HUMBLE
Advice

2022-16087 LCA PHOMI MCM CLADDING



PHOMI

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LCA PHOMI MCM

1 Table of contents

2 Glossary 3

3 Preface 4

4 Scope 5

5 Data analysis 8

6 Conclusion 9

7 Appendix 10

7.1 Results LCA 1kg PHOMI MCM CLADDING to Amsterdam 10

7.2 Results LCA 1kg PHOMI MCM CLADDING to Rotterdam 14

7.3 Results LCA 1kg PHOMI MCM CLADDING to Antwerp 18

7.4 Results LCA 1kg PHOMI MCM CLADDING to Hamburg 22

2 Glossary

For the readability of the report, a glossary has been drawn up in which the terms that appear in the report are defined.

Term	Definition
Ecoinvent	*Ecoinvent is a database containing well-documented process data for thousands of products, so that informed choices can be made about their impact on the environment.*
Environmental Product Declaration (EPD)	*An Environmental Product Declaration (EPD) is an independently verified and registered statement that provides comparable information about the environmental impact of products over the entire life cycle.*
Life Cycle Assessment (LCA)	*A Life Cycle Assessment (LCA) is a method for determining and evaluating the incoming and outgoing flows, and potential environmental impacts of a product system during its life cycle.*
Environmental-Impact	*Environmental change, adverse or favorable, resulting in whole or in part from an organization's activities or products. This environmental impact is based on life cycle analysis and detailed in the Dutch "Bepalingsmethode Milieuprestatie" of "Stichting Bouwkwaliteit (SBK)".*
Environmental Cost Indicator	*An Environmental Cost Indicator (ECI) is the unit in which the environmental costs are expressed.*
Mobius	*LCA software from Ecochain conforming to ISO 14040/44. Mobius works with the SBK Bepalingsmethode 3.1. Ecochain has made ecological footprints accessible since 2011.*
Shadow price	*Shadow prices are constructed prices for goods or factors of production that are not traded in markets.*
Scope	*The extent of the subject that has been researched and described in this report.*

3 Preface

The cladding materials made of Modified Clay Materials (MCM) that PHOMI Holding is producing, are universal and can be used on all kind of surfaces. This includes walls, floors, ceilings and columns, in the exteriors and interiors. Special molds are used in combination with special innovative technology that makes sure that the texture of each and every produced slab is unique. Now PHOMI wants to gain insight to the environmental impact of their product.

Commissioned by PHOMI, Humble-Advice is conducting an LCA research into PHOMI MCM CLADDING that can be applied to the various cladding materials in and around a building. For this product, data is collected that is calculated and expressed in an environmental cost indicator (ECI).



Figure 1 The building where PHOMI MCM is produced with PHOMI MCM on the exterior wall and arch

The Life Cycle Analysis (LCA) forms the basis for calculating the ECI scores. An LCA score can provide insight into the environmental impact of a product or process. Because the results of an LCA calculation consists different scores, a standard method has been developed to convert these into an unambiguous financial value, the ECI. The ECI is always expressed in a financial number.



Figure 2 The product lifecycle phases

4 Scope

For various materials, the environmental cost indicator (ECI) has been calculated and/or mapped out on the basis of the EPD, a method recognized and commonly used in the market. By calculating the ECI, insight is gained into the shadow price of the materials.

Shadow prices are constructed prices for goods or factors of production that are not traded in markets. Market prices are usually used in economic analysis. However, market prices are not available for all goods this is because there are no markets for them. Environmental quality is an example of this. In order to include the quality of the environment in economic analysis tools, so-called shadow prices are used. Shadow prices reflect the social value given to environmental quality. There are two ways to determine environmental quality shadow prices:

Prevention costs:
This approach is based on the costs of measures that must be taken to achieve the national environmental policy goals. The assumption is that politics expresses society's preference by setting these policy goals. This is called the abatement cost approach.

Damage costs:
This approach values environmental quality based on an estimate of the damage caused by emissions of environmentally harmful substances. The more harmful a certain emission is, with regard to for example, human health, the higher the corresponding shadow price. In both approaches, shadow prices per environmentally harmful substance are expressed in euro per kg of emissions. The shadow price reflects all the effects of the substance in question on the environment.

In this advisory report, the shadow costs and/or the shadow price of the various materials have been investigated. The calculation of this shadow price is done on the basis of the following steps:
1. Material data inventory
2. Converting data into input for the Mobius program
3. Linking data to the various databases in Mobius, including Ecoinvent.
4. Interpretation of the results of the Mobius calculator

The processes and supplied data of an ECI calculation can be divided into four phases and can be further divided into subphases (Figure 4). The main stages are the following:
A. Production and construction phase
B. Usage phase
C. Demolition and Processing Phase
D. Reuse, Recovery and Recycling Opportunities

For PHOMI MCM the phases A1 – A5, B1 - B7, C1 - C4 and D have been calculated (Figure 3).

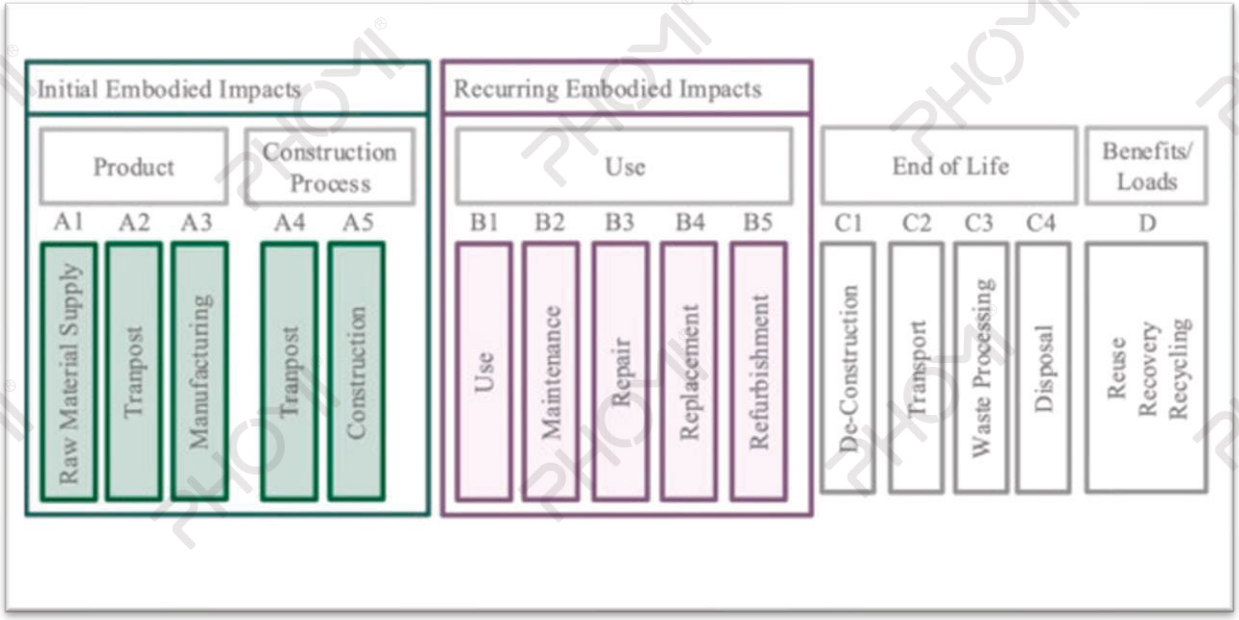


Figure 3 The detailed lifecycle phases used in life cycle assessments

Below is a description of what is calculated per phase used in this life cycle assessment:

A1. 1 m^2 of PHOMI MCM CLADDING is fabricated out of Kaolin (type of clay) and Quarz sand (SiO2).

A2. All the raw materials are extracted locally, the transport from the extraction site to the factory is estimated to be about 10 km.

A3. PHOMI MCM is partly (60%) produced with renewable energy (water and photovoltaic). On the roof of the factory PHOMI has about 20.000 m² of solar panels (see picture below), which currently generate around 1.5 million kWh per year. The rest of the energy is coal-generated electricity, where the steam from the coal powerplant's cooler is used to create conditions where the MCM powder is mixed with water to form a slurry. After the steam cools down till 70°C, it condensates and this water is re-used, so that there is no form of water waste.



Figure 4 solar panels on the roof of the factory where PHOMI MCM is produced

In addition, various binder materials are used during the production process. These are polyvinyl alcohol (PVA fiber), 3-trimethoxysilyl propyl methacrylate (silane coupling agent KH570) and polyacrylate.

A4. The transport in China is performed by truck from Laibin to Guangzhou port and from there to Europe with the modern large container vessels of different companies as Cosco and Maersk. The various cities calculated for the transport distances are Rotterdam, Amsterdam, Antwerp and Hamburg.

A5. By the installation there is no use of machinery, only manual labor is needed.

B1-B7 Stated by PHOMI the product has no need of any maintenance service during its 50 years lifespan. Therefore the use phase of the product (B1-B7) has no impact at all on the life cycle assessment.

C1-C4 The deconstruction of the product can be done without harming the integrity of the product or products nearby, furthermore there is no machinery required to demount the product. At the end of its lifecycle the product carries close to 100% of its initial physical mass and content, therefore the product is crushed into smaller fractions before it goes to a local material processor.

If the product does not go to a local production that can re-work the used slabs to new similar products, the product can be dumped in the local area. The product is so harmless, that this can be done without causing damage to the arable land or water resources or causing any toxicity.

D. The recycle potential of the product is very high. As stated, should it be crushed into smaller fractions before it can be used to mix with other similar materials out of which it was essentially created in order to become a new product again. The PHOMI slab with the remnants of the cement on its inner side is the perfect base of a new product, as the recycled cement is one of the possible components out of which the PHOMI MCM is made.

5 Data analysis

The ECI score of PHOMI MCM CLADDING is calculated on the basis of data supplied by PHOMI Holding Europe over a lifespan of 50 years. This data includes all information needed to fabricate 1 kg of PHOMI MCM CLADDING.

Subsequently, the various scores belonging to the scope of the study were made clear (see table 1) about the various ports to which the materials are shipped and subsequently exported to retail. All results of PHOMI MCM CLADDING from the input data are included in the appendix.

PHOMI MCM CLADDING					
Functional Unit	m^2	**ECI scores per port**			
Lifespan	50				
Phase		**Amsterdam**	**Rotterdam**	**Antwerp**	**Hamburg**
A1		€0,0577	€0,0577	€0,0577	€0,0577
A2		€0,0006	€0,0006	€0,0006	€0,0006
A3		€0,0548	€0,0548	€0,0548	€0,0548
A4-A5		€0,1900	€0,1896	€0,1937	€0,2176
B1-B7		-	-	-	-
C1-C4		€0,0044	€0,0044	€0,0044	€0,0044
D		€0,0062	€0,0062	€0,0062	€0,0062
ECI per Functional Unit		**€0,3138**	**€0,3134**	**€0,3175**	**€0,3414**
ECI per Functional Unit/year		**€0,0063**	**€0,0063**	**€0,0064**	**€0,0068**

Table 1 The ECI scores for the individual phases of this life cycle assessment

The base material kaolin in phase A1 has a relatively high environmental cost. Out the total of €0,058, €0,049 comes from kaolin (see appendix page 11). This is due to the estimated energy consumption, as well as emissions to air and water from production, and an estimation of the infrastructure of the site.

While producing PHOMI MCM CLADDING grey energy is used. Grey energy is energy produced from polluting sources. Therefore this part of the production had a big part (€0,046 out of €0,055) in the individual environmental cost of this phase (A3), for further details see appendix page 11.

Furthermore the use phase of the product (B1-B7) has no impact at all on the life cycle assessment. This is because PHOMI MCM CLADDING has no need of any maintenance service during its 50 years lifespan.

Because most of the other phases in the life cycle assessment are the same for the PHOMI product, we do not see any major differences. The last difference lies in the transport distances (phase A4) that the product travels after it is produced in China and exported to Europe. The ports to which the product is shipped determine this distance and the distance the product then has to travel to retail.

6 Conclusion

As shown in chapter 5, the materials going to the port of Amsterdam, Rotterdam and Antwerp are the best from the results analysis of this study, which examines the differences in environmental impact of PHOMI MCM CLADDING. It can be deduced from table 1 of the relevant chapter that the ECI score is mainly due to the value in phase A4. This is the environmental impact that arises from the transport of the material to Europe and from the port in Europe to retail. The port in Hamburg is the furthest away from Guangzhou, which explains why this port has a higher score than the other ports.

Due to the reuse potential of the product, in phase D 'end of life' negative values are obtained from the score that positively influence the environmental impact. It can be concluded from this that what is still possible with the product in the 'end of life' phase can have a major impact on the value of the environmental cost indicator.

This study considers its possible that some phases could still slightly influence the final value of the environmental cost indicator. This concerns the use phase (B1-B7). To gain more detailed insight into the environmental impact during these phases of PHOMI MCM CLADDING, a follow-up study is recommended if needed for further insights on the usage phases. Reference projects can be used to estimate, among other things, the expected replacement rate.

7 Appendix

7.1 RESULTS LCA 1KG PHOMI MCM CLADDING TO AMSTERDAM

Date	16/03/2022 Europe/Amsterdam
Account name	Humble Buildings
Workspace	PHOMI
Product Lifecycle	LCA 1 kg PHOMI MCM CLADDING to Amsterdam
Unit	1 m^2
Impact method set	sbk bepalingsmethode
Impact assessment method	SBK Bepalingsmethode 3.1
Weighing	ECI total Single score

Table 2 setup ECI calculation

Impact category name	Reference unit	A1	A2	A3	A4-A5	C1-C4	D	Total
Total use of renewable primary energy resources (PERT)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Radioactive waste disposed (HWD)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Abiotic depletion potential for non-fossil resources (ADPE)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Total use of non-renewable primary energy resources (PENRT)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Acidification potential of land and water (AP)	Euro	€ 0,0113	€ 0,0001	€ 0,0110	€ 0,0742	€ 0,0007	€ 0,0006	€ 0,0979
Total use of primary energy resources (PET)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Abiotic depletion potential for fossil resources (ADPF)	Euro	€ 0,0006	€ 0,0000	€ 0,0005	€ 0,0009	€ 0,0000	-€ 0,0002	€ 0,0019
Hazardous waste disposed (HWD)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Human toxicity potential (HTP)	Euro	€ 0,0133	€ 0,0002	€ 0,0161	€ 0,0439	€ 0,0013	-€ 0,0009	€ 0,0739
Use of net fresh water (FW)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Formation potential of tropospheric ozone photochemical oxidants (POCP)	Euro	€ 0,0004	€ 0,0000	€ 0,0003	€ 0,0021	€ 0,0000	€ 0,0000	€ 0,0028
Marine aquatic ecotoxicity potential (MAETP)	Euro	€ 0,0018	€ 0,0000	€ 0,0015	€ 0,0041	€ 0,0001	€ 0,0000	€ 0,0076
Eutrophication potential (EP)	Euro	€ 0,0024	€ 0,0000	€ 0,0022	€ 0,0189	€ 0,0003	€ 0,0001	€ 0,0240
Freshwater aquatic ecotoxicity potential (FAETP)	Euro	€ 0,0001	€ 0,0000	€ 0,0001	€ 0,0003	€ 0,0000	€ 0,0000	€ 0,0005
Global warming potential (GWP)	Euro	€ 0,0277	€ 0,0003	€ 0,0231	€ 0,0456	€ 0,0019	€ 0,0065	€ 0,1051
Terrestrial ecotoxicity potential (TETP)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0001	€ 0,0000	€ 0,0000	€ 0,0002
Non-hazardous waste disposed (NHWD)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Depletion potential of the stratospheric ozone layer (ODP)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Single score	Euro	€ 0,0577	€ 0,0006	€ 0,0548	€ 0,1900	€ 0,0044	€ 0,0062	€ 0,3138

Figure 5 environmental profile per impact category over a lifespan of 50 years - PHOMI MCM CLADDING 1m^2 to Amsterdam

Phase	Item	Amount	Unit	Type	Global warming potential (GWP) (Euro)	Single score (Euro)
A1	Kaolin	2,12	kg	normal	€ 0,0241	€ 0,0492
A1	Quarz Sand	1,72	kg	normal	€ 0,0036	€ 0,0085
A2	Transport (Raw Material)	10	km	normal	€ 0,0003	€ 0,0006
A3	3-trimethoxysilyl propyl methacrylate	0,006	kg	normal	€ 0,0010	€ 0,0022
A3	Polyacrylate	0,15952	kg	normal	€ 0,0000	€ 0,0001
A3	Polyvinyl	0,006	kg	normal	€ 0,0000	€ 0,0000
A3	Green energy	0,48	kWh	normal	€ 0,0021	€ 0,0067
A3	Grey energy	0,32	kWh	normal	€ 0,0201	€ 0,0458
A4-A5	Amsterdam to Retail	44	km	normal	€ 0,0011	€ 0,0027
A4-A5	Guangzhou - Amsterdam	18084	km	normal	€ 0,0338	€ 0,1621
A4-A5	Laibin - Guangzhou	500	km	normal	€ 0,0093	€ 0,0220
A4-A5	Retail to construction site	50	km	normal	€ 0,0013	€ 0,0031
C1-C4	Demolition	3,96	kg	normal	€ 0,0000	€ 0,0000
C1-C4	Disposal Kaolin	0,0212	kg	normal	€ 0,0002	€ 0,0005
C1-C4	Disposal Quarz Sand	0,0172	kg	normal	€ 0,0000	€ 0,0001
C1-C4	Transport to Waste Processing	50	km	normal	€ 0,0013	€ 0,0032
C1-C4	Waste Processing crushing Phomi	3,96	kg	normal	€ 0,0003	€ 0,0007
D	Elektricity	0,1	kWh	normal	€ 0,0132	€ 0,0153
D	Energy saved	0,79	kWh	normal	-€ 0,0059	-€ 0,0070
D	Raw material equivalent	3,8016	kg	normal	-€ 0,0008	-€ 0,0020

Figure 6 the different materials and processes calculated for 1m2 PHOMI MCM CLADDING over a lifespan of 50 years shipped to Amsterdam

Phase	Name	Amount		Impact in Euro	Percentage %
A1	Kaolin	2.12	kg	0.05	15.7 %
A1	Quarz Sand	1.72	kg	$8.51 \cdot 10^{-3}$	2.7 %
A2	Transport (Raw Material)	10	km	$6.45 \cdot 10^{-4}$	0.2 %
A4-A5	Amsterdam to Retail	44	km	$2.74 \cdot 10^{-3}$	0.9 %
A4-A5	Guangzhou - Amsterdam	$1.81 \cdot 10^{4}$	km	0.16	51.7 %
A4-A5	Laibin - Guangzhou	$5 \cdot 10^{2}$	km	0.02	7 %
A4-A5	Retail to construction site	50	km	$3.11 \cdot 10^{-3}$	1 %
A3	3-trimethoxysilyl propyl methacrylate	$6 \cdot 10^{-3}$	kg	$2.15 \cdot 10^{-3}$	0.7 %
A3	Polyacrylate	0.16	kg	$6.3 \cdot 10^{-5}$	0 %
A3	Polyvinyl	$6 \cdot 10^{-3}$	kg	$4.2 \cdot 10^{-6}$	$1.34 \cdot 10^{-3}$ %
A3	Green energy	0.48	kWh	$6.72 \cdot 10^{-3}$	2.1 %
A3	Grey energy	0.32	kWh	0.05	14.6 %
C1-C4	Demolition	3.96	kg	0	-
C1-C4	Disposal Kaolin	0.02	kg	$5.02 \cdot 10^{-4}$	0.2 %
C1-C4	Disposal Quarz Sand	0.02	kg	$5.36 \cdot 10^{-5}$	0 %
C1-C4	Transport to Waste Processing	50	km	$3.19 \cdot 10^{-3}$	1 %
C1-C4	Waste Processing crushing Phomi	3.96	kg	$6.71 \cdot 10^{-4}$	0.2 %
D	Elektricity	0.1	kWh	0.02	4.9 %
D	Energy saved	0.79	kWh	$-7.04 \cdot 10^{-3}$	-2.2 %
D	Raw material equivalent	3.8	kg	$-2.04 \cdot 10^{-3}$	-0.6 %

Figure 7 flat view for 1m^2 PHOMI MCM CLADDING shipped to Amsterdam over a lifespan of 50 years, divided into the single ECI score per material/process

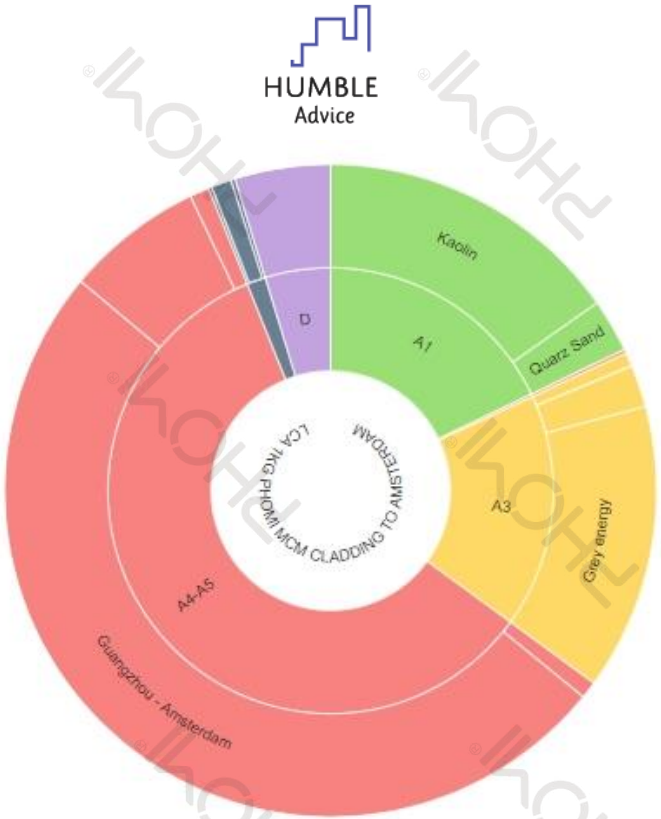


Figure 9 sunburst for 1m^2 PHOMI MCM CLADDING shipped to Amsterdam over a lifespan of 50 years, divided into the single ECI score per material/process

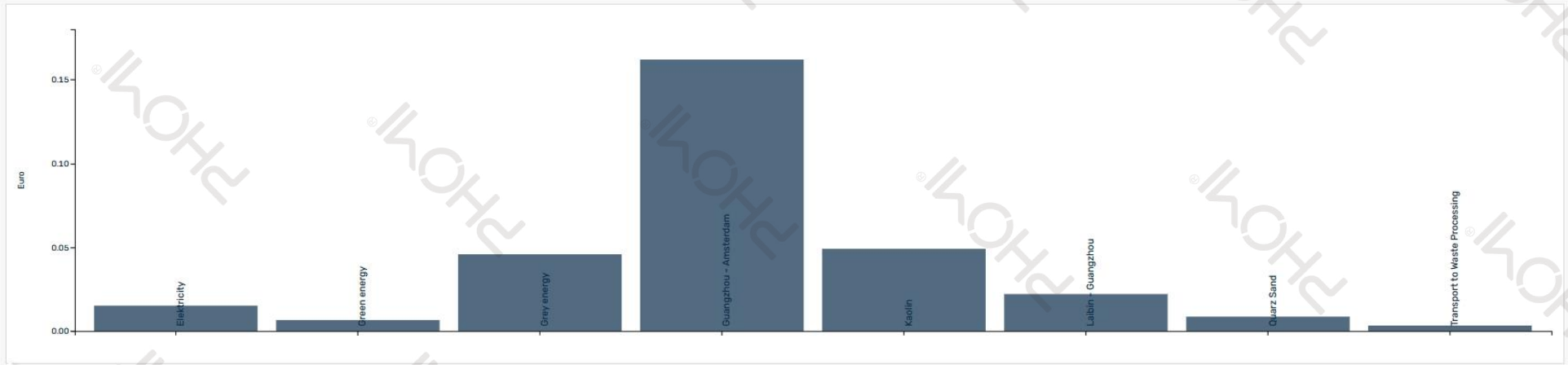


Figure 8 bar chart for 1m^2 PHOMI MCM CLADDING shipped to Amsterdam over a lifespan of 50 years, divided into the single ECI score per material/process

7.2 RESULTS LCA 1KG PHOMI MCM CLADDING TO ROTTERDAM

Date	16/03/2022 Europe/Amsterdam
Account name	Humble Buildings
Workspace	PHOMI
Product Lifecycle	LCA 1 kg PHOMI MCM CLADDING to Rotterdam
Unit	1 m^2
Impact method set	sbk bepalingsmethode
Impact assessment method	SBK Bepalingsmethode 3.1
Weighing	ECI total Single score

Table 3 setup ECI calculation

Impact category name	Reference unit	A1	A2	A3	A4-A5	C1-C4	D	Total
Total use of renewable primary energy resources (PERT)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Radioactive waste disposed (HWD)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Abiotic depletion potential for non-fossil resources (ADPE)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Total use of non-renewable primary energy resources (PENRT)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Acidification potential of land and water (AP)	Euro	€ 0,0113	€ 0,0001	€ 0,0110	€ 0,0738	€ 0,0007	€ 0,0006	€ 0,0975
Total use of primary energy resources (PET)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Abiotic depletion potential for fossil resources (ADPF)	Euro	€ 0,0006	€ 0,0000	€ 0,0005	€ 0,0009	€ 0,0000	-€ 0,0002	€ 0,0019
Hazardous waste disposed (HWD)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Human toxicity potential (HTP)	Euro	€ 0,0133	€ 0,0002	€ 0,0161	€ 0,0439	€ 0,0013	-€ 0,0009	€ 0,0739
Use of net fresh water (FW)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Formation potential of tropospheric ozone photochemical oxidants (POCP)	Euro	€ 0,0004	€ 0,0000	€ 0,0003	€ 0,0021	€ 0,0000	€ 0,0000	€ 0,0028
Marine aquatic ecotoxicity potential (MAETP)	Euro	€ 0,0018	€ 0,0000	€ 0,0015	€ 0,0041	€ 0,0001	€ 0,0000	€ 0,0076
Eutrophication potential (EP)	Euro	€ 0,0024	€ 0,0000	€ 0,0022	€ 0,0188	€ 0,0003	€ 0,0001	€ 0,0239
Freshwater aquatic ecotoxicity potential (FAETP)	Euro	€ 0,0001	€ 0,0000	€ 0,0001	€ 0,0003	€ 0,0000	€ 0,0000	€ 0,0005
Global warming potential (GWP)	Euro	€ 0,0277	€ 0,0003	€ 0,0231	€ 0,0457	€ 0,0019	€ 0,0065	€ 0,1052
Terrestrial ecotoxicity potential (TETP)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0001	€ 0,0000	€ 0,0000	€ 0,0002
Non-hazardous waste disposed (NHWD)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Depletion potential of the stratospheric ozone layer (ODP)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Single score	Euro	€ 0,0577	€ 0,0006	€ 0,0548	€ 0,1896	€ 0,0044	€ 0,0062	€ 0,3134

Figure 10 environmental profile per impact category over a lifespan of 50 years - PHOMI MCM CLADDING 1m2 to Rotterdam

Item	Amount	Unit	Type	Global warming potential (GWP) (Euro)	Single score (Euro)
Kaolin	2,12	kg	normal	€ 0,0241	€ 0,0492
Quarz Sand	1,72	kg	normal	€ 0,0036	€ 0,0085
Transport (Raw Material)	10	km	normal	€ 0,0003	€ 0,0006
3-trimethoxysilyl propyl methacrylate	0,006	kg	normal	€ 0,0010	€ 0,0022
Polyacrylate	0,15952	kg	normal	€ 0,0000	€ 0,0001
Polyvinyl	0,006	kg	normal	€ 0,0000	€ 0,0000
Green energy	0,48	kWh	normal	€ 0,0021	€ 0,0067
Grey energy	0,32	kWh	normal	€ 0,0201	€ 0,0458
Guangzhou - Rotterdam	17933	km	normal	€ 0,0335	€ 0,1608
Laibin - Guangzhou	500	km	normal	€ 0,0093	€ 0,0220
Retail to construction site	50	km	normal	€ 0,0013	€ 0,0031
Rotterdam to Retail	58	km	normal	€ 0,0015	€ 0,0036
Demolition	3,96	kg	normal	€ 0,0000	€ 0,0000
Disposal Kaolin	0,0212	kg	normal	€ 0,0002	€ 0,0005
Disposal Quarz Sand	0,0172	kg	normal	€ 0,0000	€ 0,0001
Transport to Waste Processing	50	km	normal	€ 0,0013	€ 0,0032
Waste Processing crushing Phomi	3,96	kg	normal	€ 0,0003	€ 0,0007
Elektricity	0,1	kWh	normal	€ 0,0132	€ 0,0153
Energy saved	0,79	kWh	normal	-€ 0,0059	-€ 0,0070
Raw material equivalent	3,8016	kg	normal	-€ 0,0008	-€ 0,0020

Figure 11 the different materials and processes calculated for 1m2 PHOMI MCM CLADDING over a lifespan of 50 years shipped to Rotterdam

Phase	Name	Amount		Impact in Euro	Percentage %
A1	Kaolin	2.12	kg	0.05	15.7 %
A1	Quarz Sand	1.72	kg	$8.51 \cdot 10^{-3}$	2.7 %
A2	Transport (Raw Material)	10	km	$6.45 \cdot 10^{-4}$	0.2 %
A4-A5	Guangzhou - Rotterdam	$1.79 \cdot 10^{4}$	km	0.16	51.3 %
A4-A5	Laibin - Guangzhou	$5 \cdot 10^{2}$	km	0.02	7 %
A4-A5	Retail to construction site	50	km	$3.11 \cdot 10^{-3}$	1 %
A4-A5	Rotterdam to Retail	58	km	$3.61 \cdot 10^{-3}$	1.2 %
A3	3-trimethoxysilyl propyl methacrylate	$6 \cdot 10^{-3}$	kg	$2.15 \cdot 10^{-3}$	0.7 %
A3	Polyacrylate	0.16	kg	$6.3 \cdot 10^{-5}$	0 %
A3	Polyvinyl	$6 \cdot 10^{-3}$	kg	$4.2 \cdot 10^{-6}$	$1.34 \cdot 10^{-3}$ %
A3	Green energy	0.48	kWh	$6.72 \cdot 10^{-3}$	2.1 %
A3	Grey energy	0.32	kWh	0.05	14.6 %
C1-C4	Demolition	3.96	kg	0	-
C1-C4	Disposal Kaolin	0.02	kg	$5.02 \cdot 10^{-4}$	0.2 %
C1-C4	Disposal Quarz Sand	0.02	kg	$5.36 \cdot 10^{-5}$	0 %
C1-C4	Transport to Waste Processing	50	km	$3.19 \cdot 10^{-3}$	1 %
C1-C4	Waste Processing crushing Phomi	3.96	kg	$6.71 \cdot 10^{-4}$	0.2 %
D	Elektricity	0.1	kWh	0.02	4.9 %
D	Energy saved	0.79	kWh	$-7.04 \cdot 10^{-3}$	-2.2 %
D	Raw material equivalent	3.8	kg	$-2.04 \cdot 10^{-3}$	-0.7 %

Figure 12 flat view for 1m2 PHOMI MCM CLADDING shipped to Rotterdam over a lifespan of 50 years, divided into the single ECI score per material/process

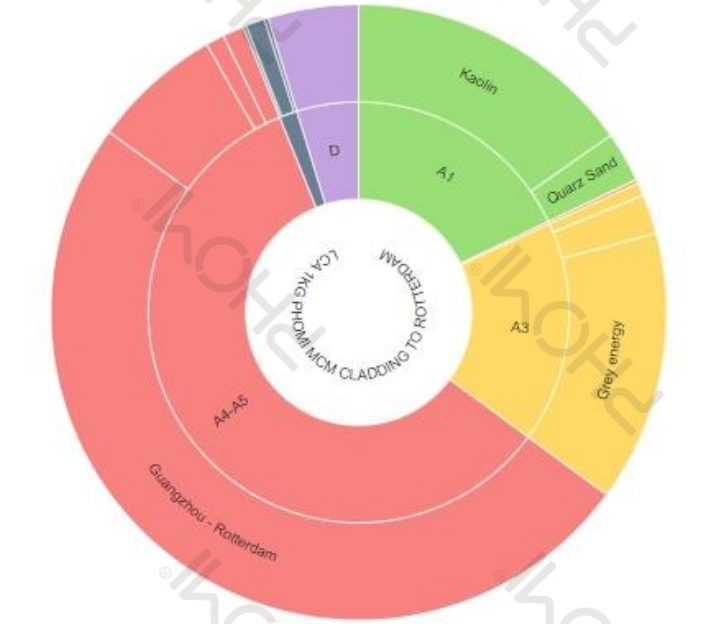


Figure 13 sunburst view for 1m2 PHOMI MCM CLADDING shipped to Rotterdam over a lifespan of 50 years, divided into the single ECI score per material/process

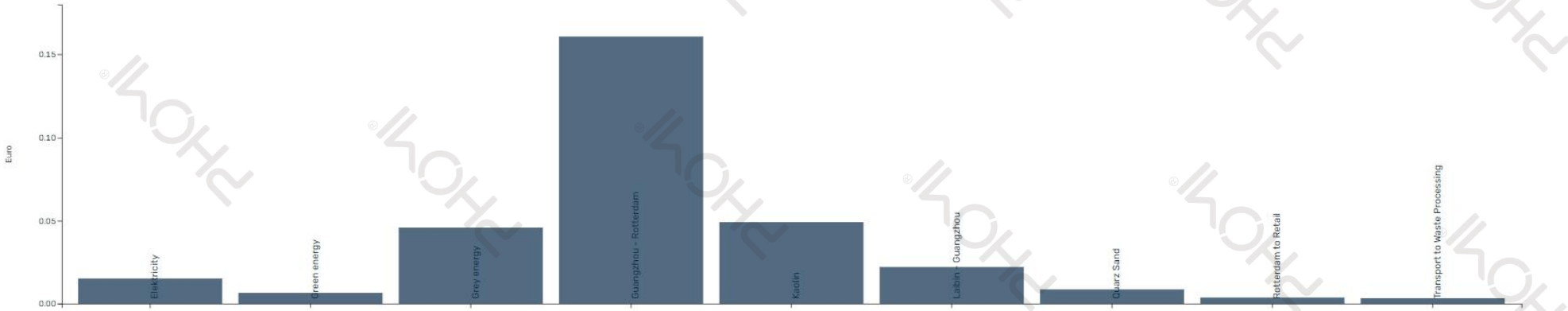


Figure 14 bar chart for 1m2 PHOMI MCM CLADDING shipped to Rotterdam over a lifespan of 50 years, divided into the single ECII score per material/process

7.3 RESULTS LCA 1KG PHOMI MCM CLADDING TO ANTWERP

Date	16/03/2022 Europe/Amsterdam
Account name	Humble Buildings
Workspace	PHOMI
Product Lifecycle	LCA 1 kg PHOMI MCM CLADDING to Antwerp
Unit	1 m^2
Impact method set	sbk bepalingsmethode
Impact assessment method	SBK Bepalingsmethode 3.1
Weighing	ECI total Single score

Table 4 setup ECI calculation

Impact category name	Reference unit	A1	A2	A3	A4-A5	C1-C4	D	Total
Total use of renewable primary energy resources (PERT)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Radioactive waste disposed (HWD)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Abiotic depletion potential for non-fossil resources (ADPE)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Total use of non-renewable primary energy resources (PENRT)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Acidification potential of land and water (AP)	Euro	€ 0,0113	€ 0,0001	€ 0,0110	€ 0,0743	€ 0,0007	€ 0,0006	€ 0,0980
Total use of primary energy resources (PET)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Abiotic depletion potential for fossil resources (ADPF)	Euro	€ 0,0006	€ 0,0000	€ 0,0005	€ 0,0010	€ 0,0000	-€ 0,0002	€ 0,0019
Hazardous waste disposed (HWD)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Human toxicity potential (HTP)	Euro	€ 0,0133	€ 0,0002	€ 0,0161	€ 0,0452	€ 0,0013	-€ 0,0009	€ 0,0752
Use of net fresh water (FW)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Formation potential of tropospheric ozone photochemical oxidants (POCP)	Euro	€ 0,0004	€ 0,0000	€ 0,0003	€ 0,0021	€ 0,0000	€ 0,0000	€ 0,0028
Marine aquatic ecotoxicity potential (MAETP)	Euro	€ 0,0018	€ 0,0000	€ 0,0015	€ 0,0042	€ 0,0001	€ 0,0000	€ 0,0078
Eutrophication potential (EP)	Euro	€ 0,0024	€ 0,0000	€ 0,0022	€ 0,0191	€ 0,0003	€ 0,0001	€ 0,0242
Freshwater aquatic ecotoxicity potential (FAETP)	Euro	€ 0,0001	€ 0,0000	€ 0,0001	€ 0,0003	€ 0,0000	€ 0,0000	€ 0,0005
Global warming potential (GWP)	Euro	€ 0,0277	€ 0,0003	€ 0,0231	€ 0,0474	€ 0,0019	€ 0,0065	€ 0,1070
Terrestrial ecotoxicity potential (TETP)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0001	€ 0,0000	€ 0,0000	€ 0,0002
Non-hazardous waste disposed (NHWD)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Depletion potential of the stratospheric ozone layer (ODP)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Single score	Euro	€ 0,0577	€ 0,0006	€ 0,0548	€ 0,1937	€ 0,0044	€ 0,0062	€ 0,3175

Figure 15 environmental profile per impact category over a lifespan of 50 years - PHOMI MCM CLADDING 1m2 to Antwerp

Phase	Item	Amount	Unit	Type	Global warming potential (GWP) (Euro)	Single score (Euro)
A1	Kaolin	2,12	kg	normal	€ 0,0241	€ 0,0492
A1	Quarz Sand	1,72	kg	normal	€ 0,0036	€ 0,0085
A2	Transport (Raw Material)	10	km	normal	€ 0,0003	€ 0,0006
A3	3-trimethoxysilyl propyl methacrylate	0,006	kg	normal	€ 0,0010	€ 0,0022
A3	Polyacrylate	0,15952	kg	normal	€ 0,0000	€ 0,0001
A3	Polyvinyl	0,006	kg	normal	€ 0,0000	€ 0,0000
A3	Green energy	0,48	kWh	normal	€ 0,0021	€ 0,0067
A3	Grey energy	0,32	kWh	normal	€ 0,0201	€ 0,0458
A4-A5	Antwerp to Retail	128	km	normal	€ 0,0033	€ 0,0080
A4-A5	Guangzhou - Antwerp	17913	km	normal	€ 0,0335	€ 0,1606
A4-A5	Laibin - Guangzhou	500	km	normal	€ 0,0093	€ 0,0220
A4-A5	Retail to construction site	50	km	normal	€ 0,0013	€ 0,0031
C1-C4	Demolition	3,96	kg	normal	€ 0,0000	€ 0,0000
C1-C4	Disposal Kaolin	0,0212	kg	normal	€ 0,0002	€ 0,0005
C1-C4	Disposal Quarz Sand	0,0172	kg	normal	€ 0,0000	€ 0,0001
C1-C4	Transport to Waste Processing	50	km	normal	€ 0,0013	€ 0,0032
C1-C4	Waste Processing crushing Phomi	3,96	kg	normal	€ 0,0003	€ 0,0007
D	Elektricity	0,1	kWh	normal	€ 0,0132	€ 0,0153
D	Energy saved	0,79	kWh	normal	-€ 0,0059	-€ 0,0070
D	Raw material equivalent	3,8016	kg	normal	-€ 0,0008	-€ 0,0020

Figure 16 the different materials and processes calculated for 1m2 PHOMI MCM CLADDING over a lifespan of 50 years shipped to Antwerp

Phase	Name	Amount		Impact in Euro	Percentage %
A1	Kaolin	2.12	kg	0.05	15.7 %
A1	Quarz Sand	1.72	kg	$8.51 \cdot 10^{-3}$	2.7 %
A2	Transport (Raw Material)	10	km	$6.45 \cdot 10^{-4}$	0.2 %
A4-A5	Guangzhou - Rotterdam	$1.79 \cdot 10^{4}$	km	0.16	51.3 %
A4-A5	Laibin - Guangzhou	$5 \cdot 10^{2}$	km	0.02	7 %
A4-A5	Retail to construction site	50	km	$3.11 \cdot 10^{-3}$	1 %
A4-A5	Rotterdam to Retail	58	km	$3.61 \cdot 10^{-3}$	1.2 %
A3	3-trimethoxysilyl propyl methacrylate	$6 \cdot 10^{-3}$	kg	$2.15 \cdot 10^{-3}$	0.7 %
A3	Polyacrylate	0.16	kg	$6.3 \cdot 10^{-5}$	0 %
A3	Polyvinyl	$6 \cdot 10^{-3}$	kg	$4.2 \cdot 10^{-6}$	$1.34 \cdot 10^{-3}$ %
A3	Green energy	0.48	kWh	$6.72 \cdot 10^{-3}$	2.1 %
A3	Grey energy	0.32	kWh	0.05	14.6 %
C1-C4	Demolition	3.96	kg	0	-
C1-C4	Disposal Kaolin	0.02	kg	$5.02 \cdot 10^{-4}$	0.2 %
C1-C4	Disposal Quarz Sand	0.02	kg	$5.36 \cdot 10^{-5}$	0 %
C1-C4	Transport to Waste Processing	50	km	$3.19 \cdot 10^{-3}$	1 %
C1-C4	Waste Processing crushing Phomi	3.96	kg	$6.71 \cdot 10^{-4}$	0.2 %
D	Elektricity	0.1	kWh	0.02	4.9 %
D	Energy saved	0.79	kWh	$-7.04 \cdot 10^{-3}$	-2.2 %
D	Raw material equivalent	3.8	kg	$-2.04 \cdot 10^{-3}$	-0.7 %

Figure 17 flat view for 1m2 PHOMI MCM CLADDING shipped to Antwerp over a lifespan of 50 years, divided into the single ECI score per material/process



Figure 18 sunburst view for 1m2 PHOMI MCM CLADDING shipped to Antwerp over a lifespan of 50 years, divided into the single ECI score per material/process

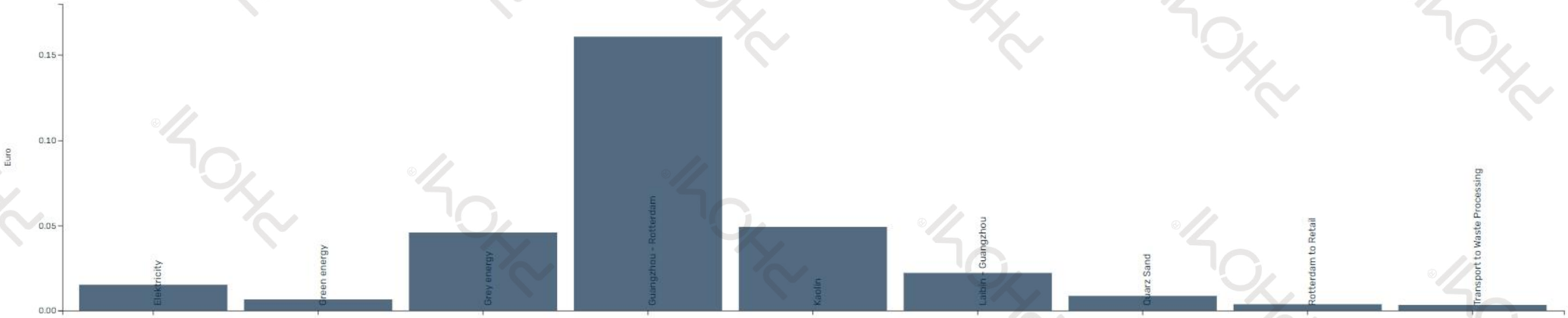


Figure 19 bar chart for 1m2 PHOMI MCM CLADDING shipped to Antwerp over a lifespan of 50 years, divided into the single ECI score per material/process

7.4 RESULTS LCA 1KG PHOMI MCM CLADDING TO HAMBURG

Date	16/03/2022 Europe/Amsterdam
Account name	Humble Buildings
Workspace	PHOMI
Product Lifecycle	LCA 1 kg PHOMI MCM CLADDING to Hamburg
Unit	1 m^2
Impact method set	sbk bepalingsmethode
Impact assessment method	SBK Bepalingsmethode 3.1
Weighing	ECII total Single score

Table 5 setup ECI calculation

Impact category name	Reference unit	A1	A2	A3	A4-A5	C1-C4	D	Total
Total use of renewable primary energy resources (PERT)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Radioactive waste disposed (HWD)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Abiotic depletion potential for non-fossil resources (ADPE)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Total use of non-renewable primary energy resources (PENRT)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Acidification potential of land and water (AP)	Euro	€ 0,0113	€ 0,0001	€ 0,0110	€ 0,0790	€ 0,0007	€ 0,0006	€ 0,1027
Total use of primary energy resources (PET)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Abiotic depletion potential for fossil resources (ADPF)	Euro	€ 0,0006	€ 0,0000	€ 0,0005	€ 0,0012	€ 0,0000	-€ 0,0002	€ 0,0022
Hazardous waste disposed (HWD)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Human toxicity potential (HTP)	Euro	€ 0,0133	€ 0,0002	€ 0,0161	€ 0,0522	€ 0,0013	-€ 0,0009	€ 0,0822
Use of net fresh water (FW)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Formation potential of tropospheric ozone photochemical oxidants (POCP)	Euro	€ 0,0004	€ 0,0000	€ 0,0003	€ 0,0024	€ 0,0000	€ 0,0000	€ 0,0030
Marine aquatic ecotoxicity potential (MAETP)	Euro	€ 0,0018	€ 0,0000	€ 0,0015	€ 0,0050	€ 0,0001	€ 0,0000	€ 0,0086
Eutrophication potential (EP)	Euro	€ 0,0024	€ 0,0000	€ 0,0022	€ 0,0208	€ 0,0003	€ 0,0001	€ 0,0259
Freshwater aquatic ecotoxicity potential (FAETP)	Euro	€ 0,0001	€ 0,0000	€ 0,0001	€ 0,0004	€ 0,0000	€ 0,0000	€ 0,0005
Global warming potential (GWP)	Euro	€ 0,0277	€ 0,0003	€ 0,0231	€ 0,0566	€ 0,0019	€ 0,0065	€ 0,1161
Terrestrial ecotoxicity potential (TETP)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0001	€ 0,0000	€ 0,0000	€ 0,0002
Non-hazardous waste disposed (NHWD)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Depletion potential of the stratospheric ozone layer (ODP)	Euro	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000	€ 0,0000
Single score	Euro	€ 0,0577	€ 0,0006	€ 0,0548	€ 0,2176	€ 0,0044	€ 0,0062	€ 0,3414

Figure 18 environmental profile per impact category over a lifespan of 50 years - PHOMI MCM CLADDING 1m2 to Hamburg

Phase	Item	Amount	Unit	Type	Global warming potential (GWP) (Euro)	Single score (Euro)
A1	Kaolin	2,12	kg	normal	€ 0,0241	€ 0,0492
A1	Quarz Sand	1,72	kg	normal	€ 0,0036	€ 0,0085
A2	Transport (Raw Material)	10	km	normal	€ 0,0003	€ 0,0006
A3	3-trimethoxysilyl propyl methacrylate	0,006	kg	normal	€ 0,0010	€ 0,0022
A3	Polyacrylate	0,15952	kg	normal	€ 0,0000	€ 0,0001
A3	Polyvinyl	0,006	kg	normal	€ 0,0000	€ 0,0000
A3	Green energy	0,48	kWh	normal	€ 0,0021	€ 0,0067
A3	Grey energy	0,32	kWh	normal	€ 0,0201	€ 0,0458
A4-A5	Guangzhou - Hamburg	18386	km	normal	€ 0,0344	€ 0,1648
A4-A5	Hamburg to Retail	444	km	normal	€ 0,0116	€ 0,0276
A4-A5	Laibin - Guangzhou	500	km	normal	€ 0,0093	€ 0,0220
A4-A5	Retail to construction site	50	km	normal	€ 0,0013	€ 0,0031
C1-C4	Demolition	3,96	kg	normal	€ 0,0000	€ 0,0000
C1-C4	Disposal Kaolin	0,0212	kg	normal	€ 0,0002	€ 0,0005
C1-C4	Disposal Quarz Sand	0,0172	kg	normal	€ 0,0000	€ 0,0001
C1-C4	Transport to Waste Processing	50	km	normal	€ 0,0013	€ 0,0032
C1-C4	Waste Processing crushing Phomi	3,96	kg	normal	€ 0,0003	€ 0,0007
D	Elektricity	0,1	kWh	normal	€ 0,0132	€ 0,0153
D	Energy saved	0,79	kWh	normal	-€ 0,0059	-€ 0,0070
D	Raw material equivalent	3,8016	kg	normal	-€ 0,0008	-€ 0,0020

Figure 19 the different materials and processes calculated for 1m2 PHOMI MCM CLADDING over a lifespan of 50 years shipped to Hamburg

Phase	Name	Amount		Impact in Euro	Percentage %
A1	Kaolin	2.12	kg	0.05	15.7 %
A1	Quarz Sand	1.72	kg	$8.51 \cdot 10^{-3}$	2.7 %
A2	Transport (Raw Material)	10	km	$6.45 \cdot 10^{-4}$	0.2 %
A4-A5	Guangzhou - Rotterdam	$1.79 \cdot 10^{4}$	km	0.16	51.3 %
A4-A5	Laibin - Guangzhou	$5 \cdot 10^{2}$	km	0.02	7 %
A4-A5	Retail to construction site	50	km	$3.11 \cdot 10^{-3}$	1 %
A4-A5	Rotterdam to Retail	58	km	$3.61 \cdot 10^{-3}$	1.2 %
A3	3-trimethoxysilyl propyl methacrylate	$6 \cdot 10^{-3}$	kg	$2.15 \cdot 10^{-3}$	0.7 %
A3	Polyacrylate	0.16	kg	$6.3 \cdot 10^{-5}$	0 %
A3	Polyvinyl	$6 \cdot 10^{-3}$	kg	$4.2 \cdot 10^{-6}$	$1.34 \cdot 10^{-3}$ %
A3	Green energy	0.48	kWh	$6.72 \cdot 10^{-3}$	2.1 %
A3	Grey energy	0.32	kWh	0.05	14.6 %
C1-C4	Demolition	3.96	kg	0	-
C1-C4	Disposal Kaolin	0.02	kg	$5.02 \cdot 10^{-4}$	0.2 %
C1-C4	Disposal Quarz Sand	0.02	kg	$5.36 \cdot 10^{-5}$	0 %
C1-C4	Transport to Waste Processing	50	km	$3.19 \cdot 10^{-3}$	1 %
C1-C4	Waste Processing crushing Phomi	3.96	kg	$6.71 \cdot 10^{-4}$	0.2 %
D	Elektricity	0.1	kWh	0.02	4.9 %
D	Energy saved	0.79	kWh	$-7.04 \cdot 10^{-3}$	-2.2 %
D	Raw material equivalent	3.8	kg	$-2.04 \cdot 10^{-3}$	-0.7 %

Figure 20 flat view for 1m2 PHOMI MCM CLADDING shipped to Hamburg over a lifespan of 50 years, divided into the single ECI score per material/process

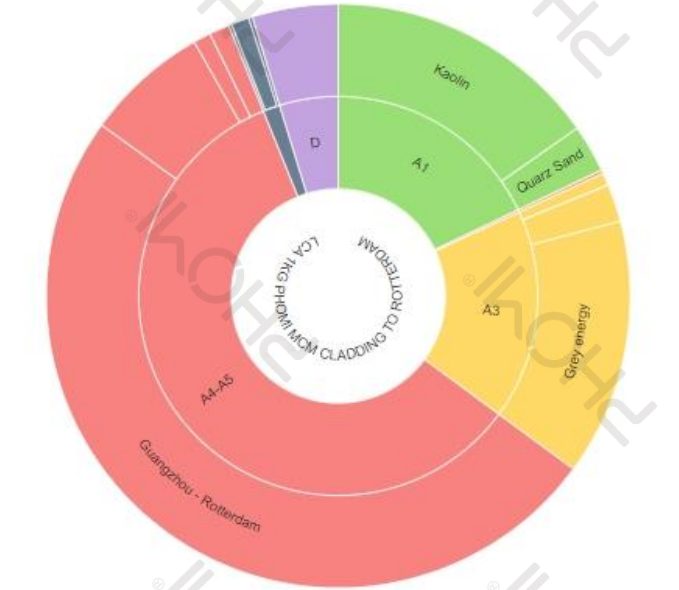


Figure 21 sunburst view for 1m2 PHOMI MCM CLADDING shipped to Hamburg over a lifespan of 50 years, divided into the single ECI score per material/process

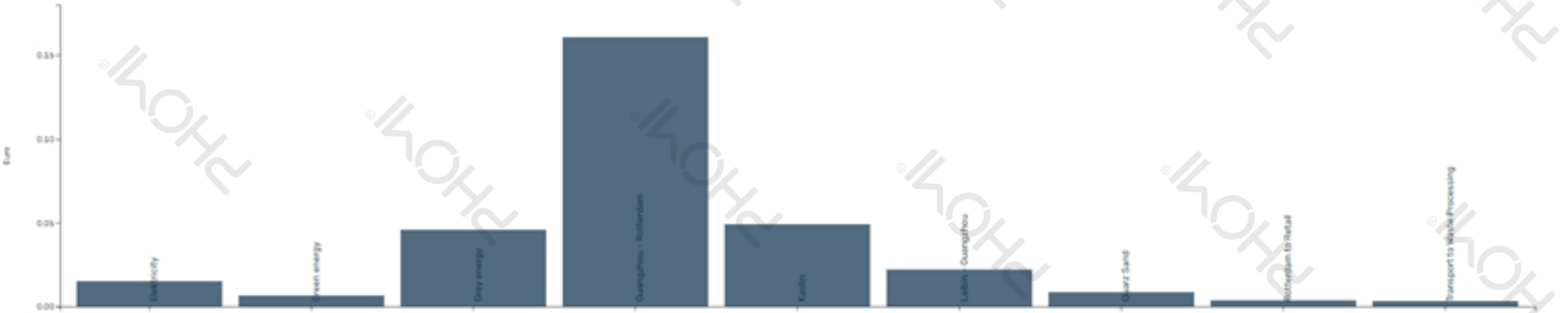


Figure 22 bar chart for 1m2 PHOMI MCM CLADDING shipped to Hamburg over a lifespan of 50 years, divided into the single ECI score per material/process

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