## Environmental Product Declaration

# HIMACS(Acrylic Solid Surfaces)

LX Hausys provides a variety of solutions that can revitalize a space through its business in the fields of building decorative materials, industrial films, and automotive materials components. With our commitment to creating value-added spaces where humans and nature exist in harmony, we strive to present innovative products that cater to the taste, interest, and lifestyle of our customers.

Kitchens and bathrooms that reflect different lifestyles of various customers, windows and coated glass that deliver remarkable insulation and durability performance, comfortable, and safe eco-friendly flooring and wallcovering, insulation products that boast exceptional insulation, acrylic solid surface and engineered stone most sought after by world-renowned architects, interior and decoration films and doors with sensuous design and functions, these are all products that we supply to create healthy and safe spaces.

Durable and reliable, HIMACS solid surface promises to deliver the best result. From simple countertops to complex, thermoformed design concepts, HIMACS is the ultimate design material for any project. Stronger surface with durability similar to that of natural stone - HIMACS stands up to everyday “wear and tear”. Should you accidentally inflict a deep scratch or surface impression, a trained professional can easily resurface your HIMACS thanks to its seamless consistency.

# ENVIRONMENTAL PRODUCT DECLARATION

LX Hausys

**HIMACS**
ARCRYLIC SOLID SURFACES

CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

**According to ISO 14025**

| | |
|---|---|
| EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE | UL Solutions<br>333 Pfingsten Rd, Northbrook, IL 60062<br>WWW.UL.COM<br>wwww.spot.ul.com |
| GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER | Program Operator Rules v 2.7 2022 |
| MANUFACTURER NAME AND ADDRESS | LX Hausys<br>• 9, Oksansandan 3-ro, Oksan-myeon, Heungdeok-gu, Cheongju-si, Chungcheongbuk-do, Republic of Korea<br>• 44-68, Sari-ro bangchukgol-gil, Sari-myeon, Goesan-gun, Chungcheongbuk-do |
| DECLARATION NUMBER | 4790626770.101.1 |
| DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT | The declared unit is 1 m2 of the HIMACS |
| REFERENCE PCR AND VERSION NUMBER | • Product Category Rule for Environmental Product Declarations for Residential Countertops, NSF Sustainability, 2023 |
| DESCRIPTION OF PRODUCT APPLICATION/USE | Residential and commercial countertop |
| PRODUCT RSL DESCRIPTION (IF APPL.) | 10 years |
| MARKETS OF APPLICABILITY | Global |
| DATE OF ISSUE | Septemeber 1, 2023 |
| PERIOD OF VALIDITY | 5 Years |
| EPD TYPE | Product-specific |
| RANGE OF DATASET VARIABILITY | Industry-average |
| EPD SCOPE | Cradle to gate with options |
| YEAR(S) OF REPORTED PRIMARY DATA | September 1, 2021 and August 31, 2022 |
| LCA SOFTWARE & VERSION NUMBER | SimaPro 9.4.0.2 |
| LCI DATABASE(S) & VERSION NUMBER | Ecoinvent v3.8 |
| LCIA METHODOLOGY & VERSION NUMBER | • Environmental Footprint (EF) 3.0 method |

| | |
|---|---|
| The PCR review was conducted by: | NSF International<br>PCR Review Panel<br>ncss@nsf.org |
| This declaration was independently verified in accordance with ISO 14025: 2006.<br>☐ INTERNAL ☒ EXTERNAL | Cooper McCollum, UL Solutions |
| This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by: | H.I.Pathway Co., LTD. |
| This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by: | Ik-Kim |

LIMITATIONS

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; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible". Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.

## 0. Key Environmental Parameters

Key environmental parameters are summarized upfront in Table 1.

| PARAMETER | AMOUNT |
|---|---|
| Climate change (kg $CO_2$ eq.) | 1.00E+02 |
| Renewable energy (from solar) | 3.34E-02 |
| Renewable energy (from wind) | 1.94E+00 |
| Renewable energy (from hydro) | 1.11E+01 |
| Post-consumer recycled contents percentage (%) | 0~8% |

## 1. Product Definition and Information

### 1.1 Description of Company/Organization

LX Hausys presents the vision of “Creating human-friendly, eco-conscious living spaces”. This represents our goal to provide eco-conscious and energy-efficient materials and products as a trendsetter in creating a future space realizing an aesthetically-pleasing and human-friendly design. This also shows our will to create living spaces that bring contentment to our customers by placing customer satisfaction as the top priority. LX Hausys pursues the three customer values of Eco-Friendly, Energy Saving, and Human-Friendly. We provide eco-friendly materials through diversification of materials to pursue the value of Eco-friendliness, and we have been accomplishing Energy Saving by enhancing energy performance with windows and doors with outstanding insulating capability, high-performance insulation materials, and lightweight automotive parts. In addition, we are realizing the Human-Friendliness by raising the value of living through our human-friendly designs and innovation in distribution to expand the customer communication touchpoints.

### 1.2 Product Description

**Product Identification**

Experience awe-inspiring design, evoking the majesty of the Aurora Borealis. Witnessing the Aurora Borealis is one of the most inspiring and captivating experiences you can have in a lifetime. Inspired by the natural beauty of the phenomenal northern lights, The Aurora Collection offers solid surface materials that captivate the imagination with stunning marble-like aesthetics. The collection combines the veining patterns of exquisite Italian “Bianco Carrara” marble with the mysterious, moody allure of the Aurora Borealis. The Aurora Collection’s seamless design allows you to join two surfaces to create one continuous surface without unsightly joint lines. The collection’s color palette and soft veining complement numerous styles and spaces with an appealing aesthetic that continues to inspire for years to come. This beautiful HIMACS collection offers the luxury of natural marble at an affordable price in an easy-to-maintain and hygienic surface. Its thermoformability allows you to create multiple shapes and designs to enhance indoor and outdoor applications. Those brings you more reasons to consider the Aurora Collection from HIMACS, with two new on-trend colors featuring natural marble-like patterning. Create remarkable spaces, dancing with light with our new Aurora colors, Aurora Daymoon and Aurora Calacatta Fiore.

**Recycled Content**

The HIMACS product offers surfaces that contain pre-consumer recycled content. The exact amount of pre-consumer recycled content ranges from 12% to 16% depending on product color: For more information on the recycled content of the HIMACS, please view the following certification documents:

https://cdn.scscertified.com/products/cert_pdfs/LXHausys_2023_SCS-RC-06280_s.pdf

https://cdn.scscertified.com/products/cert_pdfs/LXHausys_2023_SCS-RC-06281_s.pdf

https://cdn.scscertified.com/products/cert_pdfs/LXHausys_2023_SCS-RC-06282_s.pdf

https://cdn.scscertified.com/products/cert_pdfs/LXHausys_2023_SCS-RC-06283_s.pdf

https://cdn.scscertified.com/products/cert_pdfs/LXHausys_2023_SCS-RC-06284_s.pdf

https://cdn.scscertified.com/products/cert_pdfs/LXHausys_2023_SCS-RC-06285_s.pdf





## Product Specification

UNSPSC (United Nations Standard Products and Services Code) of HIMACS (Acrylic Solid Surfaces) is 30162203 (Solid surface countertop).

| TECHNICAL SPECIFICATION | NOMINAL VALUE | UNIT |
|---|---|---|
| Primary material thickness | 12 (1/2) | mm (inch) |
| Sheet/slab length | 368 (144) | cm (inch) |
| Sheet/slab width | 76 (30) | cm (inch) |
| Primary material weight | 20,738 | g/m² (lbs/ft²) |
| Underlayment included | None | - |
| Underlayment type | None | - |
| **TECHNICAL SPECIFICATION** | **NOMINAL VALUE** | **TEST METHOD** |
| Specific gravity | 1.710 | ASTM D792 |
| Boiling water resistance | No effect | NEMA LD3 |
| High temperature resistance | No effect (crazing, color change, cracking)<br>Moderate effect (blisters)<br>Slight effect (dulling) | NEMA LD3 |
| Izod impact strength | 14J/m | ASTM D256- |
| Flexural strength | 558Mpa | ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials |
| Flexural modulus | 7.0Gpa | ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials |
| Hardness, Rockwell M scale | 80 | ASTM D785 |
| Hardness, Barcol | 58 | ASTM D2583 |
| Tensile strength | 35Mpa | ASTM D638-14 |
| Tensile modules of elasticity | 7.5Gpa | |

**Flow Diagram**


1. **Fabrication of main parts and components**

- HIMACS is manufactured using processes such as mixing of raw ingredients, casting, heat curing, cutting of the surface to shape, sanding of the surface and lastly packing the products.
- The mixing process is the most basic and important process to satisfy the desired properties of HIMACS. It is a step of blending the raw material so that the product has a uniform physical property and the surface pattern is determined.
- In the casting process, the mixed material is forced through a mold to create continuous sheets, which can be later cut into various lengths of products.
- After casting, the solid surface material undergoes a curing process. This involves exposing the material to heat, typically in an oven, to initiate polymerization and hardening of the acrylic polymer. The curing process helps create a durable and stable material.
- The sanding process is crucial for achieving the desired aesthetics and texture of solid surface products. It improves not only the visual appeal but also contributes to the overall durability and functionality of the material.
- Once the solid surface products have undergone quality control and inspection, they are packaged and prepared for distribution to retailers.

2. **Construction**

- The front edge and backsplash of the countertop produced by HIMACS is made by processing HIMACS.
- Attach the particle board to the bottom of the countertop during construction of the countertop. The thickness of the particle board attached to the bottom is 12T and the area is the same as that of the countertop.
- In addition, a methyl methacrylate adhesive is used in the construction process. It also consumes electricity from the use of grinders for adhesive removal and surface sanding, and the use of jig saws for making cutouts for sinks or range tops.

3. **Installation**

- It is the step of installing the produced countertop at the construction site. During the installation process a methyl methacrylate adhesive is used in the construction process. It also consumes electricity from the grinders and circular sander for adhesive removal and surface sanding.

4. **Use**

- The period of use of HIMACS is 10 years. HIMACS is a durable product that you can keep for a long time the luxury of solid surface with the simple care of wiping it with bleach that is diluted with water once a month.

5. **End of life**

- HIMACS cannot be re-used for countertops applied to various buildings, and it is impossible to obtain the primary data for the disposal process. Data were collected by applying the waste stage scenario presented in PCR

### 1.3 Application

- Residential: Kitchen Top, Sink Bowl for home, Bathtub (Wash Basin), Living Space, Furniture
- Commercial: Public Building and Office, Facades and Wall cladding, Shops and Exhibitions, Healthcare and Hospital, Educational institutions, Others (Hotel, Marine industry, Airport, etc.)

### 1.4 Material composition

| PRODUCT COMPONENTS | WEIGHT, % | POST-CONSUMER MATERIAL, WEIGHT-% | RENEWABLE MATERIAL, WEIGHT-% |
|---|---|---|---|
| Alumina Trihydrate (ATH) | 55.9% | 0% | 0% |
| Methyl Methacrylate (MMA) | 25.9% | 0% | 0% |
| CHIPS | 8.2% | 0% | 0% |
| Poly Methyl Methacrylate (PMMA) | 6.4% | 0% | 0% |
| PMMA (recycled) | 1.1% | 100% | 0% |
| Others | 2.5% | 0% | 0% |
| TOTAL | 100.0% | 1.1%* | 0% |

* The post-consumer material rate of 1.1% is the average input rate and is input at a rate of 0 to 8% depending on the detailed model included in HIMACS.

## 2. Methodological Framework

### 2.1. Functional or Declared Unit

The functional unit is 1 $m^2$ (10.76 $ft^2$) of 12-mm thick surface for a period of 10 years in use.

### 2.2. System Boundary

The entire life cycle of HIMACS is to be covered including all industrial processes from raw material acquisition and pre-processing into a countertop pre-form, construction of the countertop, distribution, transportation and installation in end user location, use/maintenance, and end-of-life.

In this study, primary data was used in the construction, installation, and use stages. The data of the construction stage was collected based on the work manual. Installation and use stage data were calculated through operator interviews and product use manuals.

### 2.3. Cut-off Criteria

Cut off rules which applied in this study comes from PCR for Environmental Product Declarations for Residential Countertops, NSF Sustainability, 2023.

- Mass and energy flows that consist of less than 1% may be omitted from the inventory analysis.

- Cumulative omitted mass or energy flows shall not exceed 5%.
- Mass or energy flows that contribute more than 10% to an impact category shall be included.

### 2.4. Data Sources

Input/output data for the HIMACS production was derived from specific data which managed by ERP (Enterprise Resource Planning) system for the HIMACS production site.

Upstream data for the inputs for the HIMACS production which is raw materials, energy and utilities were utilized in the Ecoinvent v3.8.

### 2.5. Data Quality

The specific data collected at LX Hausys factory is the actual activity data of the production site between September 1, 2021 and August 31, 2022 (12 month).

The LCI database applied to external purchasing materials, energy and utilities utilized the Ecoinvent v3.8 revised in 2021.

#### 2.6.1. Time Coverage

The data are intended to represent HIMACS production during the 2021 to 2022 calendar year. As such, LX Hausys provided primary data for 12 consecutive months during the 2021 to 2022 calendar years.

#### 2.6.2. Technology coverage

This study is intended to be representative of the HIMACS production processes. All primary data was collected from LX Hausys for its facilities and is intended to represent LX Hausys's technologies.

#### 2.6.3. Geographical coverage

This EPD report represents HIMACS produced in the Rep. of Korea. However almost of raw materials are imported from other countries. Background data are representative of these countries, with exceptions noted in Section 4.3.

Regionally specific datasets were used to represent each manufacturing location's energy consumption, but proxy datasets were used as needed for raw material inputs to address lack of data for a specific material or for a specific geographical region. These proxy datasets were chosen for their technological representativeness of the actual materials.

### 2.6. Allocation and assumption

The input / output of processes that are not related to the production of HIMACS were excluded from the scope of environmental impact assessment.

No other co-product allocation occurs in the product foreground system. No multi-input allocation occurs in the product system. Allocation was used in the background data, as described below.

Allocation of upstream data (energy and materials):

- For all refinery products, allocation by mass and net calorific value is applied. The manufacturing route of every refinery product is modeled and so the effort of the production of these products is calculated specifically. Two allocation rules are applied:

the raw material (crude oil) consumption of the respective stages, which is necessary for the production of a product or an intermediate product, is allocated by energy (mass of the product * calorific value of the product); and
the energy consumption (thermal energy, steam, electricity) of a process, e.g. atmospheric distillation, being required by a product or an intermediate product, are charged on the product according to the share of the throughput of the stage (mass allocation).

– No other raw materials allocation occurs in the product background system.

LX Hausys's assumption is that the amount of energy and utility required to produce fabricated parts and components is proportional to the weight of the product.

## 3. Life Cycle Assessment Results

### 3.1. Life Cycle Impact Assessment Results

**Table 1. Impact Assessment Results**

| PARAMETER | UNIT | MATERIAL ACQUISITION | CONSTRUCTION | INSTALLATION | USE | END OF LIFE | TOTAL |
|---|---|---|---|---|---|---|---|
| Climate change | kg $CO_2$ eq. | 8.098E+01 | 1.663E+01 | 8.753E-01 | 1.984E-01 | 1.344E+00 | 1.000E+02 |
| Ozone depletion | kg CFC-11 eq. | 4.741E-06 | 1.576E-06 | 3.556E-08 | 2.878E-08 | 2.667E-08 | 6.408E-06 |
| Acidification | mol H+ eq | 2.283E+01 | 3.143E+00 | 8.089E-02 | 4.924E-02 | 5.564E-02 | 2.616E+01 |
| Eutrophication | kg N eq. | 1.338E-01 | 1.013E-01 | 3.713E-02 | 5.840E-04 | 8.105E-02 | 3.539E-01 |
| Photochemical oxidant formation: human health | kg $O_3$ eq. | 4.198E+00 | 9.954E-01 | 2.236E-02 | 1.280E-02 | 2.462E-02 | 5.254E+00 |
| Material resources: metals/minerals* | kg antimony eq. | 2.343E-04 | 7.112E-05 | 3.232E-06 | 2.574E-06 | 3.911E-07 | 3.116E-04 |
| Energy resources: non-renewable* | MJ | 1.133E+03 | 2.068E+02 | 4.325E+00 | 2.513E+00 | 1.993E+00 | 1.349E+03 |

### 3.2. Life Cycle Inventory Results

**Table 2. LCI results**

| PARAMETER | UNIT | MATERIAL ACQUISITION | CONSTRUCTION | INSTALLATION | USE | END OF LIFE | TOTAL |
|---|---|---|---|---|---|---|---|
| Fossil-fuel based | MJ | 1.225E+03 | 2.225E+02 | 4.696E+00 | 2.723E+00 | 2.129E+00 | 1.457E+03 |
| Nuclear | MJ | 6.529E+01 | 3.027E+01 | 1.217E+00 | 1.836E-01 | 5.498E-02 | 9.702E+01 |
| Solar | MJ | 2.131E-02 | 1.096E-02 | 4.056E-04 | 8.552E-05 | 6.365E-04 | 3.340E-02 |
| Wind | MJ | 1.044E+00 | 7.428E-01 | 1.251E-01 | 2.370E-02 | 6.338E-03 | 1.942E+00 |
| Hydro | MJ | 7.948E+00 | 2.800E+00 | 1.847E-01 | 9.823E-02 | 2.766E-02 | 1.106E+01 |
| Biomass | MJ | 5.650E+00 | 6.260E+01 | 1.249E-01 | 4.622E-02 | 1.283E-02 | 6.843E+01 |
| Geothermal | MJ | 9.297E-02 | 8.511E-02 | 1.247E-02 | 3.501E-03 | 7.781E-04 | 1.948E-01 |
| EMISSION TO AIR | | | | | | | |
| $SO_X$ | kg | 1.832E-05 | 1.147E-05 | 7.954E-07 | 1.684E-07 | 1.425E-06 | 3.218E-05 |
| $SO_X$, KR | kg | 0.000E+00 | 3.340E-05 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.340E-05 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $SO_2$ | kg | 3.072E-01 | 2.673E-02 | 8.022E-04 | 5.191E-04 | 2.492E-04 | 3.355E-01 |
| $NO_X$ | kg | 1.686E-01 | 3.898E-02 | 8.632E-04 | 5.141E-04 | 9.919E-04 | 2.100E-01 |
| $NO_X$, KR | kg | 0.000E+00 | 1.470E-04 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 1.470E-04 |
| $CO_2$ (fossil) | kg | 6.993E+01 | 1.546E+01 | 6.695E-01 | 1.825E-01 | 9.412E-01 | 8.718E+01 |
| $CO_2$ (biogenic) | kg | 2.633E-01 | 4.294E+00 | 5.208E-01 | 5.273E-03 | 1.159E+00 | 6.243E+00 |
| $CO_2$ (land transformation) | kg | 1.013E-02 | 1.245E-02 | 2.423E-04 | 2.325E-04 | 1.039E-04 | 2.315E-02 |
| Methane | kg | 6.777E-08 | 1.501E-05 | 1.145E-09 | 1.180E-09 | 8.756E-10 | 1.509E-05 |
| Methane (biogenic) | kg | 3.291E-03 | 8.071E-04 | 3.184E-05 | 7.704E-05 | 5.958E-06 | 4.213E-03 |
| $N_2O$ | kg | 6.813E-04 | 6.431E-04 | 6.690E-05 | 5.510E-06 | 7.892E-05 | 1.476E-03 |
| CO | kg | 0.000E+00 | 3.920E-04 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 3.920E-04 |
| CO (fossil) | kg | 1.006E-01 | 1.643E-02 | 5.728E-04 | 1.920E-04 | 4.407E-04 | 1.182E-01 |
| CO (biogenic) | kg | 8.629E-04 | 6.792E-03 | 4.324E-05 | 2.063E-05 | 6.021E-05 | 7.779E-03 |
| CO (land transformation) | kg | 3.603E-05 | 4.316E-05 | 7.482E-07 | 5.543E-07 | 7.586E-07 | 8.125E-05 |
| **EMISSION TO WATER** | | | | | | | |
| Phosphates | kg | 3.028E-02 | 1.809E-02 | 6.364E-04 | 1.788E-04 | 2.148E-04 | 4.940E-02 |
| Nitrates | kg | 6.496E-03 | 9.372E-03 | 1.850E-03 | 6.300E-05 | 3.500E-03 | 2.128E-02 |
| Dioxin | kg | 3.259E-17 | 1.860E-17 | 4.982E-19 | 4.583E-19 | 4.088E-19 | 5.256E-17 |
| Heavy metals, As | kg | 3.958E-04 | 5.112E-05 | 6.935E-06 | 5.598E-07 | 1.334E-05 | 4.678E-04 |
| Heavy metals, Cd | kg | 1.198E-05 | 2.985E-04 | 2.060E-04 | 1.900E-07 | 4.678E-04 | 9.845E-04 |
| Heavy metals, Cr | kg | 8.735E-07 | 1.527E-06 | 2.854E-07 | 5.739E-07 | 2.578E-08 | 3.285E-06 |
| Heavy metals, Pb | kg | 3.767E-04 | 2.190E-03 | 1.382E-03 | 6.482E-06 | 3.125E-03 | 7.080E-03 |
| Heavy metals, Hg | kg | 2.826E-06 | 4.750E-06 | 2.235E-06 | 2.513E-08 | 4.961E-06 | 1.480E-05 |
| Freshwater consumption | kg | 4.930E+04 | 4.440E+04 | 2.939E+03 | 1.575E+03 | 3.244E+02 | 9.854E+04 |
| **WASTE MANAGEMENT** | | | | | | | |
| Landfill avoidance (recycling) | kg | 1.799E+00 | 1.470E+00 | 1.048E+00 | 0.000E+00 | 2.383E+00 | 6.70E+00 |
| Landfill (non-hazardous waste) | kg | 0.000E+00 | 3.801E+00 | 2.709E+00 | 0.000E+00 | 6.160E+00 | 1.27E+01 |
| Incineration (municipal and waste plastic) | kg | 4.424E-01 | 9.502E-01 | 6.772E-01 | 0.000E+00 | 1.540E+00 | 3.61E+00 |

## 4. LCA Interpretation

### 4.1. Data quality assessment

Inventory data quality is judged by its precision (measured, calculated, estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied) and representativeness (geographical, temporal, and technological).

To cover these requirements and to ensure reliable results, first-hand industry data in combination with consistent

background LCA information from the Ecoinvent v3.8 were used. The LCI datasets from the Ecoinvent v3.8 are widely distributed and used with the SimaPro Software.

The datasets have been used in LCA models worldwide in industrial and scientific applications in internal as well as in many critically reviewed and published studies. In the process of providing these datasets they are cross-checked with other databases and values from industry and science.

- Precision: As the majority of the relevant foreground data are measured data or calculated based on primary information sources of the owner of the technology, precision is considered to be high. Seasonal variations and variations across different manufacturers were balanced out by using yearly averages and production-weighted averages. All background data are sourced from Ecoinvent v3.8 with the documented precision.
- Completeness: Each foreground process was checked for mass balance and completeness of the emission inventory. No data were knowingly omitted. Completeness of foreground unit process data is considered to be high. All background data are sourced from Ecoinvent v3.8 with the documented completeness.
- Consistency: To ensure data consistency, all primary data were collected with the same level of detail, while all background data were sourced from the Ecoinvent v3.8.
- Reproducibility: Reproducibility is supported as much as possible through the disclosure of input-output data, dataset choices, and modeling approaches in this report. Based on this information, any third party should be able to approximate the results of this study using the same data and modeling approaches.
- Temporal: All primary data were collected for a twelve-month period during 2021 to 2022 calendar years. Secondary data come from Ecoinvent v3.8 are representative of the years 2021. As the study intended to communicate the environmental impact of HIMACS to stakeholders for the reference year 2021 to 2022, temporal representativeness is considered to be high.
- Geographical: All primary and secondary data were collected specific to the countries or regions under study. Where country-specific or region-specific data were unavailable, proxy data were used. Geographical representativeness is considered to be high.
- Technological: All primary and secondary data were modeled to be specific to the technologies or technology mixes under study. Where technology-specific data were unavailable, proxy data were used. Technological representativeness is considered to be high. Data was collected from the LX Hausys which producer of HIMACS.

## 4.2. Key-issue identification

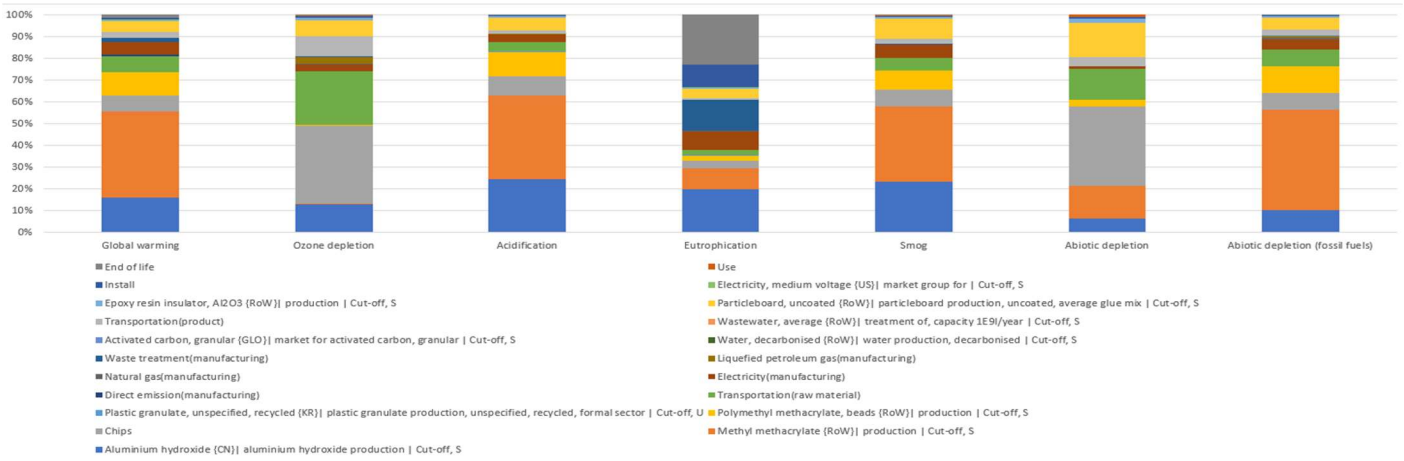


Figure 1 Contribution of impact assessment about HIMACS

The inputs of methyl methacrylate, ATH, chips, poly methyl methacrylate and transportation of raw materials are significant drivers in all impact categories. The environmental impact contribution by the inputs is between 37.70% and 87.21% for each environmental impact category.

**Table 3 Environmental impact contribution analysis results**

| Impact category | Material acquisition | | | | | | Construction | | | | | Installation | Use | End of life |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ATH | MMA | Chips | PMMA | Transportation of raw materials | Others | Electricity (Korea) | Waste treatment (manufacturing) | Transportation of fabricated product | Particleboard (construction) | Others | | | |
| Global warming | 15.98% | 39.69% | 7.24% | 10.52% | 7.39% | 0.14% | 5.54% | 1.87% | 2.72% | 4.83% | 1.67% | 0.88% | 0.20% | 1.34% |
| Ozone depletion | 12.66% | 0.46% | 35.98% | 0.19% | 24.61% | 0.08% | 3.20% | 0.29% | 9.45% | 7.08% | 4.58% | 0.55% | 0.45% | 0.42% |
| Acidification | 24.43% | 38.54% | 8.79% | 11.18% | 4.27% | 0.06% | 3.51% | 0.18% | 1.59% | 5.78% | 0.96% | 0.31% | 0.19% | 0.21% |
| Eutrophication | 19.85% | 9.38% | 3.75% | 2.33% | 2.40% | 0.10% | 8.65% | 14.20% | 0.80% | 4.05% | 0.93% | 10.49% | 0.17% | 22.90% |
| Smog | 23.39% | 34.55% | 7.61% | 8.69% | 5.57% | 0.11% | 6.15% | 0.42% | 2.20% | 9.23% | 0.95% | 0.43% | 0.24% | 0.47% |
| ADP(elements) | 6.30% | 15.07% | 36.39% | 3.12% | 14.15% | 0.16% | 1.04% | 0.10% | 3.89% | 15.84% | 1.96% | 1.04% | 0.83% | 0.13% |
| ADP(fossil) | 10.11% | 46.08% | 7.79% | 12.13% | 7.81% | 0.10% | 4.63% | 0.11% | 2.92% | 5.46% | 2.21% | 0.32% | 0.19% | 0.15% |

The output of emissions from waste treatment(manufacturing), installation and end-of-life are significant drivers in eutrophication impact categories. The emission contributes 47.59% of total eutrophication impact category of HIMACS.

## 5. References


- Product Category Rule for Environmental Product Declarations for Residential Countertops, NSF Sustainability, 2023
- ISO 14025:2006. Environmental labels and declarations — Type III environmental declarations — Principles and procedures
- ISO 14040:2006. Environmental management – Life cycle assessment – Principles and framework
- ISO 14044:2006. Environmental management – Life cycle assessment – Requirements and guidelines
- LCA software SimaPro 9.4.0.2
- Ecoinvent database version 3.8 (https://ecoinvent.org/the-ecoinvent-database/)

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According to ISO 14025

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