** | **A5** | **C1** | **C2** | **C3** | **C4** | **D** |
| Components for re-use | 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 |
| Material for recycling | kg | 0.00E+00 | 0.00E+00 | 2.72E-01 | 0.00E+00 | 0.00E+00 | 1.06E-01 | 0.00E+00 | 0.00E+00 |
| Materials for energy recovery | kg | 0.00E+00 | 0.00E+00 | 1.70E-02 | 0.00E+00 | 0.00E+00 | 1.92E+00 | 0.00E+00 | 0.00E+00 |
| Exported energy, electricity | MJ | 0.00E+00 | 0.00E+00 | 1.14E-01 | 0.00E+00 | 0.00E+00 | 6.39E+00 | 0.00E+00 | 6.50E+00 |
| Exported energy, thermal | MJ | 0.00E+00 | 0.00E+00 | 2.02E-01 | 0.00E+00 | 0.00E+00 | 1.15E+01 | 0.00E+00 | 1.17E+01 |

The estimated impact results are only relative statements, which do not indicate the endpoints of the impact categories, exceeding threshold values, safety margins and/or risks. The results of the end-of-life stage (module C) should be considered when using the results of the production stage (modules A1-A4).

## Other environmental performance indicators

# Additional environmental information

- the existence of a quality or environmental management system or any type of organised environmental activity, and
- information on where interested parties may find more details about the organisation's environmental work.

Additional environmental information can also include information on carbon offset, carbon storage and delayed emissions, or on release of dangerous substances to indoor air, soil and water during the use stage.

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