Henning Larsen

Josephine Uggerhøj Kornerup,
Sille Willum Foltinger and
Martha Lewis

August 27, 2024

Climate Impact of Indoor Paint

Climate Impact of Indoor Paint

Institution:	Henning Larsen Architects
Authors:	Josephine Uggerhøj Kornerup, Sille Willum Foltinger og Martha Lewis
Control:	Martha Lewis (mle@henninglarsen.com)

Publication date: August 27, 2024

Contents

The Task

Calculation of the climate footprint (Global Warming Potential, GWP) for indoor painting of white wall paint (20 products) and white wood paint (10 products). The wood paint study includes eight plastic paints and two linoleum paints, where the wall paint study includes five mineral paints, 13 plastic paints, and two linoleum paint.

The calculations are included as part of the project "Unwanted chemistry in paint" which is a collaboration between the Danish Consumer Council “Tænk”, the Danish Technological Institute, Henning Larsen and Aalborg University. The project is financed by Realdania and the Landowners Investment Foundation.

The other reports are available here:

Danish Consumer Council: online evaluations and project resume (in Danish)

Danish Technological Institute: *Problematic chemicals in paint*

Aalborg University: *Målinger på malings slidstyrke og frigivet mikroplast ved mekanisk slitage* (in Danish)

Method

Product Data

Product data (such as coverage, density, recommended number of treatment layers and type of binder) is obtained from information available on the manufacturers' and/or retailers' websites. If the necessary information was not available, it was requested from the retailer or manufacturer to ensure that the study reflects the most accurate product information. If it was not possible to collect data, average values were used.

Climate Impact Data

The paint's climate impact [CO2 emissions over a life cycle] is mainly obtained from generic data from Ökobau, (the German government's life cycle database for construction products) and is based on three different datasets; indoor lime paint, indoor plastic paint and plastic paint for wood. The project's selected dataset appears from BR18, appendix 2, table 7, "Generic data basis" and is thus approved for use in BR18 life cycle calculations.

Among the project's selected paint products, only a few have a product-specific environmental product declaration (Environmental Product Declaration, EPD). Among the twenty wall paints examined, eight products have specific EPDs, generic data from Ökobau is used on eleven, and one product (a linseed oil paint) is based on a reference value from a similar product. The environmental data used is divided between product-specific and industry data, which represents the average over similar products from industry organizations such as e.g. Verband der deutschen Lack- und Druckfarbenindustrie e.V. Of the ten wood paints examined, two products have specific EPDs, seven use generic Ökobau data and one product has no available data. The distribution of data sources can be read in Figure 1.

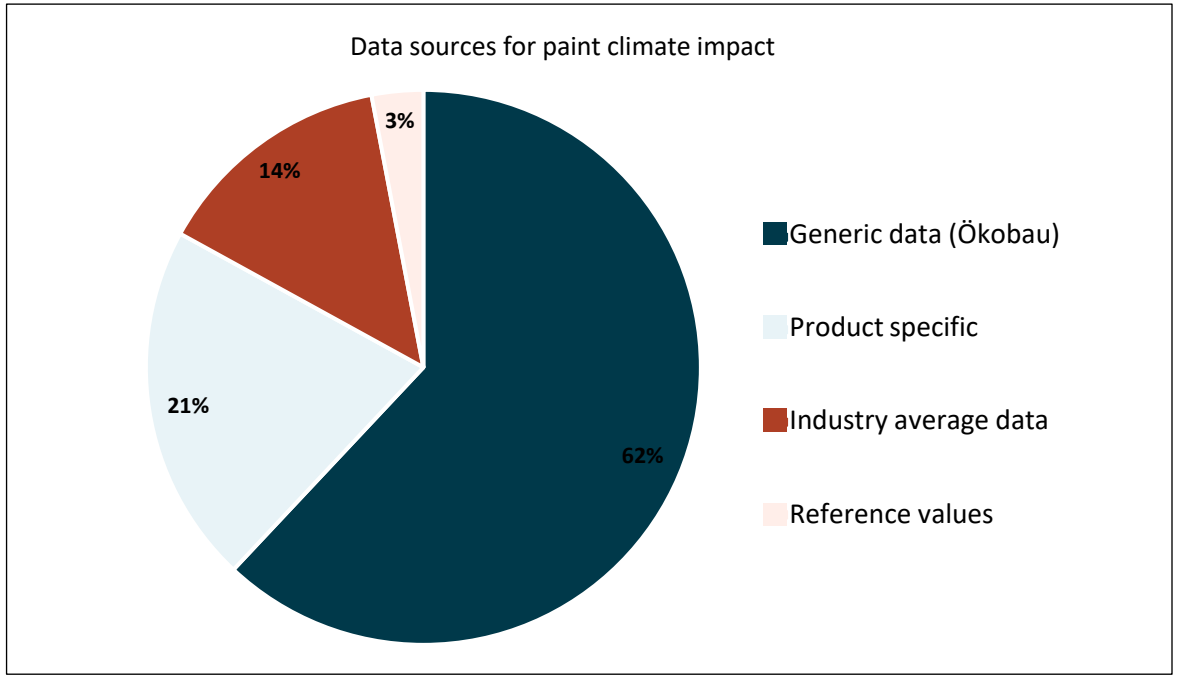


Fig. 1: Data sources for the study

Data for Linseed Oil Paints

Available environmental data on linseed oil paint is very limited, and there is no generic data on plant-based or linseed oil paint in the Ökobau database. There is one linseed oil producer in the Nordics who has prepared EPDs. In this project, one of the EPDs is used as a reference value for products with similar content to which an uncertainty margin is added.

Calculation Method

In this study, the climate impact of the investigated paint products is expressed in the unit kg CO2 e/m2 finished painted surface. This is to ensure comparable results and facilitate understanding for the consumer. It is worth noting that the recommended number of paint coats used has a large impact on the CO2 results. The same applies to the coverage, which depends on the surface quality. The parameters included in the calculation are often stated by the manufacturer or supplier as a range, therefore three different scenarios are worked on; best case, average case and worst case. Functional Unit (FU) is the unit of the product evaluated in EPDs, which is in most cases kg, but can also be given as m2 or litres.

$$Best\ case = \frac{density \cdot optimistic\ number\ of\ layers}{optimistic\ coverage} \cdot \text{kg CO2 e} \quad /\text{F U in kg}$$

$$Baseline\ case\ = \frac{density \cdot 2\ layers}{average\ coverage} \cdot \text{kg CO2 } e \quad /\text{F U in kg}$$

$$Worst\ case = \frac{density \cdot conservative\ number\ of\ layers}{conservative\ coverage} \cdot \text{kg CO2 e} \quad /\text{F U in kg}$$

Product data used for the parameters 'number of treatment layers' and ‘coverage' comes from the information declared by the manufacturer and retailer. Therefore, the results are also largely influenced and bound by the recommendation thereof.

Life Cycle Phases in the Calculations

The project addresses the climate impacts at product level and thus does not address the 50 years of the life of a building, rather represents a single execution of one square meter. This means that maintenance and replacement are not included. CO2 emissions associated with the manufacturing modules A1 – A3 form the basis for the calculations.

The data base for C3 and C4 modules, which indicate end-of-life loads, in paint EPDs is assessed to be uncertain. Many paint manufacturers on the Nordic market have EPDs based on the EPD standard EN 15804:2012+A1:2013, an older version where C modules are not indicated. EPDs with a publication date before 1 July 2022 may use the A1:2013 version of the standard. The challenge in the Danish context lies in the fact that building regulations require data from C phases as well.

In the latest version of the standard, EN 15804:2012+A2:2019, where C module data is required, the end-of-life scenario is frequently based on the paint's substrate, because the paint is not separated from the substrate at the end-of-life. Paint intended for mineral substrates (plaster, brick or concrete) indicates an end-of-life scenario for mineral products which is landfill, a C4 impact.

Outside of the scope of the project, however, there are product-specific EPDs for wood paint which indicate end-of-life scenarios as landfill, a scenario for the wood which is prohibited in Denmark. Likewise, there are metal paint EPDs that refer to landfill, a highly unusual end-of-life treatment for metal.

One of this study's EPDs comments on challenges with C-phase data for paint products with the following text, "It should be noted that the quality of the information and existing models in the Ecoinvent database used regarding the end of life of individual materials is lower than desired, as cited by several scientific articles. Therefore, it is recommended to be cautious in making decisions based on the results obtained by the study at this stage."

EPD-modeling

It is assumed that there is a difference in background data in different calculation tools and which version forms the basis for EPD modelling, which can affect environmental data. In the project there are EPDs that are modeled on Ecoinvent 3.2, Ecoinvent 3.8, CEPE RM Database v3.0, SimaPro 9.5.0.0 / Ecoinvent v.3.9.1, Simapro 9.3 and GaBi Version 8.7. The project does not include comparison of modeling background data.

Results

The results show that the paint products with a mineral binding agent (such as lime, clay and silicate-based paints) on average emit significantly less CO2 than products with plastic as a binding agent (see figure 2). Using data from the baseline calculations (a product's average coverage + two layers of treatment) the CO2 emissions are reduced by 44% for mineral-based interior paint compared to the use of plastic-based interior paint. The available data for linoleum paint is currently too limited to be included in the comparison.

Figure 2 shows how the products' binding agents affect the climate impact. The appendix contains detailed GWP results for the individual product's best-case, baseline case and worst-case scenarios.

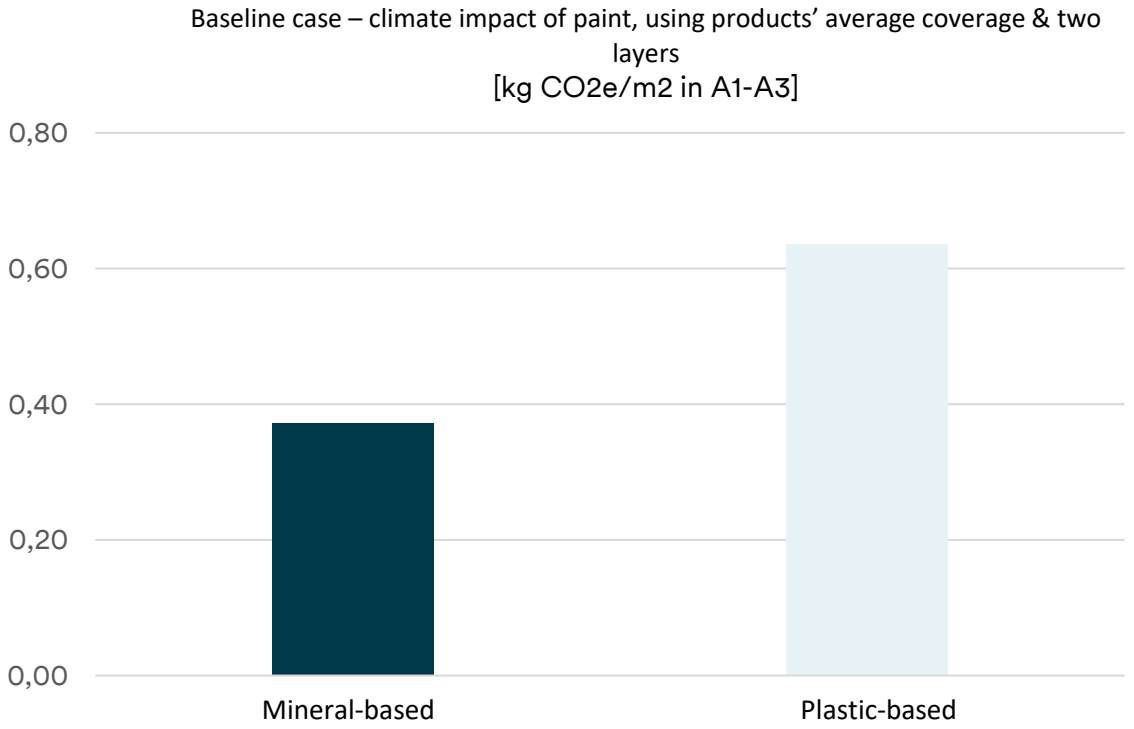


Fig. 2: – Climate impact of indoor paint according to binder type (A1-A3 modules)

The bar charts in the Appendix, show an overview of the respective 20 wall and 10 wood paints. In the worst-case scenarios where the climate impact is particularly high compared to their respective baseline case, this is due to the manufacturer or retailer recommending up to three layers of treatment (see figure 3). The amount used has a significant influence on the degree to which the paint impacts the climate. Therefore, the coverage (conservative or optimistic) and number of layers (conservative or optimistic) of the product plays a decisive role in the climate results.

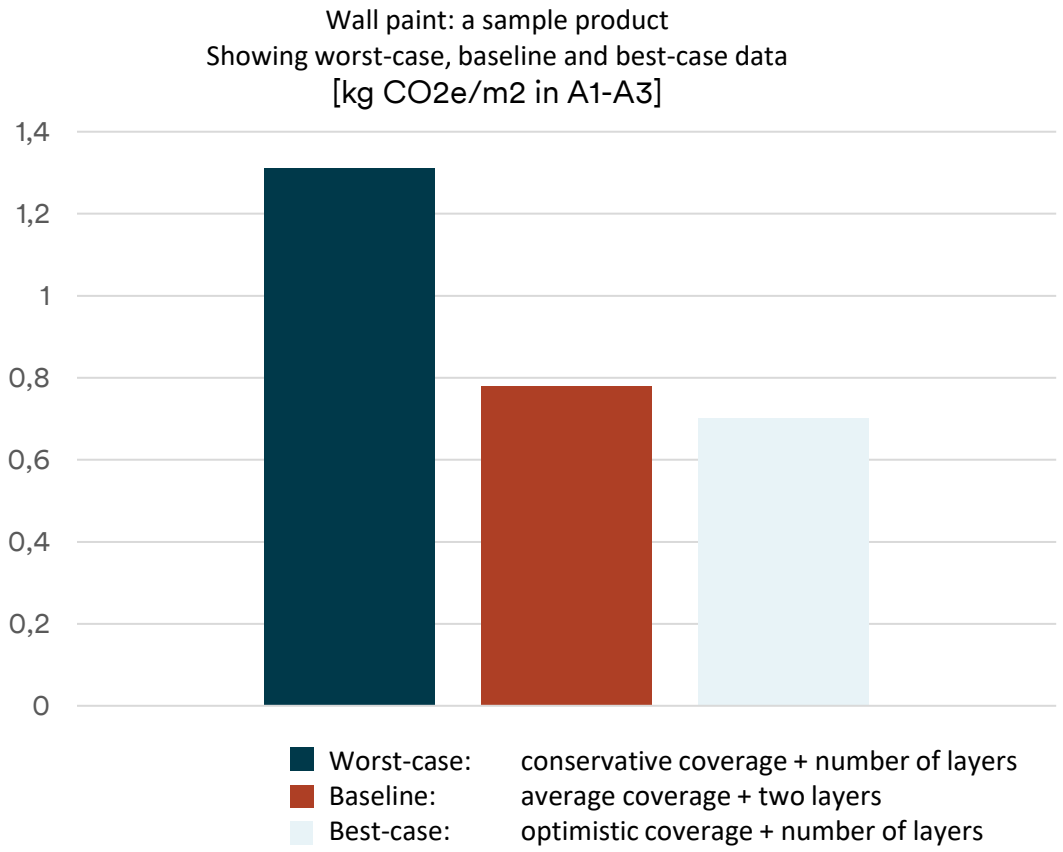


Fig. 3: – Climate impact of a sample product showing implications of coverage and number of layers (A1-A3 modules)

Conclusion

Quality of environmental data

The project has led to the assessment that the currently available environmental data for paint products is generally not sufficient. This is assessed as few product-specific EPDs exist and many manufacturers have released EPDs just prior to the EPD15804 version A1 cut-off date. As a result, many of these EPDs exclusive of C-module data are valid until 2026 or 2027. There are inexplicably large gaps in C-module values in the data that includes C-modules, and the argument that the paint follows the end-of-life of the substrate is not always the case with wood and metal paint respectively. In general, there is a lack of EPDs from plant-based paint products, with no generic data and only one manufacturer in Denmark with a product-specific EPDs.

Climate impact and indoor paint products

Despite the lack of product-specific data and data irregularities, the study concludes that indoor paint products with mineral binding agents (such as lime, clay and silicate-based paints) emit significantly less CO2 than products with plastic binding agents (acrylic, acrylic latex, polyvinyl acetate and polyurethane).

The second biggest influence on the individual paint's climate impact is the amount of product consumption per square meter. Several factors are at play here: the number of applied layers and the product’s coverage. The number of treatment layers applied is influenced by both the substrate and the consumer's satisfaction.

The results also show that the environmental data source has a significant impact on the environmental results. Product-specific EPDs tend to give better values. For example all product-specific plastic wall paints have a lower climate impact than Ökobau's plastic wall paint. For linoleum paint, it is considered that there is not enough data available to form a conclusion.

The project highlights an interest in the use and assessment of the amount of paint. It raises the question of whether it is, to the same extent, an aesthetic assessment as a question of what the consumer is willing to accept. In certain applications interior paint fulfills a functionality and in many other applications paint fulfills a purely aesthetic need. A desire for a full-covering, homogeneously painted wall has greater environmental consequences. Perhaps our aesthetic understanding of what constitutes a beautiful wall is outdated?

Appendix

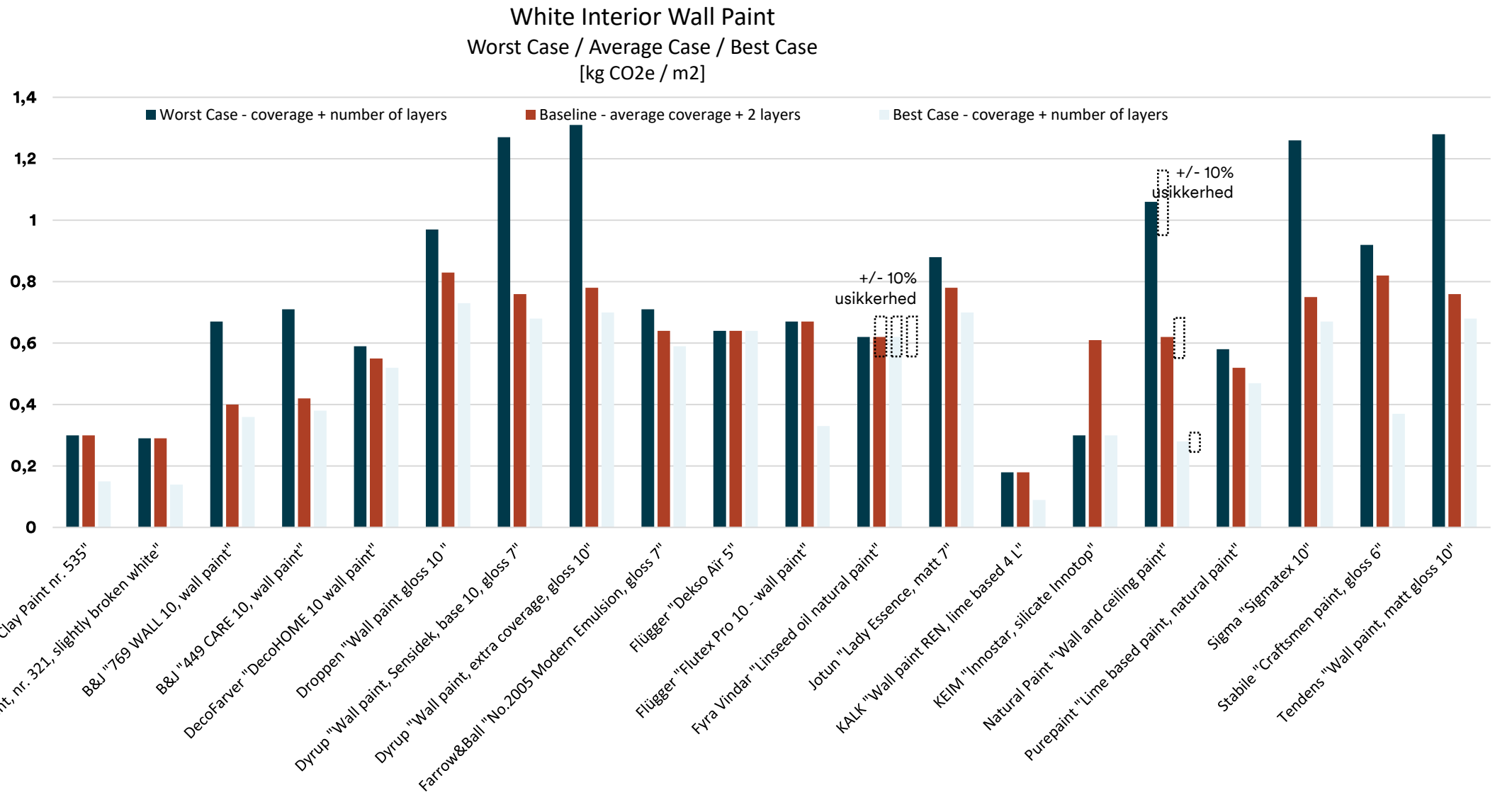
White Interior Wall Paint – data sources used in global warming potential calculations

Manufacturer / Supplier	Product Name in Danish (see bar chart for English)	Binder	EPD	Modules available in the EPD
Auro	Auro, ”Colours for Life "Hvid Professionel Lermaling nr. 535"	Lime	Ökobau indendørs kalkmaling	A1-A3, C4
Auro	Auro "Vægmaling, nr. 321, let brækket hvid"	Lime	Ökobau indendørs kalkmaling	A1-A3, C4
B&J	B&J "769 WALL 10, Vægmaling"	Plastic	EPD-VDL-20190085-IBG1-DE	A1-A3
B&J	B&J "449 CARE 10, Vægmaling"	Plastic	EPD-VDL-20190085-IBG1-DE	A1-A3
Deco	DecoFarver "DecoHOME 10 Vægmaling"	Plastic	EPD-VDL-20190085-IBG1-DE	A1-A3
Droppen (Harald Nyborg)	Droppen "Vægmaling Glans 10 - Hvid"	Plastic	Ökobau indendørs plastmaling	A1-A3, C4
Dyrup	Dyrup "Vægmaling, Sensidek, base 10, glans 7"	Plastic	Ökobau indendørs plastmaling	A1-A3, C4
Dyrup	Dyrup "Vægmaling, ekstra dækkende, hvid, glans 10"	Plastic	Ökobau indendørs plastmaling	A1-A3, C4
Farrow & Ball	Farrow & Ball "All White No. 2005, Modern Emulsion (glans 7%)"	Plastic	Ökobau indendørs plastmaling	A1-A3, C4
Flügger	Flügger "Dekso Aïr 5"	Plastic	S-P-11696	A1-A3, C4
Flügger	Flügger "Flutex Pro 10 - Vægmaling"	Plastic	S-P-03214	A1-A3
Fyra Vindar	Fyra Vindar "Linolie naturmaling hvid"	Plant	MD-23215-EN med en +/- 10% usikkerhedsfaktor	A1-A3, C3, C4
Jotun	Jotun "Lady Essence Silkamat 7"	Plastic	NEPD-4867-4122-NO	A1-A3, C4
KALK	KALK "Vægmaling REN hvid 4 L"	Lime	S-P-01050	A1-A3, C4
Keim	KEIM "Innostar, silikat innotop"	Silicate	A-data fra KEIM EPD EPD-VDL-KEI-20200170-IBG1-EN /	A1-A3
Naturmaling	Naturmaling "Væg- og loftmaling"	Plant	MD-23215-EN med en +/- 10% usikkerhedsfaktor	A1-A3, C4
Purepaint	Purepaint "Kalkmaling Naturmaling"	Lime	Ökobau indendørs kalkmaling	A1-A3, C4
Sigma	Sigma "Sigmatex 10"	Plastic	Ökobau indendørs plastmaling	A1-A3, C4
Stabile (produceret af Flügger)	Stabile "Håndværkermaling glans 6 hvid"	Plastic	Ökobau indendørs plastmaling	A1-A3, C4
Tendens (Bilka)	Tendens "Vægmaling Silkemat 10"	Plastic	Ökobau indendørs plastmaling	A1-A3, C4

White Interior Wood Paint – data sources used in global warming potential calculations

Manufacturer / Supplier	Product Name in Danish (see bar charts for English)	Binder	EPD	Modules available in the EPD
Auro	Auro "Glansmaling, 516-90, blank hvid"	Plastic	Ökobau plastmaling til træ	A1-A3, C3
Deco (B&J)	DecoFarver "DecoFREE 30 Allergivenlig Træmaling"	Plastic	Ökobau plastmaling til træ	A1-A3, C3
Decora (Harald Nyborg)	Decora "Træ og metal Glans 50 - hvid"	Plastic	Ökobau plastmaling til træ	A1-A3, C3
Dyrup	Dyrup "Træ & Metal Ekstra Dækkende 50"	Plastic	Ökobau plastmaling til træ	A1-A3, C3
Flügger	Flügger "Interior High Finish 50"	Plastic	Ökobau plastmaling til træ	A1-A3, C3
Hafnia (Røverkøb)	Hafnia "Træ- og Metalmaling 40"	Plastic	Ökobau plastmaling til træ	A1-A3, C3
Jotun	Jotun "Lady Supreme Finish 40 Træ- og Listemaling"	Plastic	NEPD-3269-1910-NO	A1–A3
Linolie.dk	Linolie & Pigment "Linoliemaling 70 / Hvid"	Plant	MD-23212-EN	A1-A3, C3, C4
Jem&Fix	Luxi "Træ- & metalmaling oliebaseret hvid glans 45"	Plastic	Ökobau plastmaling til træ	A1-A3, C3
Skovgaard og Frydensberg	Skovgaard & Frydensberg "Linoliemaling indendørs"	Plant	No data. There is no generic environmental data on plant-based paints. The content of S&F's linseed oil paint does not resemble the few product-specific EPDs on linseed oil paint.	--

Climate impact calculations (GWP) of 20 indoor wall paint products based on the available data (A1 – A3 phases)



Climate impact calculations (GWP) of 10 indoor wood paint products based on the available data (A1 – A3 phases)