

ENVIRONMENTAL PRODUCT DECLARATION

BEHR PRO[®] e600 EXTERIOR PAINTS

EXTERIOR PAINTS



Shown above: BEHR PRO e600 Exterior Paint is specifically designed to meet the expectations of professional painters.



Masco Coatings Group, home to Behr Process Corporation and Masterchem Industries LLC, the makers of BEHR[®] and KILZ[®] Brands respectively, is one of the largest manufacturers and suppliers of paint, primers, stains and surface finish products to Do-it-Yourselfers and Professionals. Sustainability is the core concept of our business strategy and culture ensuring top economic, social and environmental performance. Masco Coatings Group's commitment to sustainability, quality, value and performance has driven our desire for innovation and transparency. The creation of a Life Cycle Assessment (LCA) report and Environmental Product Declarations (EPD) allows us to continually improve our operations and illustrate a complete story behind our products.

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In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, such differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at the building level per ISO 21930 guidelines. The results of this EPD reflect an average performance by the product and its actual impacts may vary on a case-to-case basis.



e600 Exterior Paints

According to ISO 14025

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. Accuracy of Results: EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.



PROGRAM OPERATOR	UL Environment
DECLARATION HOLDER	Behr
DECLARATION NUMBER	4787851154.103.1
DECLARED PRODUCT	e600 Exterior Paints
REFERENCE PCR	PCR for architectural coatings: NAICS 325510, NSF 2015
DATE OF ISSUE	November 14, 2017
PERIOD OF VALIDITY	5 Years
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications
The PCR review was conducted by:	Review Panel Chair: Thomas P. Gloria ncss@nsf.org
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories <input type="checkbox"/> INTERNAL <input checked="" type="checkbox"/> EXTERNAL	 Wade Stout, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	 Thomas P. Gloria, Industrial Ecology Consultants



Product Definition

This Environmental Product Declaration covers Behr Process Corporation e600 Exterior Paints, which deliver a durable and beautiful finish. Behr Pro e600 is available in flat, satin, and semi-gloss sheens and white, deep, and mid bases for virtually unlimited color options.

Declared Product Description

The e600 Exterior Paints are specifically designed to meet the expectations of professional painters. Developed for optimal sprayability with minimized flashing and surfactant leaching, this 100% acrylic formula provides excellent hiding power and a uniform finish. Dried film is mold and mildew resistant. This product line includes the following sheens: e610 Flat, e640 Satin, e670 Semi-gloss, and is available in 1-gallon and 5-gallon size containers. There are tint bases offered for all sheens in the series as follows: White, Medium, and Deep Bases that allow custom tinting to any desired color.

Product Components Related to Life Cycle Assessment

The material composition of the paints are in the following range:

Table 1: Material composition range in % by mass for the e600 Exterior Paints product line

	Minimum [%]	Maximum [%]
Acrylic resin	15	45
Additive	0	1.5
Attapulgite clay	0	0.5
Coalescent	1	1.7
Defoamer	0.1	0.5
Dispersant	0.6	1.3
Kaolin	0	3.5
Mica	0	8.3
Nepheline syenite	1.2	25
Opacifying polymer	0	8.3
pH buffer	0	0.2
Preservative	0.7	1.1
Rheology modifier	0.6	6.3
Surfactant	0	0.5
Titanium dioxide	0	26
Water	26	39



The functional unit for the study is covering and protecting 1m² of substrate for a period of 60 years (the assumed lifetime of a building), exhibiting 97% opacity after drying. The functional unit and reference flow required for the functional unit were calculated for both the market life and design life as prescribed by the PCR. Market life for exterior paints is 10 years and design life is based on the quality as determined by ASTM test methods for blistering (ASTM D714 - 02(2007)), erosions (ASTM D662 - 93(2011)), flaking/peeling (ASTM D772 - 86(2011)), and biologic growth (ASTM D3274 - 95 or -09(2013)). Design life for paint products are shown in Table 3. Market life for paint products are shown in Table 4. Results were calculated for all base and sheen formulations. For further technical information on e600 Exterior Paints, visit www.behr.com.

Table 2: Design life by coating type and quality designation

Coating Type	Low Quality	Mid Quality	High Quality	Alternative
Interior Paint	3 years	7 years	15 years	N/A
Exterior Paint	5 years	10 years	20 years	Warranty

Table 3: Design Life- Lifetime, reference flow, and quantity of colorant

	Lifetime (years)	Amount of paint needed during lifetime (kg / Functional Unit)	Amount of tint needed during lifetime (lb / Functional Unit)
e610	20	0.414	0.0309
e613	20	0.395	0.103
e614	20	0.389	0.0834
e640	20	0.375	0.0324
e643	20	0.335	0.112
e644	20	0.348	0.0884
e670	20	0.373	0.0325
e673	20	0.33	0.113
e674	20	0.333	0.0906

Table 4: Market Life- Lifetime, reference flow, and quantity of colorant

	Lifetime (years)	Amount of paint needed during lifetime (kg / Functional Unit)	Amount of tint needed during lifetime (lb / Functional Unit)
e610	10	0.827	0.0463
e613	10	0.79	0.151
e614	10	0.779	0.123
e640	10	0.751	0.0479
e643	10	0.67	0.16
e644	10	0.697	0.127
e670	10	0.747	0.048
e673	10	0.66	0.161
e674	10	0.666	0.13





Scope and Boundaries of the Life Cycle Assessment

System Boundaries

The LCA was performed according to ISO 14040 standards. The system is a cradle-to-grave LCA and includes the following modules as defined in the PCR. The declaration covers the full range of e600 sold in the North American market for the reference year.

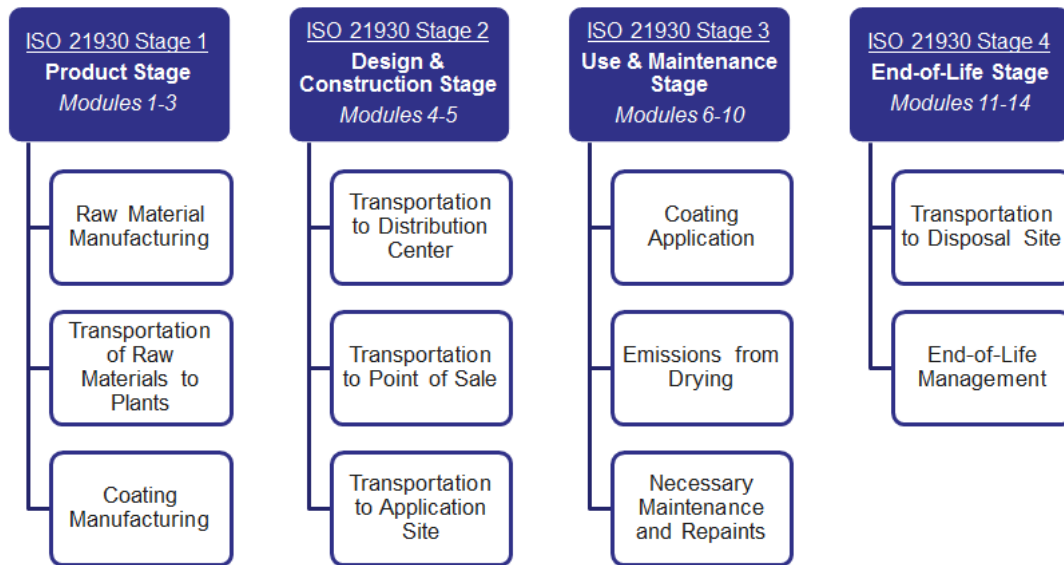


Figure 1: System boundaries for cradle to grave LCA

Assumptions

The described modeling approach makes assumptions in order to represent the cradle-to-grave environmental performance of Behr paint products. These assumptions include those that are prescribed by the PCR, such as in packaging disposal and recovery treatment, as well as transportation distances and use phase assumptions.

Cut-off Criteria

No cut-off criteria are defined by this study. For processes within the system boundary, all available energy and material flow data have been included in the model.





Data Quality

Primary data were obtained from Behr's eight facilities, one each in Chicago Heights, IL; Allentown, PA; St. Louis, MO; Roanoke, TX; and Atlanta, GA; and three in Santa Ana, CA for the 2016 reference year. Background data were obtained from the GaBi 2017 database and are representative of the years 2007-2016. Overall, both primary and background data are representative of the product system and have been deemed very good quality.

Allocation

Manufacturing inputs for the eight facilities were allocated to each paint product by volume.

Product Stage

e600 Exterior Paints are produced at Behr's production facilities according to the following processing steps.

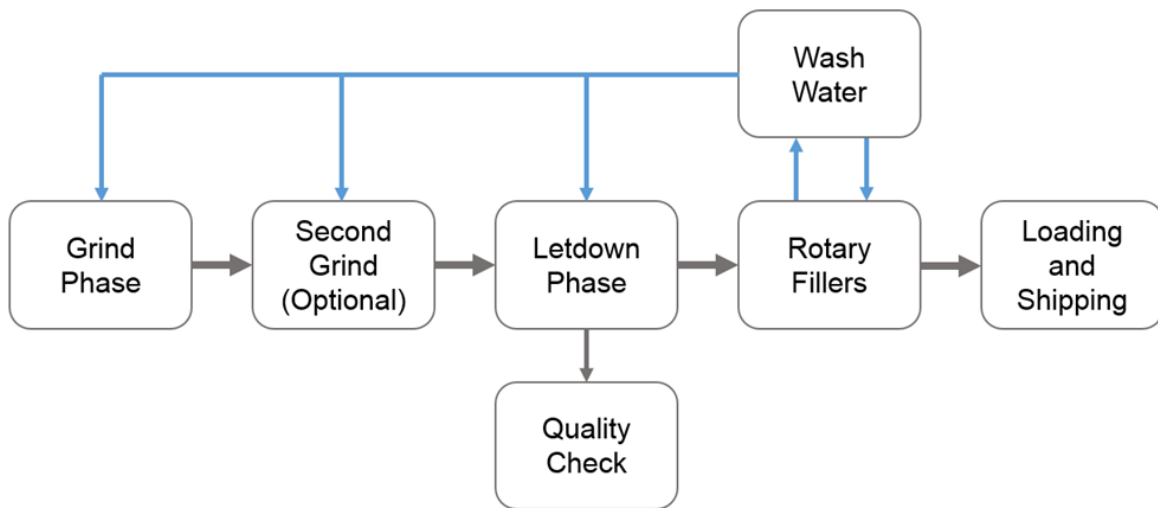


Figure 2: Behr process flow schematic

Design and Construction Stage

The design and construction stage begins with the packaged paint product leaving the production site and ends





with the coating being delivered to the point of application. Within this stage, the paint product is modeled as distributed to a warehouse and from there to Home Depot stores. At the stores, it is purchased and transported to the point of application. This stage also includes the addition of colorant, represented by carbon black, at the point of sale, per the PCR.

Use and Maintenance Stage

Application and Use

The use stage begins when the user applies the product to a substrate. Environmental burdens associated with repaints are attributed to the original stage in which they occurred (e.g. production of the coating for the repaint is attributed to Stage 1 - Product). This stage does not require any energy or additional cleaning inputs, but includes the VOCs emitted during application. The e600 Exterior Paints are considered by GREENGUARD to be low-VOC paint products, which is a designation applicable to products with less than fifty grams of VOC emissions per liter of paint, based on the ANSI/ASHRAE Standard 62.1-2007 test method.

Health, Safety, and Environmental Aspects during Installation

Customers obtain material from a store or have the store deliver it. The customer or their contractor applies the coating to substrate(s) at customer site(s). The coating remains on the substrate material until the substrate is disposed of. This may include up to a 60 year life time, with additional /subsequent protective coatings. If the coating is handled and applied using the recommendations in the safety data sheet and technical data sheet, minimal health and environmental impacts should occur, and maximum product and substrate life should be expected.

Waste

Disposal of any leftover coating and discarded packaging is categorized under the end-of-life stage. A 10% paint loss rate during application was included per the PCR.

Packaging

e600 Exterior Paints are available in 1-gallon and 5-gallon containers. e600's plastic packaging is often made from 100% recycled material.

End of Life Stage

Recycling or Reuse

ENVIRONMENTAL PRODUCT DECLARATION



Behr Pro e600 Exterior Paints

According to ISO 14025

Home Depot stores encourage customers to use PaintCare or local paint recycling programs.

Unused Materials

The manufacturing facilities recycle materials and by-products. The Chicago Heights, Atlanta, Garry, and Roanoke facilities also send off-spec products to GDB International, an organization that recycles paint waste into paint products.

Disposal

Product end-of-life occurs with the disposal of the substrate material. 100% of the waste is disposed of in a landfill at the end-of-life stage, and cannot be separated from the substrate before disposal. Packaging is recovered at a rate of 9.5% for plastics, 33% for metals, and 65% for paper and corrugate material. Recovery rates represent the average fraction of generated waste that is recovered in the US.



Life Cycle Impact Assessment

In accordance to the guiding PCR, TRACI 2.1 impact characterization methodology is used to calculate the declared environmental impacts, except for global warming potential results, which follow the methodology in the IPCC 5th assessment report. Additional inventory metrics are also calculated per the guiding PCR. The declared impacts and inventory metrics are summarized in this section.

Key Environmental Parameters

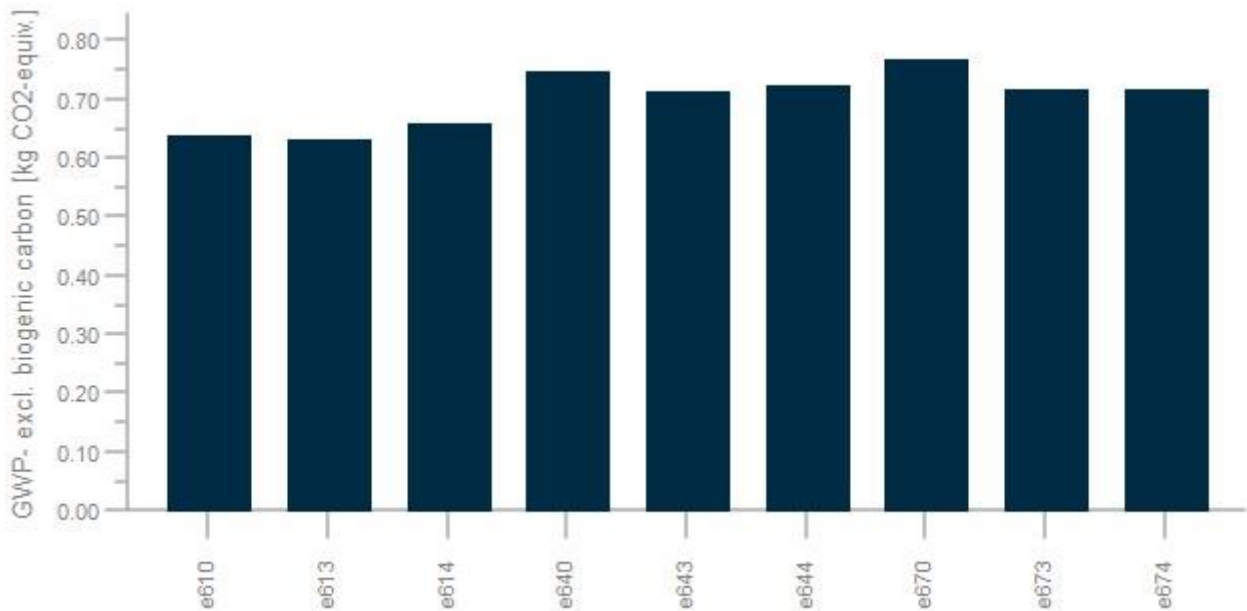


Figure 3: Global warming potential, excluding biogenic carbon for design lifetime

Table 5: Impact assessment results for design lifetime by PCR stages, (representative product, e610)

	Stage 1	Stage 2	Stage 3	Stage 4
GWP, excl. biogenic carbon [kg CO2-Equiv.]	4.80E-01	1.35E-01	-	2.37E-02
GWP, incl. biogenic carbon [kg CO2-Equiv.]	4.79E-01	1.33E-01	-	2.44E-02
Acidification [kg SO2-Equiv.]	4.64E-03	3.80E-04	-	3.31E-04
Eutrophication [kg N-Equiv.]	8.90E-05	3.38E-05	-	1.27E-04
Ozone depletion [kg CFC 11-Equiv.]	5.44E-10	3.68E-12	-	8.99E-11
Smog formation [kg O3-Equiv.]	2.06E-02	8.95E-03	4.15E-02	2.92E-03



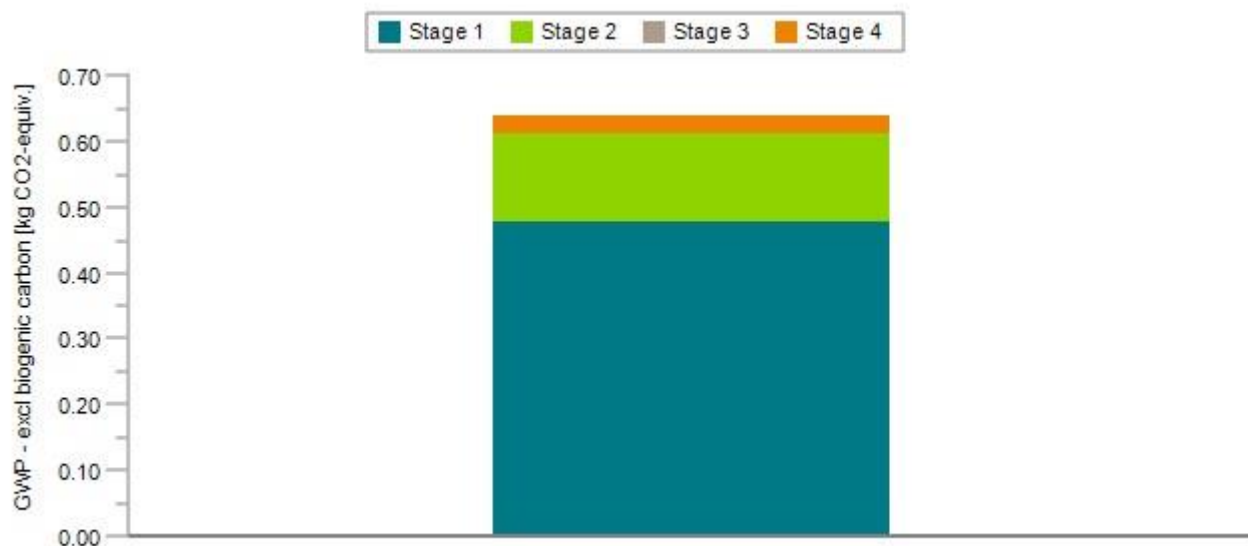


Figure 4: Global warming potential, excluding biogenic carbon for design lifetime, (representative product, e610)

Table 6: Impact assessment results for design lifetime

	GWP, excl. biogenic carbon [kg CO2-Equiv.]	GWP, incl. biogenic carbon [kg CO2-Equiv.]	Acidification [kg SO2-Equiv.]	Eutrophication [kg N-Equiv.]	Ozone depletion [kg CFC 11-Equiv.]	Smog formation [kg O3-Equiv.]
e610	6.39E-01	6.36E-01	5.35E-03	2.50E-04	6.38E-10	7.40E-02
e613	6.31E-01	6.37E-01	2.18E-03	2.28E-04	4.66E-10	6.66E-02
e614	6.59E-01	6.57E-01	2.97E-03	2.34E-04	5.21E-10	7.02E-02
e640	7.47E-01	7.47E-01	5.97E-03	2.54E-04	6.58E-10	7.68E-02
e643	7.14E-01	7.08E-01	2.26E-03	2.19E-04	5.77E-10	7.11E-02
e644	7.23E-01	7.17E-01	3.25E-03	2.28E-04	5.92E-10	7.23E-02
e670	7.69E-01	7.64E-01	6.40E-03	2.55E-04	6.39E-10	7.69E-02
e673	7.15E-01	7.09E-01	2.23E-03	2.16E-04	7.31E-10	6.99E-02
e674	7.18E-01	7.12E-01	3.09E-03	2.22E-04	6.73E-10	7.26E-02



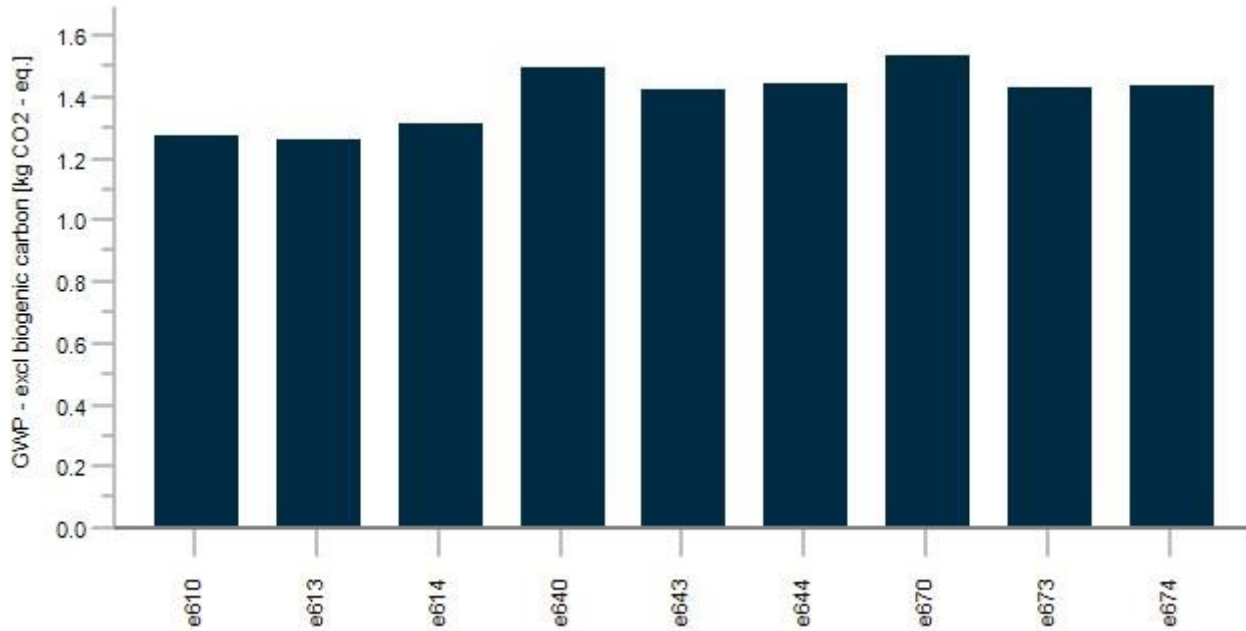


Figure 5: Global warming potential, excluding biogenic carbon for market lifetime

Table 7: Life cycle inventory data for market lifetime, (representative product, e610)

	Stage 1	Stage 2	Stage 3	Stage 4
GWP, excl. biogenic carbon [kg CO2-Equiv.]	9.61E-01	2.71E-01	-	4.73E-02
GWP, incl. biogenic carbon [kg CO2-Equiv.]	9.58E-01	2.66E-01	-	4.87E-02
Acidification [kg SO2-Equiv.]	9.28E-03	7.60E-04	-	6.62E-04
Eutrophication [kg N-Equiv.]	1.78E-04	6.76E-05	-	2.53E-04
Ozone depletion [kg CFC 11-Equiv.]	1.09E-09	7.36E-12	-	1.80E-10
Smog formation [kg O3-Equiv.]	4.11E-02	1.79E-02	8.31E-02	5.83E-03

ENVIRONMENTAL PRODUCT DECLARATION



Behr Pro e600 Exterior Paints

According to ISO 14025

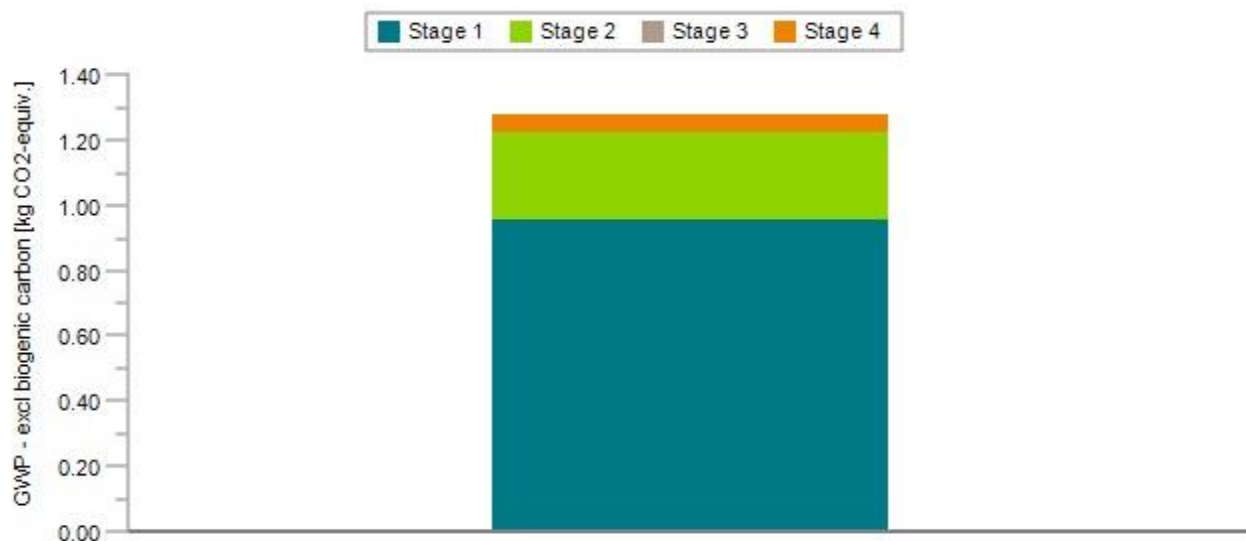


Figure 5: Global warming potential, excluding biogenic carbon for market lifetime, (representative product, e610)

Table 8: Impact assessment results for market lifetime

	GWP, excl. biogenic carbon [kg CO2-Equiv.]	GWP, incl. biogenic carbon [kg CO2-Equiv.]	Acidification [kg SO2-Equiv.]	Eutrophication [kg N-Equiv.]	Ozone depletion [kg CFC 11-Equiv.]	Smog formation [kg O3-Equiv.]
e610	1.28E00	1.27E00	1.07E-02	4.99E-04	1.28E-09	1.48E-01
e613	1.26E00	1.27E00	4.35E-03	4.56E-04	9.31E-10	1.33E-01
e614	1.32E00	1.31E00	5.93E-03	4.68E-04	1.04E-09	1.40E-01
e640	1.49E00	1.49E00	1.19E-02	5.08E-04	1.32E-09	1.54E-01
e643	1.43E00	1.42E00	4.52E-03	4.38E-04	1.15E-09	1.42E-01
e644	1.45E00	1.43E00	6.51E-03	4.56E-04	1.18E-09	1.45E-01
e670	1.54E00	1.53E00	1.28E-02	5.11E-04	1.28E-09	1.54E-01
e673	1.43E00	1.42E00	4.45E-03	4.32E-04	1.46E-09	1.40E-01
e674	1.44E00	1.42E00	6.17E-03	4.45E-04	1.35E-09	1.45E-01

Material and Energy Resources, Emissions, and Wastes

The additional inventory results required by the PCR for each product are shown in the tables below.





Table 9: Energy resources for design lifetime, (representative product, e610) [MJ, net calorific value]

	Stage 1	Stage 2	Stage 3	Stage 4
Crude oil (resource)	3.06E00	2.16E00	-	1.82E-01
Hard coal (resource)	1.21E00	6.45E-02	-	-2.38E-02
Lignite (resource)	2.44E-01	7.21E-03	-	9.86E-03
Natural gas (resource)	5.38E00	1.01E-01	-	2.25E-02
Peat (resource)	4.67E-04	3.96E-06	-	-1.70E-07
Uranium (resource)	4.96E-01	3.28E-02	-	3.21E-03
Primary energy from geothermics	1.05E-02	1.10E-03	-	-1.68E-04
Primary energy from hydro power	9.91E-02	7.43E-03	-	2.04E-03
Primary energy from solar energy	4.24E-01	7.47E-02	-	1.70E-02
Primary energy from waves	1.13E-08	3.17E-15	-	-2.31E-09
Primary energy from wind power	1.06E-01	5.88E-03	-	1.89E-03

Table 10: Material resources for design lifetime, (representative product, e610)

	Stage 1	Stage 2	Stage 3	Stage 4
Non renewable resources	8.04E-01	2.27E-02	-	9.96E-02
Renewable resources	2.28E02	1.28E01	-	8.91E00

Table 11: Other environmental information for design lifetime, (representative product, e610)

	Stage 1	Stage 2	Stage 3	Stage 4
Blue water consumption [kg]	2.42E00	5.51E-01	-	2.77E-02
Hazardous waste, deposited [kg]	8.99E-07	4.06E-07	-	1.43E-09
Non-hazardous waste, deposited [kg]	8.09E-03	2.13E-04	-	4.72E-01
Recycled materials [kg]	-	-	-	6.06E-03
Secondary raw material [kg]	4.30E-04	-	-	-



Table 12: Energy resources for market lifetime, (representative product, e610) [MJ, net calorific value]

	Stage 1	Stage 2	Stage 3	Stage 4
Crude oil (resource)	6.12E00	4.31E00	-	3.65E-01
Hard coal (resource)	2.43E00	1.29E-01	-	-4.75E-02
Lignite (resource)	4.88E-01	1.44E-02	-	1.97E-02
Natural gas (resource)	1.08E01	2.01E-01	-	4.50E-02
Peat (resource)	9.34E-04	7.92E-06	-	-3.40E-07
Uranium (resource)	9.92E-01	6.57E-02	-	6.42E-03
Primary energy from geothermics	2.11E-02	2.20E-03	-	-3.36E-04
Primary energy from hydro power	1.98E-01	1.49E-02	-	4.07E-03
Primary energy from solar energy	8.47E-01	1.49E-01	-	3.40E-02
Primary energy from waves	2.26E-08	6.33E-15	-	-4.63E-09
Primary energy from wind power	2.12E-01	1.18E-02	-	3.78E-03

Table 13: Material resources for market lifetime, (representative product, e610)

	Stage 1	Stage 2	Stage 3	Stage 4
Non renewable resources	1.61E00	4.55E-02		1.99E-01
Renewable resources	4.56E02	2.56E01		1.78E01

Table 14: Other environmental information for market lifetime, (representative product, e610)

	Stage 1	Stage 2	Stage 3	Stage 4
Blue water consumption [kg]	4.85E00	1.10E00	-	5.54E-02
Hazardous waste, deposited [kg]	1.80E-06	8.13E-07	-	2.86E-09
Non-hazardous waste, deposited [kg]	1.62E-02	4.27E-04	-	9.45E-01
Recycled materials [kg]	-	-	-	1.21E-02
Secondary raw material [kg]	8.59E-04	-	-	-

Impact Assessment Interpretation

For the e600 Exterior Paints products, raw materials and manufacturing (Stage 1) are the highest contributors to all impact categories. The impact from the design and construction stage is comparatively small but not insignificant and can be mostly attributed to transportation. There is also a small contribution to smog formation potential from emissions of VOCs during the use stage.





References

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ISO 14040	ISO 14040:2009-11 Environmental management - Life cycle assessment - Principles and framework
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