ENVIRONMENTAL PRODUCT DECLARATION

EGE SERAMIK FLOOR TILE

After Ege Seramik Sanayi ve Ticaret A.Ş., which was founded in Izmir in 1972 by İbrahim Polat, started production in 1975, it gave weight to infrastructure, technology, design and quality standards especially in the nineties. It is currently in the position of one of the most important companies which dominates the sector with the consistent investment and the ambition for growth and with the innovations it has had the sector gain. Ege Seramik has approximately 24 million 300 thousand m²/year production capacity in the production plants in an area of 416.752 m^2, 26 km far from Izmir Port in Kemalpaşa, Izmir. Shares of the company open to public have been dealt in Stock Market İstanbul since 1992.

Ege Seramik, which bears a number of the first in the sector, contributed to development of the sector by introducing digital printing technology to Turkish Ceramic Sector with the mark "Digital Tile by Ege Seramik" in 2009. Ege Seramik is maintaining the goal of producing products as real as the real ones which it connects them with this important technology with the slogan "Perfect Nature, Perfect Beauty". Ege Seramik is the first company to be entitled to have ISO 9001 certificate.

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CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

ENVIRONMENTAL PRODUCT DECLARATION

EGESERAMİK
Floor Tile

EGESERAMİK

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 Provided
DECLARATION HOLDER	UL Provided
DECLARATION NUMBER	UL Provided
DECLARED PRODUCT	EGE SERAMİK FLOOR TILE
REFERENCE PCR	UL Provided
DATE OF ISSUE	UL Provided
PERIOD OF VALIDITY	UL Provided
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:	UL Provided UL Provided UL Provided
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	UL Provided
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	UL Provided

EGESERAMİK
Floor Tile

According to ISO 14025

Product

This EPD document is for Floor Tile manufactured by EGE SERAMİK where the manufacturing plant located in Kemalpaşa / İzmir / Turkey.

Product Description

Floor Tile is produced from multiple mineral-based natural materials such as clay, feldspar, kaolin, sand. These products are fired at very high temperatures, usually in excess of 2000°F.

Application Area

Floor Tile is commonly used in commercial, institutional and residential interior applications. Floor Tile is generally used in kitchens and bathrooms.

No substances included in the Candidate List of Substances of Very High Concern for authorization under the REACH Regulations are present in the ceramic tiles manufactured by Ege Seramik, either above the threshold for registration with the European Chemicals Agency or above 0.1% (wt/wt).

Technical Information and Product Standards

Ege Seramik Floor Tile may be produced in different sizes. Technical information and product standards of each product are given in the table below.

Class (P1-P4, E1-E4, or O1-O4)	P2
Tile type (Porcelain, pressed floor, mosaic, quarry, gauged, or glass)	Porcelain *(Floor Tile)*
Grade (Standard or second)	Standard Grade
Facial area	1 m^2
Thickness	9 mm
Product weight	20,449 kg/m^2
Dimensional categories (Natural, calibrated, or rectified)	Calibrated and Rectified

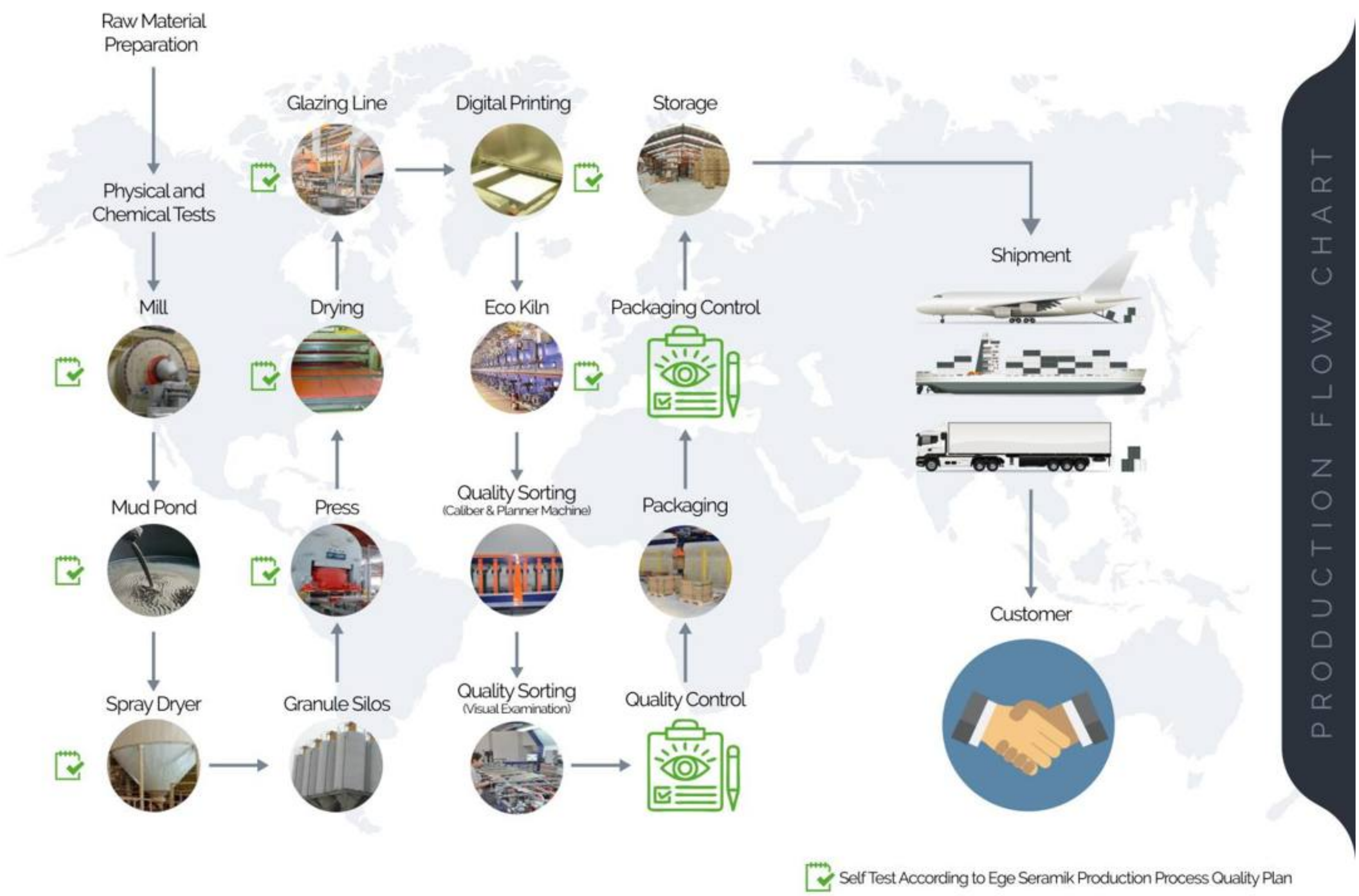
Base Materials

Clay, feldspar, kaolin, sand, sodium silicate and pumice are the base materials of Ege Seramik Floor Tile. The base materials as mass percentage per unit are shown in the table below.

Base Materials	Mass Percentage
Clay	48.05%
Feldspar	41.70%
Kaolin	7.05%
Sand	1.60%
Sodium silicate	1.50%
Pumice	0.10%

Manufacturing

Manufacturing flow chart is given in the figure below. Moreover, waste hot air at 480° C that occurs during the production of electrical energy in the cogeneration plant is used in spray dryers and masse preparation. In addition, waste heat is recycled from various parts of the furnaces to ensure that the heat inside the furnace remains efficient.



Delivery and Installation Stage

- ✓ **Delivery and transport:** The company sends the product all over the world. One group of the product is transported by only truck and the other group is transported by both truck and ship.
- ✓ **Installation:** Average 4,2 kg mortar (primer and grout) is assumed to be used by adding 0,4 kg water for installation of 1 m^2 product. Mortar is considered to be prepared manually without using electric mixer as it is not commonly preferred. Besides, since the product is suitable to be cut by conventional saw, electric saw use during installation has not been considered.
- ✓ **Health, safety and environmental aspects during installation:** Protective clothes, earplugs, protective masks, helmets and safety shoes are recommended to be used for health and safety during installation. All values established inside and outside the production facility are below the applicable requirements governing noise protection. Acidic solutions are not recommended for cleaning during installation as it is not environmentally preferable.
- ✓ **Waste:** During application, a little waste is generated because of losses, packaging materials and health-safety products. Cardboard, plastic and wood come off as packaging waste. Cardboard is sent to incineration facility, wood and plastic waste is considered as landfill waste. On the other hand, 0,2 kg mortar and 10% of ceramic is assumed to become landfill waste during installation.

Use Stage

- ✓ **Use:** In accordance with the PCR “UL - Part B: Flooring EPD Requirements - UL 10010-7”, the building Estimated Service Life (ESL) is assumed to be 75 years. Since the manufacturer indicated that the lifespan of Floor Tile is equal to building’s lifespan, Reference Service Life (RSL) of Floor Tile is considered as 75 years. Since a reference service life (RSL) for mortar is not declared, mortar is expected to last itself at least as long as the building. Likewise, EPD documents prepared for mortar products were reviewed, it was seen that mortar's RSL is equal to building’s service life.
- ✓ **Cleaning and maintenance:** The recommended cleaning procedure is cleaning with wet cloth weekly. There is no maintenance procedure as it is not required. During the 75 years, 58,5 kg water is considered to be consumed and 0,1 kg cloth is considered to be used and become waste per 1 m^2 tile.

End of Life

- ✓ **Recycling, reuse or repurpose:** The manufacturer has no procedure related to recycling, reuse or repurpose for lifetime completed products.
- ✓ **Disposal:** Since the manufacturer has no procedure for lifetime completed products, all products are considered to be sent to landfill in the end of life period.

Life Cycle Assessment

The LCA study and analysis were conducted according to the PCR "UL - Part B: Flooring EPD Requirements - UL 10010-7" in accordance with ISO 14040 and ISO 14044.

General

Product stage, construction stage, use stage, end of life stage, and benefits and loads beyond the product system boundary are considered as life cycle stages.

Description of the functional unit

The functional unit is $1m^2$ of the products Floor Tile.

Estimates and Assumptions

This LCA study is conducted in accordance with all methodological considerations, such as performance, system boundaries, data quality, allocation procedures, and decision rules to evaluate inputs and outputs.

All estimations and assumptions regarding the cut off criteria and the allocation are declared in the part "Cut-off Criteria" except the estimations/assumptions below:

- Module A5: Recommended installation is assumed to be applied. According to the prepared EPDs for mortar products, RSL of mortar is expected as it is equal to building's service life.
- Module B7: Recommended cleaning activities are assumed to be applied.
- Module C2: Since there is no follow up procedure, transportation distance to the closest disposal area is estimated as 50 km and common transportation type and fuel are used in the calculation.
- Module C4: Since there is no follow up procedure, worst case scenario is assumed for waste disposal.

Cut-off Criteria

All inputs and outputs are included in the calculation. Data gaps are filled by conservative assumptions with average or generic data, as described above. There is no neglected unit process more than 1% of total mass and energy flows. The total neglected input and output flows are also not exceeded 5% of energy usage or mass as indicated in the PCR. This LCA study includes the provision of all materials, transportation, energy and emission flows, usage considerations and end of life processing of product. The entire life cycle is covered from cradle to grave, including all industrial processes from raw material acquisition and pre-processing, production, product distribution and installation, use and maintenance, and end-of-life management. The production of capital goods, used paint on packaging cardboards, infrastructure, carrying of product to the storage are in manufacturing site, production of manufacturing equipment and personnel-related activities are not included in this LCA study as indicated in the PCR.

Allocation

The allocation was performed in which the product output fixed to 1 m^2 and the corresponding amount of product was used in calculations.

Average breakdown was done by considering product total weight per year production. According to this, the total energy, water, and raw materials used to produce the product were divided by the total annual production.

In the factory, wall tile, floor tile and glazed porcelain ceramic tile are produced. Since the production processes of these products same, the annual production percentages are taken into consideration to allocate water and energy consumption and waste outputs. Additionally, since the used energy in oven is different for each product, energy consumption of oven is monitored separately and allocated to each product. On the other hand, recovered and used energy in factory is shared according to the energy consumption rates of each product.

Distribution distance was calculated as weighted average according to the percentage ratios of for each destination points.

Background Data

The LCA model of Ege Seramik Floor Tile was created using GaBi DB Version 6.115 software system for life cycle engineering by ERKE Sustainable Building Design and Consultancy Ltd.

For conservative assumptions in combination with plausibility considerations an expert judgment can be used to demonstrate compliance in practice. In this assessment, all modelling calculations are based on the amounts declared by manufacturer.

The primary data collection was accomplished in the form of spreadsheet and questionnaires and supplemented by conversations done with the manufacturer. All relevant background data necessary for the materials used in the model are included in the GaBi database. The data provided by company and calculations made by LCA practitioner can be found in Life Cycle Inventory section. Once the data had been collected, it was imported into GaBi where the modelling was carried out.

Data Quality and data quality assessment

For consistency and completeness of data, GaBi 6 Software-System and Databases for Life Cycle Engineering DB Version 6.115 is used. It provides the life cycle inventory database in all branches to assess the potential environmental burdens of a product from cradle to grave. All input and output flows, type of materials used, energy consumption, transportation and wastes were primary data taken from manufacturer. The manufacturer issues a declaration for the compatibility of their data with reality.

All primary required data for LCA Analysis were in the time period between 29.10.2018 and 25.10.2019 for 12 consecutive months. Datasets used in GaBi for calculation are attempted to select within the last 5 years.
The specific data quality coverages are also;

- Geographical coverage: the study applies to the actual manufacturing situation in Turkey. The processes as from distribution are the processes that do not take place only in Turkey.
- Time period covered: goal of the study is to determine the actual environmental loads for 12 consecutive months, so data for the time period between 29.10.2018 and 25.10.2019 is used.
- Technology coverage: the objective of the study is to use data that apply to average technology which represents actual situation. Data available for those processes in GaBi are expected to show limited variability globally.

The study generally applies to the actual situation in Turkey. When there is no specific data for Turkey, European data has been preferred to use as the conditions in Europe are similar to Turkey. European data for raw materials, packaging materials, haulage vehicles, diesel used for transportation and waste has been used as a substitute for Turkey's specific data. However, using European data (which is similar to Turkish data) does not cause significant differences in the LCA results. Since there is not one single application method for the installation phase, it has been envisaged that conventional methods will be used. Cleaning operations will differ depending on the application areas, but generalization has also been made for the use of the product since there is no follow-up on the use of the product. There are no instructions and follow-ups for the end-of-life process, therefore the calculations were made according to the worst scenario by utilizing the processes of GaBi. This study considers the data of the last year, however the last year may not refer the general case. Since the average data are used, the study may not give an exact result in terms of product. All these cases are the limitations of this study.

The different data sources for different stages are summarized in the table below. The data quality has been assessed based on Table 8.2 of WRI Product Standard. The declaration of raw material inputs and outputs were collected on site by weighting each type of materials, therefore "Very Good" was assigned for sourcing and extraction stage. Manufacturer has reasonable data for the stages manufacturing, delivery and installation and use, data quality of these stages has been determined as "Good". However, manufacturer has no available data for the end of life treatment method of the product, but it is known that ceramic or porcelain waste are sent to landfill in Turkey, so "Fair" data quality has been assigned for end of life stage.

Different LCA software and background LCI datasets may lead to different results for life cycle stages. Therefore, without understanding the specific variability, the user is not encouraged to compare the LCA results. Even for similar products data quality may produce incomparable results. Moreover, LCIA results are relative statements and do not anticipate category endpoints, exceeding thresholds, safety margins, or effects on risks.

System Boundaries

The scope of study includes the stages "product stage, construction process stage, use stage, end of life stage". Delivery of main materials, ancillary materials and packaging materials, emissions to air, water and soil during manufacturing, installation and use, distribution of the product and disposal were included to the study. Construction of capital equipment, maintenance and operation of support equipment, human labor and employee commute, overhead of manufacturing facilities and internal transportation were excluded.

Impact declaration and use stage normalization

The reference service life of Floor Tile is equal to building estimated service life '75 years'. Therefore, during use stage no replacement is considered. On the other hand, maintenance, repair or energy use is not required for use. In use stage, just water use for cleaning is considered for 75 years.

Results of the assessment

For the results of life cycle assessment according to relevant PCR, the following life cycle stages and information modules are considered;

- ✓ **Sourcing and Extraction:** This stage covers the extraction and delivery of the main materials, ancillary materials and packaging materials.
- ✓ **Manufacturing:** This stage includes the production processes of final product in the factory as gate to gate processes. Energy and water consumption and waste generation are accounted in this stage.
- ✓ **Delivery and Installation:** This stage starts with the product leaving the gate of the production facility and ends with the used product entering the end-of-life stage. Transport of the final product to the final consumer, considering retail and warehousing is included. Disposal of packaging materials of the final product and generated waste during installation because of construction and used ancillary materials and used mortar for installation is also included in this stage.
- ✓ **Use:** During use of the product, there is no energy or emission generation and product do not require maintenance during warranted lifetime. Only cleaning process is required.
- ✓ **End of Life:** This stage covers the end of life treatment processes of the final product.

Life Cycle Assessment Results

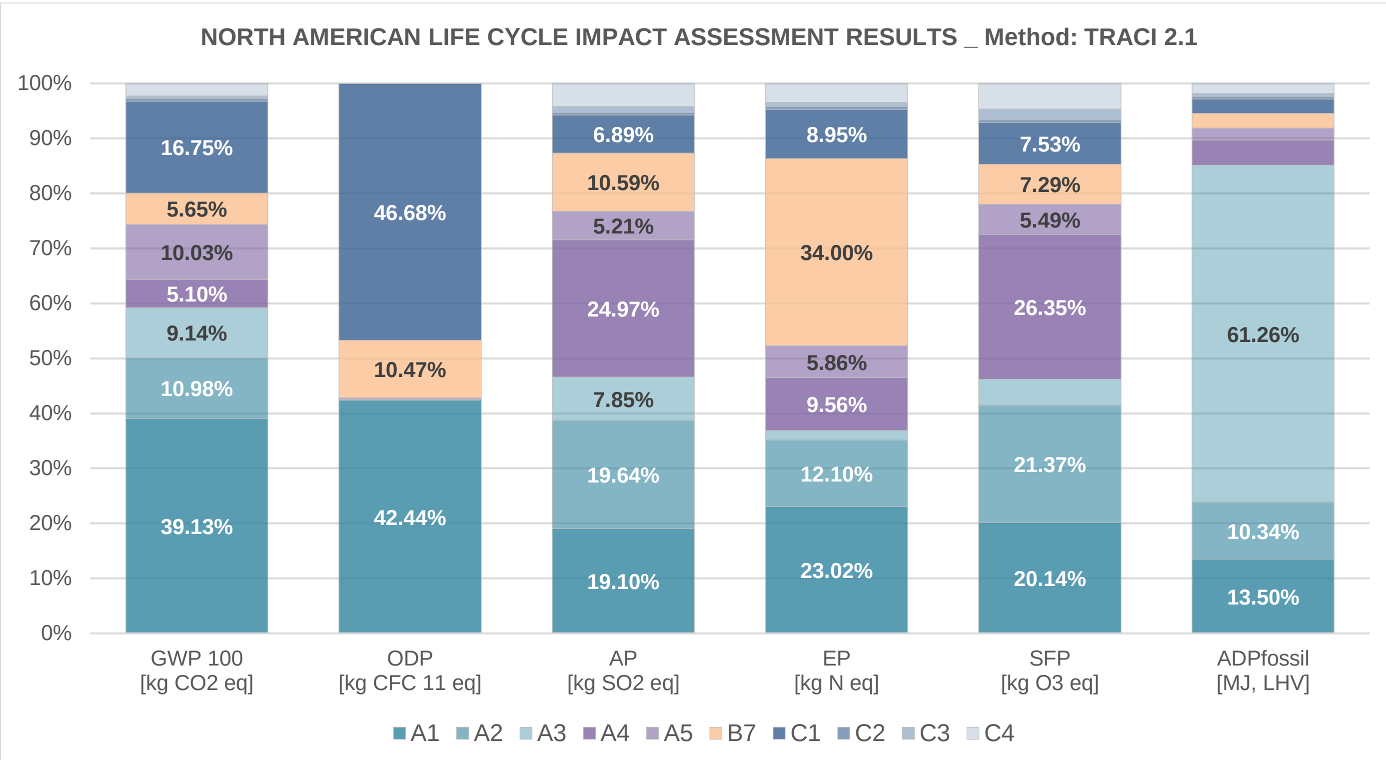
EGE SERAMIK 1m² FLOOR TILE

NORTH AMERICAN LIFE CYCLE IMPACT ASSESSMENT RESULTS _ Method: TRACI 2.1

The following table and bar-chart exhibit quantities and relative contributions (%) from life cycle stages of 1m² Floor Tile to total Global Warming Potential (GWP 100), Ozone Depletion Potential (ODP), Acidification Potential (AP), Eutrophication Potential (EP), Smog Formation Potential (SFP) and Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADPfossil) for Northern America according to the method TRACI 2.1.

NORTH AMERICAN LIFE CYCLE IMPACT ASSESSMENT RESULTS Method: TRACI 2.1	PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE	END OF LIFE STAGE			
	A1	A2	A3	A4	A5	B7	C1	C2	C3	C4
	Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Building operational water use during product use	Deconstruction	Transport	Waste processing	Disposal
GWP 100 [kg CO2 eq]	6.62E+00	1.86E+00	1.55E+00	8.64E-01	1.70E+00	9.57E-01	2.83E+00	8.59E-02	6.75E-02	3.90E-01
ODP [kg CFC 11 eq]	1.13E-08	1.33E-11	6.47E-13	4.89E-12	8.35E-11	2.79E-09	1.24E-08	6.52E-13	7.32E-13	4.10E-12
AP [kg SO2 eq]	1.15E-02	1.19E-02	4.74E-03	1.51E-02	3.15E-03	6.39E-03	4.16E-03	2.96E-04	6.12E-04	2.57E-03
EP [kg N eq]	1.42E-03	7.46E-04	1.10E-04	5.90E-04	3.61E-04	2.10E-03	5.52E-04	2.93E-05	4.64E-05	2.16E-04
SFP [kg O3 eq]	2.14E-01	2.27E-01	4.96E-02	2.79E-01	5.82E-02	7.73E-02	7.98E-02	6.03E-03	2.01E-02	4.97E-02
ADPfossil [MJ, LHV]	4.67E+00	3.57E+00	2.12E+01	1.60E+00	7.52E-01	9.10E-01	9.14E-01	1.67E-01	1.70E-01	6.38E-01

GWP 100: Global Warming Potential
ODP: Ozone Depletion Potential
AP: Acidification Potential
EP: Eutrophication Potential
SFP: Smog Formation Potential
ADPfossil: Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources



Analysis on relative contribution (%) from each impact category indicates that:

- GWP is relatively higher in A1 (raw material supply) with 39% and C1 (deconstruction) with 17% than in other modules. In A1 module, clay has the highest GWP share, however it is not possible to change an essential raw material with another material. Even so, recycled clay may be evaluated to be used as raw material if it doesn't affect the product quality or more sustainably produced clay may be preferred if the transportation distance is proper. On the other hand, for deconstruction stage, a follow up procedure may be applied in order to decrease the impact. Moreover, more sustainable transportation strategies may be planned to decrease GWP.

- Module C1 (deconstruction) causes ODP at a high rate with 47%, followed by A1 (raw material supply) with 42%. For deconstruction stage, a follow up procedure may be applied in order to decrease the impact. On the other hand, in A1 module, kaolin has the highest ODP share, however it is not possible to change an essential raw material with another material. Since ODP of the product is quite low as against GWP, it is more logical to create scenarios on decreasing GWP instead of looking for alternatives to kaolin. Thereby, ODP will have already been decreased thanks to the scenarios on decreasing GWP.

- 25% of AP is because of module A4 (distribution) which has the highest share, followed by A2 (transportation) and A1 (raw material supply) with 20% and 19%, respectively. More sustainable transportation strategies may be planned to decrease AP. On the other hand, in A1 module, kaolin and clay have the highest AP shares, however it is not possible to change the essential raw materials with other materials. Even so, more sustainably produced raw materials may be preferred if the transportation distances are proper. Since AP of the product is quite low as against GWP, it is more logical to create scenarios on decreasing GWP. Thereby, AP will have already been decreased thanks to the scenarios on decreasing GWP.

- 34% of EP is because of module B7 (water use in use stage) which has the highest share, followed by A1 (raw material supply) with 23%. Since EP of the product is quite low as against GWP, it is more logical to create scenarios on decreasing GWP instead of looking for alternatives to cleaning and alternative raw materials for production. Thereby, EP will have already been decreased thanks to the scenarios on decreasing GWP.

- 26% of SFP is because of module A4 (distribution) which has the highest share, followed by A2 (transportation) and A1 (raw material supply) with 21% and 20%, respectively. More sustainable transportation strategies may be planned to decrease SFP. On the other hand, in A1 module, several raw materials cause SFP, however it is not possible to change the essential raw materials with other materials. Even so, more sustainably produced raw materials may be preferred if the transportation distances are proper. Since SFP of the product is quite low as against GWP, it is more logical to create scenarios on decreasing GWP. Thereby, SFP will have already been decreased thanks to the scenarios on decreasing GWP.

- 61% of ADPfossil is because of module A3 (manufacturing) which has the highest share. Almost 100% of ADPfossil in module A3 (manufacturing) is because of natural gas use. Renewable energy sources as an alternative may be used during production to decrease ADPfossil.

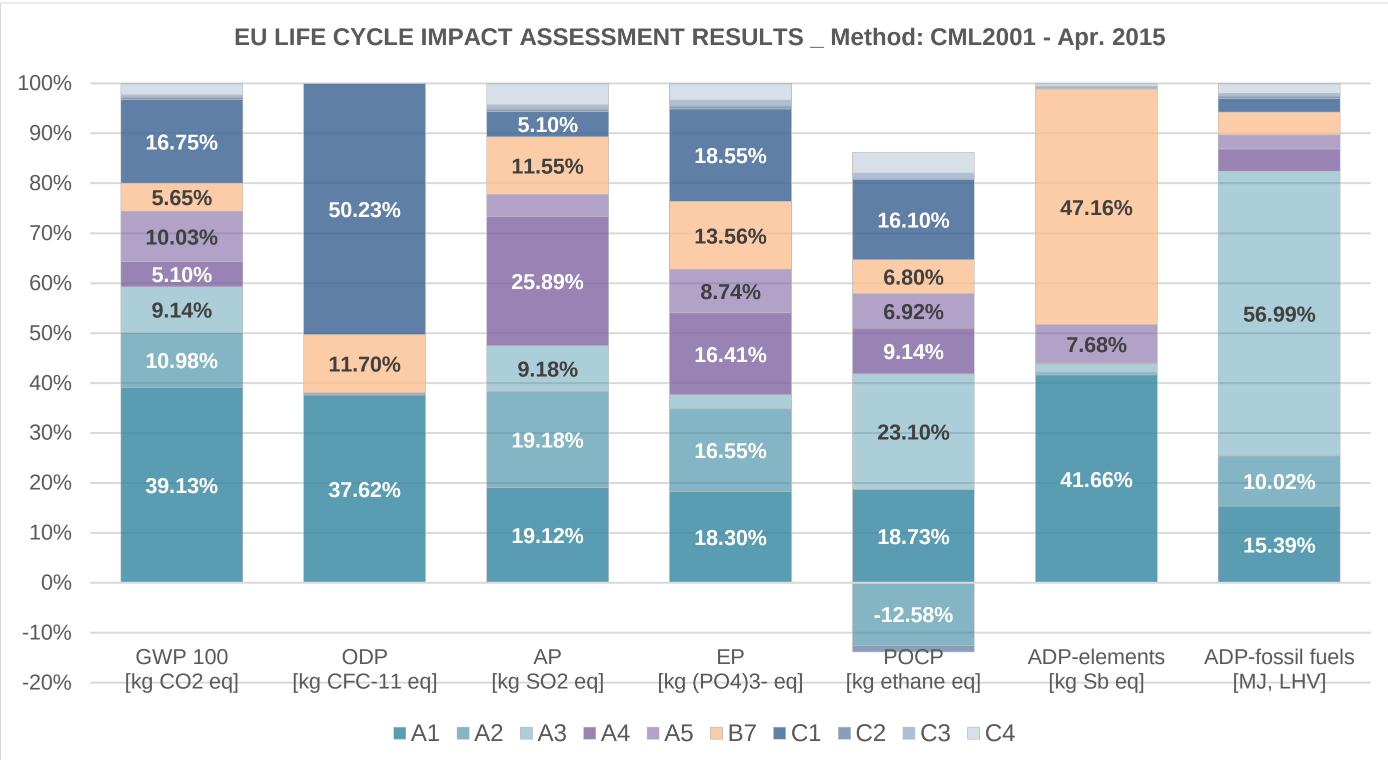
EGE SERAMIK 1m² FLOOR TILE

EU LIFE CYCLE IMPACT ASSESSMENT RESULTS _ Method: CML2001 - Apr. 2015

The following table and bar-chart exhibit quantities and relative contributions (%) from life cycle stages of 1m² Floor Tile to total Global Warming Potential (GWP 100), Ozone Depletion Potential (ODP), Acidification Potential (AP), Eutrophication Potential (EP), Photochemical Oxidant Creation Potential (POPC), Abiotic Depletion Potential of Non-Fossil Resources (ADP-elements) and Abiotic Depletion Potential of Fossil Resources (ADP-fossil fuels) for Europe according to the method CML – Apr. 2015.

EU LIFE CYCLE IMPACT ASSESSMENT RESULTS Method: CML2001 - Apr. 2015	PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE	END OF LIFE STAGE			
	A1	A2	A3	A4	A5	B7	C1	C2	C3	C4
	Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Building operational water use during product use	Deconstruction	Transport	Waste processing	Disposal
GWP 100 [kg CO2 eq]	6.62E+00	1.86E+00	1.55E+00	8.64E-01	1.70E+00	9.57E-01	2.83E+00	8.59E-02	6.75E-02	3.90E-01
ODP [kg CFC-11 eq]	8.55E-09	1.25E-11	6.10E-13	4.59E-12	7.86E-11	2.66E-09	1.14E-08	6.13E-13	6.89E-13	3.86E-12
AP [kg SO2 eq]	1.04E-02	1.04E-02	5.00E-03	1.41E-02	2.39E-03	6.29E-03	2.78E-03	2.31E-04	4.58E-04	2.35E-03
EP [kg (PO4)3- eq]	1.75E-03	1.58E-03	2.68E-04	1.57E-03	8.35E-04	1.30E-03	1.77E-03	5.44E-05	1.11E-04	3.20E-04
POCP [kg ethane eq]	1.02E-03	-6.87E-04	1.26E-03	4.99E-04	3.78E-04	3.71E-04	8.79E-04	-6.84E-05	6.69E-05	2.26E-04
ADP-elements [kg Sb eq]	1.06E-05	1.27E-07	4.31E-07	4.31E-08	1.96E-06	1.20E-05	3.00E-08	6.34E-09	1.18E-07	1.36E-07
ADP-fossil fuels [MJ, LHV]	3.83E+01	2.50E+01	1.42E+02	1.11E+01	7.02E+00	1.14E+01	6.71E+00	1.17E+00	1.26E+00	5.10E+00

GWP 100: Global Warming Potential
ODP: Depletion potential of the stratospheric ozone layer
AP: Acidification Potential of soil and water
EP: Eutrophication Potential
POPC: Photochemical Oxidant Creation Potential
ADP-elements: Abiotic depletion potential for non-fossil resources
ADP-fossil fuels: Abiotic depletion potential for fossil resources



Analysis on relative contribution (%) from each impact category indicates that:

- GWP is relatively higher in A1 (raw material supply) with 39% and C1 (deconstruction) with 17% than in other modules. In A1 module, clay has the highest GWP share, however it is not possible to change an essential raw material with another material. Even so, recycled clay may be evaluated to be used as raw material if it doesn't affect the product quality or more sustainably produced clay may be preferred if the transportation distance is proper. On the other hand, for deconstruction stage, a follow up procedure may be applied in order to decrease the impact. Moreover, more sustainable transportation strategies may be planned to decrease GWP.

- Module C1 (deconstruction) causes ODP at a high rate with 50%, followed by A1 (raw material supply) with 38%. For deconstruction stage, a follow up procedure may be applied in order to decrease the impact. On the other hand, in A1 module, kaolin has the highest ODP share, however it is not possible to change an essential raw material with another material. Since ODP of the product is quite low as against GWP, it is more logical to create scenarios on decreasing GWP instead of looking for alternatives to kaolin. Thereby, ODP will have already been decreased thanks to the scenarios on decreasing GWP.

- 25% of AP is because of module A4 (distribution) which has the highest share, followed by both A2 (transportation) and A1 (raw material supply) with 19%. More sustainable transportation strategies may be planned to decrease AP. On the other hand, in A1 module, kaolin and clay have the highest AP shares, however it is not possible to change the essential raw materials with other materials. Since AP of the product is quite low as against GWP, it is more logical to create scenarios on decreasing GWP instead of looking for alternative raw materials for production. Thereby, AP will have already been decreased thanks to the scenarios on decreasing GWP.

- EP is relatively higher in C1 (deconstruction) with 19%, followed by A1 (raw material supply), A2 (transportation) and A4 (distribution) with 18%, 17%, 16%, respectively. For deconstruction stage, a follow up procedure may be applied in order to decrease the impact. More sustainable transportation strategies may be planned to decrease EP. Since EP of the product is quite low as against GWP, it is more logical to create scenarios on decreasing GWP instead of looking for alternative raw materials for production. Thereby, EP will have already been decreased thanks to the scenarios on decreasing GWP.

- 32% of POCP is because of module A3 (manufacturing) which has the highest share, followed by A1 (raw material supply) with 26%. Almost 100% of POCP in module A3 (manufacturing) is because of natural gas use. Renewable energy sources as an alternative may be used during production to decrease POCP. Since POCP of the product is quite low as against GWP, it is more logical to create scenarios on decreasing GWP instead of looking for alternative raw materials for production. Thereby, POCP will have already been decreased thanks to the scenarios on decreasing GWP.

- 47% of ADP-elements is because of module B7 (water use in use stage) which has the highest share, followed by A1 (raw material supply) with 42%. Almost 100% of ADP-elements in module B7 (water use in use stage) is because of used cloth for cleaning. Since ADP-elements of the product is quite low as against GWP, it is more logical to create scenarios on decreasing GWP instead of looking for alternatives to cleaning and alternative raw materials for production. Thereby, ADP-elements will have already been decreased thanks to the scenarios on decreasing GWP.

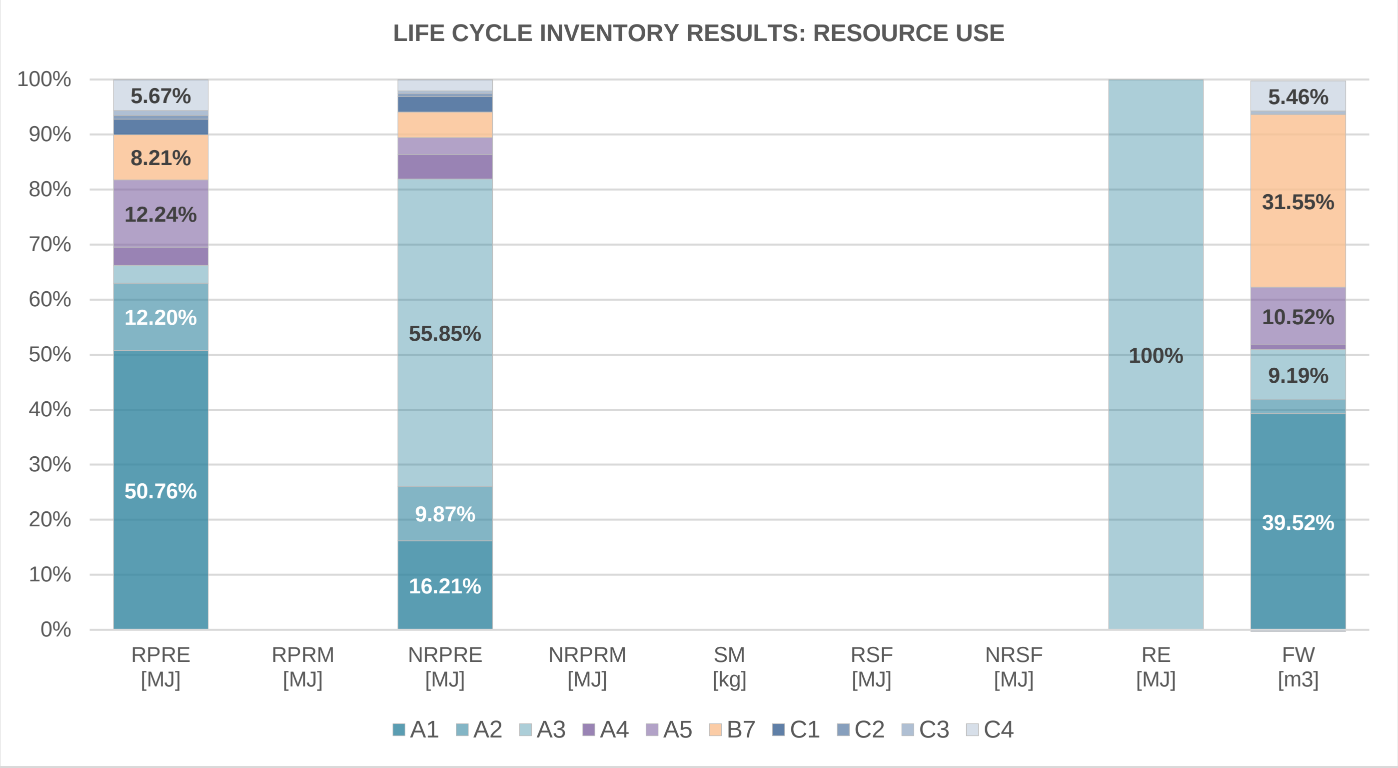
- 57% of ADP-fossilfuels is because of module A3 (manufacturing) which has the highest share. Almost 100% of ADP-fossilfuels in module A3 (manufacturing) is because of natural gas use. Renewable energy sources as an alternative may be used during production to decrease ADP-fossilfuels.

EGE SERAMIK 1m² FLOOR TILE
LIFE CYCLE INVENTORY RESULTS: RESOURCE USE

The following table and bar-chart exhibit quantities and relative contributions (%) from life cycle stages of 1m² Floor Tile to total Renewable primary re-sources used as energy carrier (fuel) (RPRE), Non-renewable primary re-sources used as energy carrier (fuel) (NRPRE), Recovered energy (RE) and Use of net fresh water resources (FW) in resource use.

LIFE CYCLE INVENTORY RESULTS: RESOURCE USE	PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE	END OF LIFE STAGE			
	A1	A2	A3	A4	A5	B7	C1	C2	C3	C4
	Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Building operational water use during product use	Deconstruction	Transport	Waste processing	Disposal
RPRE [MJ]	5.39E+00	1.30E+00	3.45E-01	3.49E-01	1.30E+00	8.71E-01	3.00E-01	6.73E-02	9.68E-02	6.02E-01
RPRM [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	0.00E+00
NRPRE [MJ]	4.12E+01	2.51E+01	1.42E+02	1.12E+01	7.84E+00	1.18E+01	7.32E+00	1.17E+00	1.29E+00	5.29E+00
NRPRM [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	0.00E+00
SM [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	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	0.00E+00
RE [MJ]	0.00E+00	0.00E+00	6.67E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW [m³]	2.14E+03	1.35E+02	4.97E+02	4.75E+01	5.69E+02	1.71E+03	-1.56E+01	6.69E+00	3.00E+01	2.95E+02

RPRE: Renewable primary re-sources used as energy carrier (fuel)
RPRM: Renewable primary re-sources with energy content used as material
NRPRE: Non-renewable primary resources used as an energy carrier (fuel)
NRPRM: Non-renewable primary resources with energy content used as material
SM: Secondary materials
RSF: Renewable secondary fuels
NRSF: Non-renewable secondary fuels
RE: Recovered energy
FW: Use of net fresh water re-sources



Analysis on relative contribution (%) from each impact category indicates that:

- RPRE has the highest share in A1 (raw material supply) with 51%, followed by both A5 (installation) and A2 (transportation) with 12%.
- NRPRE has the highest share in A3 (manufacturing) with 56%. Renewable energy sources as an alternative may be used during production instead of natural gas.
- RE is only used in A3 (manufacturing). Due to the cogeneration system, waste heat is recovered to energy and used in the production.
- FW has the highest share in A1 (raw material supply) with 40%, followed by B7 (water use in use stage) with 32%. In A1 module, supply of several raw materials cause FW use, however it is not possible to change an essential raw material with another material. Even so more sustainably produced raw materials may be preferred if the transportation distances are proper. On the other hand, for the cleaning procedure, there is no known alternative way which works to highly decrease the impact.

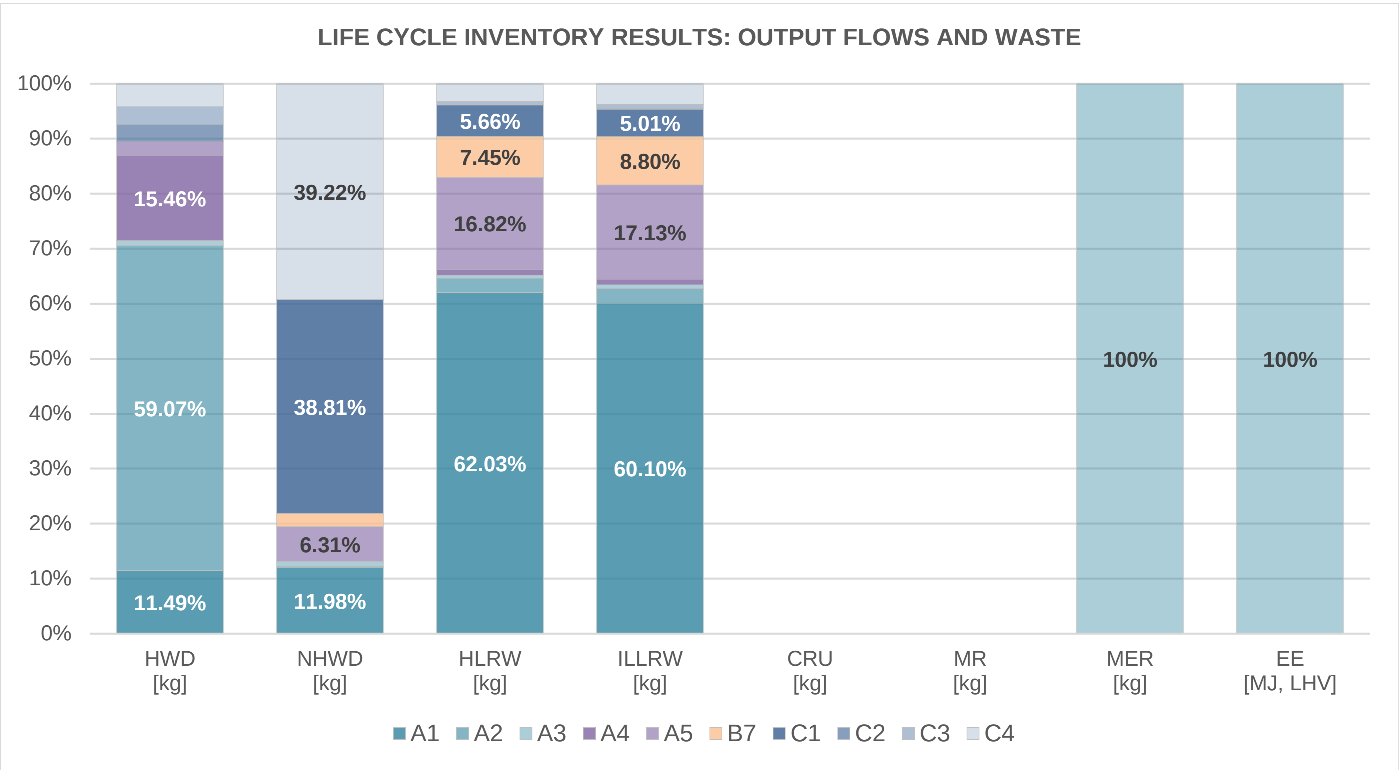
EGE SERAMIK 1m² FLOOR TILE

LIFE CYCLE INVENTORY RESULTS: OUTPUT FLOWS AND WASTE

Table and bar-chart in the figure below exhibit quantities and relative contributions (%) from varying LCI stages of 1m² Floor Tile to total Hazardous waste disposed (HWD), Non-hazardous waste disposed (NHWD), High-level radioactive waste, conditioned, to final repository (HLRW), Intermediate- and low-level radioactive waste, conditioned, to final repository (ILLRW) in output flows and waste.

LIFE CYCLE INVENTORY RESULTS: OUTPUT FLOWS AND WASTE	PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE	END OF LIFE STAGE			
	A1	**A2**	**A3**	**A4**	**A5**	**B7**	**C1**	**C2**	**C3**	**C4**
	Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Install	Building operational water use during product use	Deconstruction	Transport	Waste processing	Disposal
HWD [kg]	3.27E-07	1.68E-06	2.48E-08	4.40E-07	7.26E-08	1.11E-10	0.00E+00	8.78E-08	9.19E-08	1.21E-07
NHWD [kg]	7.75E+00	1.28E-01	5.71E-01	4.39E-02	4.08E+00	1.57E+00	2.51E+01	6.36E-03	6.72E-02	2.54E+01
HLRW [kg]	1.78E-06	7.51E-08	1.55E-08	2.79E-08	4.82E-07	2.13E-07	1.62E-07	3.68E-09	1.58E-08	9.22E-08
ILLRW [kg]	1.14E-03	5.12E-05	1.24E-05	1.90E-05	3.26E-04	1.68E-04	9.54E-05	2.51E-06	1.25E-05	7.30E-05
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	0.00E+00
MR [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	0.00E+00
MER [kg]	0.00E+00	0.00E+00	1.90E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	6.67E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

HWD: Hazardous waste disposed
NHWD: Non-hazardous waste disposed
HLRW: High-level radioactive waste, conditioned, to final repository
ILLRW: Intermediate- and low-level radioactive waste, conditioned, to final repository
CRU: Components for re-use
MR: Materials for recycling
MER: Materials for energy recovery
EE: Recovered energy exported from the product system



Analysis on relative contribution (%) from each impact category indicates that:

- HWD has the highest share in A2 (transportation) with 59%. More sustainable transportation strategies may be planned to decrease GWP.
- NHWD has the highest shares in both C1 (deconstruction) and C4 (disposal) with 39%.
- HLRW has the highest share in A1 (raw material supply) with 62%.
- ILLRW has the highest share in A1 (raw material supply) with 60%.
- MER is only generated in A3 (manufacturing). Generated cardboard waste is sent to waste incineration facility which produces energy from waste.
- EE is only generated in A3 (manufacturing). Due to the cogeneration system, waste heat is recovered to energy and used in the production.

Sensitivity Analysis:

When the LCA results are evaluated, it is determined that the suggested strategies to reduce GWP will already reduce other impacts. For this reason, considering the fact that GWP is an impact category that should be evaluated as a priority, sensitivity analysis is handled on the reduction of GWP. Feldspar and clay, used as raw materials, are the primary causes of GWP with 20% and 17%, respectively. However, it does not make sense to change the formula of the product, as it will change the quality of the product. For this reason, reducing the thickness of the product and using recycled raw materials that will not affect the quality of the product are the most logical ways to reduce GWP at higher rates.

On the other hand, energy recovery is currently carried out in the factory and energy efficient applications that can be made in the current system are already being implemented. However, switching to renewable energy in production has been discussed. This practice can cause the production system to change completely or partially. When the old system that is released as waste, the embedded carbon of the new system, transportation and installation during the system change are considered, the effect of this change on GWP will not be positive at least in the short term. The effects in the long term cannot be precisely calculated due to the uncertainties. For these reasons, the effects of transition to renewable energy use are not included in this report. Despite this, the use of renewable energy systems is not entirely rejected, instead a detailed feasibility report including the calculation of embedded carbon is proposed for such an investment.

Considering the solutions that will reduce GWP, if the product thickness is reduced by 10%, the total GWP from cradle to grave will decrease by 8.7%. If 10% of 'the product waste generated during installation' and 'the end-of-life product' are collected from close distances to the factory site and participate in production as a raw material, the total GWP from cradle to grave will decrease by 5%. When these two applications are applied simultaneously, the total GWP from cradle to grave will decrease by 13.2%.

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