ENVIRONMENTAL PRODUCT DECLARATION

# FACTORY OF USG MIDDLE EAST

## RADAR™ & OLYMPIA MICRO™ CLIMAPLUS


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Sustainable practices have naturally been an inherent part of our business at Factory of USG Middle East. They help shape the innovative products that become the homes where we live, the buildings where we work and the arenas where we play.

From the product formulations we choose, to the processes we employ, Factory of USG Middle East is committed to designing, manufacturing, and distributing products that minimize overall environmental impacts and contribute toward a healthier living space.

We believe that transparency of product information is essential to our stakeholders and EPDs are the next step toward an even more transparent Factory of USG Middle East.

USG ME's ceiling panels listed in this UL Environment Certified Document provides an acoustical ceiling panel's: Life Cycle Assessment (LCA), LCA Impact Measures, Product Composition, Material Definitions, Manufacturing Process, Product Performance Attributes and Product Application.

UL CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

# ENVIRONMENTAL PRODUCT DECLARATION

**USG ME**
**Radar™ ClimaPlus and Olympia Micro™ ClimaPlus**
**Acoustical Ceiling Panels**

According to ISO 14025, ISO 21930:2007 and EN 15804

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

| | |
|---|---|
| PROGRAM OPERATOR | UL Environment |
| DECLARATION HOLDER | USG Middle East LTD CO |
| DECLARATION NUMBER | 4787281571.102 |
| DECLARED PRODUCT | USG ME Radar ClimaPlus and Olympia Micro ClimaPlus Acoustical Ceiling Panels |
| REFERENCE PCR | UL Part B: Non-Metal Ceiling Panel, v.1.0 October 2015 & UL Part A, v.1.3 2014 |
| DATE OF ISSUE | July 1, 2020 |
| PERIOD OF VALIDITY | 5 Years |
| CONTENTS OF THE DECLARATION | Product definition and information about building physics<br>Information about basic material and the material's origin<br>Description of the product's manufacture<br>Indication of product processing<br>Information about the in-use conditions<br>Life cycle assessment results<br>Testing results and verifications |

| | |
|---|---|
| The PCR review was conducted by: | UL Environment<br>PCR Review Panel<br>epd@ulenvironment.com |
| This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories.<br>☐ INTERNAL ☒ EXTERNAL | Grant R. Martin<br>Grant R. Martin, UL Environment |
| This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by: | James Mellentine<br>James Mellentine, Ramboll |

This EPD conforms with ISO 21930:2007 and EN 15804:2012

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**Acoustical Ceiling Panels**

According to ISO 14025

## 1. General Information

This EPD document is for Radar™ ClimaPlus and Olympia Micro™ ClimaPlus manufactured by Factory of USG Middle East where the manufacturing plant located in Dammam, Kingdom of Saudi Arabia.

## 2. Product System Documentation

### 2.1. Product Description

Radar™ ClimaPlus acoustical ceiling (Radar™) is a Mineral Fiber substrate with factory-applied water-based paint. The product is Type: III, Form: 2 and the Patterns are: C, D and E as per ASTM E1264. Radar™ have a clean appearance offers fast and efficient installation. The panels are economical for all purpose ceiling pattern offered in many sizes, ideal for a balancing of sound absorption that provides balance to room acoustics and sound attenuation that is ideal for general constructions. Radar™ can be used in many areas and not limited to: educational facilities, corridors, libraries, open office plans and retail stores.

Olympia Micro™ ClimaPlus acoustical ceiling (Olympia Micro™) is a Mineral Fiber substrate with factory-applied water-based paint. The product is Type: III, Form: 2 and the Pattern are C and E as per ASTM E1264. Olympia Micro™ have light granulated surface texture with virtually invisible micro-perforation for a smoother look than standard perforations that improve sound absorption reduces light fixtures and energy use. Olympia Micro™ offered in many sizes and available in plank size for corridor use. Olympia Micro™ can be used in many areas and not limited to: educational facilities, corridors, reception and lobby areas, restaurant, sports hall, general offices and shopping centers.

Radar™ ClimaPlus Acoustical Ceiling

Olympia Micro™ ClimaPlus Acoustical Ceiling

## 2.2. Application

Radar™ ClimaPlus and Olympia Micro™ ClimaPlus are commonly used in commercial, institutional and residential interior applications. Radar™ ClimaPlus and Olympia Micro™ ClimaPlus are installed quickly and easily. Radar™ ClimaPlus is classified as low-emitting ceiling panel which is ideal for offices, schools, corridors and retail stores. Olympia Micro™ ClimaPlus is classified as low-emitting ceiling panel which is ideal for offices, corridors and reception, lobby, hospitality and retail stores.

Olympia Micro™ ClimaPlus is available in concealed edge details to increase the area aesthetics. USG ME produces both of Radar™ ClimaPlus and Olympia Micro™ ClimaPlus in metric and imperial sizes to fit all construction types and to match the contractors lighting fixtures demand.

## 2.3. Technical Data

Technical information and product standards are given in the table below.

| Name | Radar™ ClimaPlus (Value/Unit) | Olympia™ Micro ClimaPlus (Value/Unit) |
|---|---|---|
| Noise Reduction Coefficient (NRC) Test Method C423 | 0.60 | 0.65 |
| Ceiling Attenuation Class (CAC) Test Method ASTM E1414 & ASTM E413 | 40 dB | 37 dB |
| Surface Burning Characteristics Test Method ASTM E84 | Class A, Flame Spread of 10 or less, smoke developed of 20 or less | Class A, Flame Spread of 10 or less, smoke developed of 20 or less |
| Fire Rating Test Method ASTM E119 | 2hrs Time-Rated Assembly [J201] | 2hrs Time-Rated Assembly [J201] |
| Light Reflectance Test Method ASTM E1477 | 0.85 | 0.89 |
| Thermal Transmission Test Method ASTM C518 | 0.31 m² °K/W - R 1.8 | 0.31 m² °K/W - R 1.8 |
| Humidity Resistance Test Method ASTM C367/C367M | Max. 99% RH / 40°C | Max. 99% RH / 40°C |

Radar™ ClimaPlus and Olympia Micro™ ClimaPlus are being produced with the most stringent manufacturing facility of its type in the MENA region, the company has ISO 9001:2015 certificate and ISO 14001:2015 certificate. Radar™ ClimaPlus and Olympia Micro™ ClimaPlus are GREENGUARD gold certified products with very low VOC emission level as per UL 2818 - 2013 Gold Standard for Chemical Emissions for Building Materials, Finishes and Furnishings.Certificate reference is 83793-420 for Olympia Micro™ ClimaPlus and 83791-420 for Radar™ ClimaPlus.

## 2.4. Placing on the Market / Application Rules

The respective standard and general technical approval for these products are indicated above. Further detail may be found on the www.usgme.com website.

## 2.5. Delivery Status

The products under consideration are typically delivered in bundles of 10-18 pieces per carton surrounded by a cardboard sleeve and wrapped with plastic.

## 2.6. Base Materials / Ancillary Materials

Mineral wool, perlite, corn starch, waste paper, ball clay and coating are the base materials of both Radar™ ClimaPlus and Olympia Micro™ ClimaPlus. Olympia Micro™ ClimaPlus additionally includes $CaCO_3$ as a base material. The base materials as mass percentage per unit are shown in the table below.

| Base Materials | Radar™ ClimaPlus | Olympia™ Micro ClimaPlus |
|---|---|---|
| | Mass Percentage | Mass Percentage |
| Mineral Wool | < 25% | < 23% |
| Perlite | < 40% | < 36% |
| Corn Starch | < 9% | < 16% |
| Waste Paper | < 13% | < 4% |
| Ball Clay | < 3% | < 3% |
| Coating | < 16% | < 17% |
| $CaCO_3$ (0.35-0.75 mm) | - | < 6% |

## 2.7. Manufacture

In wet felted production, the panel ingredients are mixed into a slurry, filtered and then distributed onto a moving wire fabric, dewatered using gravity and vacuum drainage and formed into a dewatered base mat. The dewatered base mat is then pressed and dried. The dried panels are cut or trimmed into the appropriate sizes and further finished with various fissuring, texturing and perforating options. The coatings are then applied to the entire surface of the board. Painting may involve two or more coatings with a drying cycle between coatings. After inspection, the ceiling panel are packaged for shipment. Panel trim and panels that are chipped or broken during manufacturing (referred to as "broke") are recycled and returned to the process. USG ME produce its own paint coatings and the primary ingredients for these coatings are also included in the analysis.

Manufacturing flow chart is given in the figure below.


## 2.8. Environment and Health During Manufacturing

All appropriate equipment required by federal, state and local regulations are in place at all USG ME manufacturing facilities.

## 2.9. Product Processing / Installation

The ceiling panels must be installed in accordance with all applicable USG ME installation guidelines.
Approved installation procedures are provided in the Ceiling Systems Catalogs must be followed. Installation of USG ME's ceiling and grid products is accomplished by manual labor using mostly hand tools. No material or energy inputs are required on the jobsite.

## 2.10. Packaging

USG ME ceiling panels are packaged using cardboard sleeves and are then wrapped in plastic shrink wrap. USG ME encourages the proper recyling of these packaging materials. Both the production and disposal of these packaging materials was modeled in this LCA study.

## 2.11. Condition of Use

To insure the longevity of the product, panels should not be exposed to moisture, high relative humidity or high temperature. Criteria can be found in the USG ME Warranties and Limitations information specific for each product.

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## 2.12. Environment and Health During Use

These product is not expected to produce any unusual hazards during normal use. Exposure to high dust levels may irritate the skin, eyes, nose, throat or upper respiratory tract. Proper personal protective gear should be worn by installer for protection.
The installed ceiling panel is GREENGUARD Gold Certified products for low chemical emissions.

## 2.13. Reference Service Life

A default RSL of 75 years shall be assumed for the product and ceiling panel mounting system. An assumed Estimated Service Life (ESL) of 75 years shall be used for building life.

## 2.14. Extraordinary Effects

**Fire**
All ceiling products covered by this study are certified to be Class A (flame spread of 10 or less, smoke developed of 20 or less per ASTM E84).

**Water**
Moisture must not come in contact with the ceiling panel as a result of a leaking roof, a sweating pipe, a leaking radiator, a flood, condensation on more subtle surfaces where dew points are reached, humidified air from the HVAC system or any other similar causes.

**Mechanical Destruction**
The product must be installed and maintained in accordance with current USG ME written instructions and best industry practice, including the CISCA Handbook and ASTM C636, ‘’Standard Practice for Installation of Metal Ceiling Suspension System for Accoustical Tile and Lay-in Panels.

## 2.15. Re-use Phase

With proper care, USG ME ceiling panels may be reused at the end of a building’s life.

## 2.16. Disposal

This EPD covers product stage modules A1, A2, A3 and does not cover end of life stage. In normal practice, most grid components are recycled at end-of-life while all ceiling panel waste generated during installation and at end-of-life is assumed to be disposed of in an appropriate landfill.

## 2.17. Further Information

For further information, please visit www.usgme.com.

## 3. LCA Calculation Rules

The LCA study and analysis were conducted according to the PCR "UL - Part B: Non-Metal Ceiling Panel EPD Requirements October 2015 v1" in accordance with ISO 14040 and ISO 14044.

Product stage including the modules A1 (raw material supply), A2 (transport), A3 (manufacturing) is considered as life cycle stage.

### 3.1. Declared and Functional Unit

The declared unit is 1m$^2$ of the products 'USG ME Radar™ ClimaPlus and Olympia Micro™ ClimaPlus'. Please see the table below for declared unit, declared thickness and surface weight per declared unit.

| Name | Radar™ ClimaPlus | Olympia Micro™ ClimaPlus |
|---|---|---|
| | Value/Unit | Value/Unit |
| Declared unit | 1 m$^2$ | 1 m$^2$ |
| Declared thickness | 19 mm | 19 mm |
| Surface weight per declared unit | 4.50 kg/m$^2$ | 4.85 kg/m$^2$ |

### 3.2. System Boundary

The scope of study includes the product stage 'cradle to gate'. Product stage includes the modules A1 (raw material supply), A2 (transport), A3 (manufacturing). Extraction and delivery of base materials and packaging materials, emissions to air, water and soil during manufacturing are included in the LCA study. Construction of capital equipment, maintenance and operation of support equipment, human labor and employee commute, overhead of manufacturing facilities and internal transportation are excluded.

### 3.3. Estimates and Assumptions

LCA study of USG ME's non-metal ceiling tiles 'Radar™ ClimaPlus and Olympia Micro™ ClimaPlus' 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.

Since all the data used in this study except moisture contents of the raw materials are already provided by the manufacturer, there is no data gaps which should be filled by estimates and conservative assumptions with average or generic data. The only estimated values used within this study are the moisture contents of the raw materials.

### 3.4. Cut-off Criteria

All inputs and outputs to unit processes for which data available are included in the calculation. The life cycle is covered from cradle to gate, including all industrial processes from raw material acquisition, pre-processing and production. The LCA study includes the provision of all materials, transportation, energy and emission flows.

There is no neglected unit process more than 1% of total mass and energy flows. The total neglected input and output flows do also not exceed 5% of energy usage or mass as indicated in the PCR.

The production of capital goods, paint used on packaging cardboards, infrastructure, carrying of product to the storage in manufacturing site, production of manufacturing equipment and personnel-related activities are not included in the LCA study as indicated in the PCR.

### 3.5. Background Data

The LCA models of 1m$^2$ of USG ME's non-metal ceiling tiles 'Radar™ ClimaPlus and Olympia Micro™ ClimaPlus' have been created by using GaBi DB Version 6.115 software system for life cycle engineering by ERKE Sustainable Building Design and Consultancy Ltd.

In this assessment, all modelling calculations are based on the amounts declared by manufacturer.

The primary data collection is accomplished in the form of spreadsheet and questionnaires, and supplemented by manufacturer communication. All relevant background data necessary for the materials used in the model are included in the GaBi database.

### 3.6. Data Quality

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

All the primary data required for LCA Analysis are 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 last 5 years.

The specific data quality coverages are also;

- Geographical coverage: The study partially complies with the actual manufacturing situation in Middle East.
- Time period coverage: The goal of the study is to determine the actual environmental loads for 12 consecutive months, therefore the data for 29.10.2018-25.10.2019 period are used.
- Technology coverage: The objective of the study is to use data that apply to average technology which represents actual situation. Data available for these processes in GaBi are expected to show limited global variability.

The data quality is assessed based on Table 8.2 of WRI Product Standard. The declaration of raw material inputs and outputs are collected on site by weighting each material type, therefore “Very Good” is assigned for raw material supply and manufacturing stages. Since the manufacturer has sufficient data for the stage transportation, the data quality is determined as “Good”.

Since there is no specific data for Saudi Arabia in GaBi, European data are mostly preferred as they are the average of various countries. European data for raw materials, haulage vehicles, diesel used for transportation, electricity and water resources and wastewater are used as a substitute for Saudi Arabia’s specific data. Using European data does not cause significant differences in the LCA results, because, the processes used are common around the world since the technologies used are similar.

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.

### 3.7. Period Under Review

All raw material and energy inputs are for the time period between 29.10.2018 and 25.10.2019.

### 3.8. Allocation

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

Average values for 1$m^2$ of the product which is used within this study is calculated by considering the total product weight per annual production. According to this, the total energy, water, and packaging materials used during production and the waste water generated are divided by the total annual production. Since the formulation of each product is certain, base materials do not need to be allocated. The damaged end products which are shredded and put into production again are calculated by scaling the annual casualties to the annual production. Accordingly, since there is no waste during the production phase, waste allocation is not applicable.

In the factory, several kinds of non-metal ceiling tiles are produced. Since the production processes of these products are similar, the annual production percentages are taken into consideration to allocate water and energy consumption. Additionally, since the energy used in dryer is different for each product, the energy consumption of oven is monitored separately and allocated for each product.

### 3.9. Comparability

A comparison or evaluation of EPD data is only possible if all data sets to be compared are 1) created according to EN 15804 and 2) are considered in a whole building context or utilize identical defined use stage scenarios. Comparisons are only allowable when EPDs report cradle-to-grave information using a functional unit. Refer to section 5.3 of EN 15804 for further information.

## 4. LCA: Results

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

- **Module A1_ Raw material supply:** This stage covers the extraction of the base materials.
- **Module A2_ Transport:** This stage covers the delivery of the base materials, ancillary materials and packaging materials.
- **Module A3_ Manufacturing:** This stage includes the production processes of the final product in the factory as gate to gate processes. Energy and water consumption and waste generation are accounted in this stage.

| DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRODUCT STAGE | | | CONSTRUCTION PROCESS STAGE | | USE STAGE | | | | | | | END OF LIFE STAGE | | | | BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARYS |
| Raw material supply | Transport | Manufacturing | Transport from gate to site | Assembly / Install | Use | Maintenance | Repair | Replacement | Refurbishment | Operational Energy Use | Operational Water Use | Deconstruction | Transport | Waste processing | Disposal | Reuse, Recovery, Recycling Potential |
| A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
| X | X | X | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND |

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## USG ME 1m² RADAR™ CLIMAPLUS & OLYMPIA MICRO™ CLIMAPLUS
## North American LCA Environmental Impact Results
## Method: TRACI 2.1 Impact Assessment, October 2013

The following table and bar-chart exhibit quantities and relative contributions (%) from life cycle stages of 1m² Radar™ ClimaPlus and Olympia Micro™ ClimaPlus to total Global warming potential (GWP), Stratospheric ozone layer depletion potential (ODP), Acidification potential (AP), Eutrophication potentials (EP), Photochemical ozone creation potential (POCP), Abiotic resource depletion potential – fossil fuels (ADP) for North America according to the method TRACI 2.1 Impact Assessment, October 2013.

| **North American LCA Environmental Impact Results** Method: TRACI 2.1 Impact Assessment, October 2013 | | | PRODUCT STAGE | | |
|---|---|---|---|---|---|
| | | | **A1** | **A2** | **A3** |
| **Parameter** | | **Unit** | Raw material supply | Transport | Manufacturing |
| GWP | Global warming potential | [kg $CO_2$ Eq.] | 7.97E+00 | 2.29E+00 | 6.07E-02 |
| ODP | Stratospheric ozone layer depletion potential | [kg CFC-11 Eq.] | 9.93E-08 | 1.07E-11 | 1.77E-11 |
| AP | Acidification potential | [kg $SO_2$ Eq.] | 7.80E-02 | 5.63E-02 | 1.71E-04 |
| EP | Eutrophication potentials | [kg N Eq.] | 2.16E-03 | 1.98E-03 | 4.28E-05 |
| POCP | Photochemical ozone creation potential | [kg $O_3$ Eq.] | 3.75E-01 | 1.04E+00 | 2.82E-03 |
| ADP | Abiotic resource depletion potential – fossil fuels | [MJ, LHV] | 1.29E+01 | 4.13E+00 | 9.62E+00 |

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## USG ME 1m² RADAR™ CLIMAPLUS & OLYMPIA MICRO™ CLIMAPLUS
## EU and ROW Life Cycle Environmental Impact Results
## Method: CML 4.1 Impact Assessment (per EN 15804:2012 + A1:2013)

The following table and bar-chart exhibit quantities and relative contributions (%) from life cycle stages of 1m² Radar™ ClimaPlus and Olympia Micro™ ClimaPlus to total Global warming potential (GWP), Depletion potential of the stratospheric ozone layer (ODP), Acidification potentials for air emissions (AP Air), Eutrophication potentials (EP), Formation potential of tropospheric ozone (POCP), Abiotic depletion potential for non-fossil resources (ADP elements), Abiotic depletion potential for fossil resources (ADP fossil fuels) for Europe and rest of the world according to the method CML 4.1 Impact Assessment (per EN 15804:2012 + A1:2013).

| **EU and ROW Life Cycle Environmental Impact Results** Method: CML 4.1 Impact Assessment (per EN 15804:2012 + A1:2013) | | | PRODUCT STAGE | | |
|---|---|---|---|---|---|
| | | | **A1** | **A2** | **A3** |
| **Parameter** | | **Unit** | Raw material supply | Transport | Manufacturing |
| GWP | Global warming potential | [kg $CO_2$ Eq.] | 7.97E+00 | 2.29E+00 | 6.07E-02 |
| ODP | Depletion potential of the stratospheric ozone layer | [kg CFC-11 Eq.] | 9.11E-08 | 1.01E-11 | 1.66E-11 |
| AP Air | Acidification potentials for air emissions | [kg $SO_2$ Eq.] | 6.86E-02 | 5.31E-02 | 1.45E-04 |
| EP | Eutrophication potentials | [kg $(PO4)^{3-}$ Eq.] | 4.43E-03 | 5.57E-03 | 3.30E-05 |
| POCP | Formation potential of tropospheric ozone | [kg ethane Eq.] | 4.50E-03 | 2.72E-03 | 1.27E-05 |
| ADP elements | Abiotic depletion potential for non-fossil resources | [kg Sb Eq.] | 6.31E-06 | 8.70E-08 | 5.38E-07 |
| ADP fossil fuels | Abiotic depletion potential for fossil resources | [MJ, LHV] | 1.18E+02 | 2.88E+01 | 6.45E+01 |

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## USG ME 1m² RADAR™ CLIMAPLUS & OLYMPIA MICRO™ CLIMAPLUS
## LCA Results: Resource Use

The following table and bar-chart exhibit quantities and relative contributions (%) from life cycle stages of 1m² Radar™ ClimaPlus and Olympia Micro™ ClimaPlus to total Renewable primary energy as energy carrier (PERE), Renewable primary energy resources as material utilization (PERM), Total use of renewable primary energy resources (PERT), Non-renewable primary energy as energy carrier (PENRE), Non-renewable primary energy as material utilization (PENRM), Total use of non-renewable primary energy resources (PENRT), Use of secondary material (SM), Use of renewable secondary fuels (RSF), Use of non-renewable secondary fuels (NRSF), Use of net fresh water (FW) in resource use.

| **LCA Results: Resource Use** | | | PRODUCT STAGE | | |
|---|---|---|---|---|---|
| | | | **A1** | **A2** | **A3** |
| **Parameter** | | **Unit** | Raw material supply | Transport | Manufacturing |
| PERE | Renewable primary energy as energy carrier | [MJ, LHV] | 2.03E+01 | 4.94E-01 | 2.28E-01 |
| PERM | Renewable primary energy resources as material utilization | [MJ, LHV] | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| PERT | Total use of renewable primary energy resources | [MJ, LHV] | 2.03E+01 | 4.94E-01 | 2.28E-01 |
| PENRE | Non-renewable primary energy as energy carrier | [MJ, LHV] | 1.27E+02 | 2.89E+01 | 6.47E+01 |
| PENRM | Non-renewable primary energy as material utilization | [MJ, LHV] | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| PENRT | Total use of non-renewable primary energy resources | [MJ, LHV] | 1.27E+02 | 2.89E+01 | 6.47E+01 |
| SM | Use of secondary material | [MJ, LHV] | 3.20E-01 | 0.00E+00 | 0.00E+00 |
| RSF | Use of renewable secondary fuels | [MJ, LHV] | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| NRSF | Use of non-renewable secondary fuels | [MJ, LHV] | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| FW | Use of net fresh water | [m³] | 3.50E+03 | 9.99E+01 | 1.69E+02 |
| Caption | PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water | | | | |

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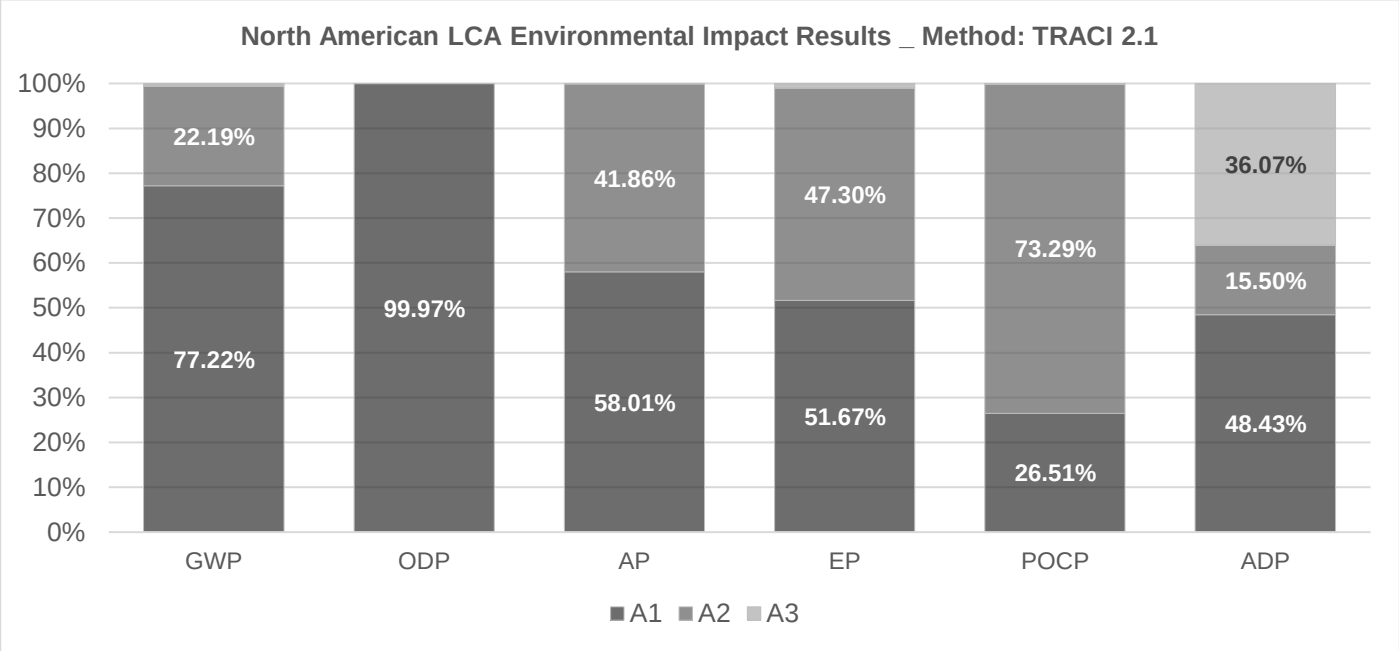
## USG ME 1m² RADAR™ CLIMAPLUS & OLYMPIA MICRO™ CLIMAPLUS
## LCA Results: Output Flows and Waste Categories

Table and bar-chart in the figure below exhibit quantities and relative contributions (%) from varying LCI stages of 1m² Radar™ ClimaPlus and Olympia Micro™ ClimaPlus to total Hazardous waste disposed (HWD), Non-hazardous waste disposed (NHWD), Radioactive waste disposed (RWD), Components for re-use (CRU), Materials for recycling (MFR), Materials for energy recovery (MER), Exported energy (EE) in output flows and waste.

| **LCA Results: Output Flows and Waste Categories** | | | PRODUCT STAGE | | |
|---|---|---|---|---|---|
| | | | **A1** | **A2** | **A3** |
| **Parameter** | | **Unit** | Raw material supply | Transport | Manufacturing |
| HWD | Hazardous waste disposed | [kg] | 6.09E-07 | 5.85E-07 | 2.40E-09 |
| NHWD | Non-hazardous waste disposed | [kg] | 2.92E-01 | 7.74E-04 | 3.24E-03 |
| RWD | Radioactive waste disposed | [kg] | 2.71E-03 | 4.24E-05 | 8.55E-05 |
| CRU | Components for re-use | [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MFR | Materials for recycling | [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MER | Materials for energy recovery | [kg] | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| EE | Exported energy | [MJ, LHV] | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Caption | HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EE = Exported energy | | | | |

## 5. LCA: Interpretation




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

- A1 Module has a very high share in GWP with 77%, following that A2 Module has 22% share in GWP. In Module A1, 45% of GWP is caused by mineral wool and 43% of GWP is caused by coating. To reduce GWP, the amount of mineral wool may be reduced in case product quality is not affected. In addition, more sustainable transport strategies may be planned to reduce GWP.
- Almost all ODP is caused by Module A1. The majority of AP and EP are caused by Module A1 followed by Module A2. POCP is mostly caused by Module A2 and then by Module A1. Since these impacts are very low as against GWP, it is more logical to develop scenarios for decreasing GWP, and accordingly ODP, AP, EP, POCP will already have decreased by GWP scenarios.
- Module A1, Module A3 and Module A2 are the cause of ADP with 48.5%, 36% and 15.5%, respectively. In addition to the strategies that is suggested to reduce GWP, renewable energy sources may be preferred in production to reduce ADP in Module A3.

**Sensitivity Analysis**

When the LCA results are evaluated, it is determined that the suggested strategies to reduce GWP will already have reduced the other impacts. For this reason, considering the fact that GWP is an impact category that should be evaluated as a priority, sensitivity analysis is conducted in order to reduce GWP. Mineral wool and coating used as raw materials are the major sources of GWP. Reducing both mineral wool and coating by 15% (each), decreases the GWP of 1 $m^2$ of product by 10.2%.

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**Acoustical Ceiling Panels**

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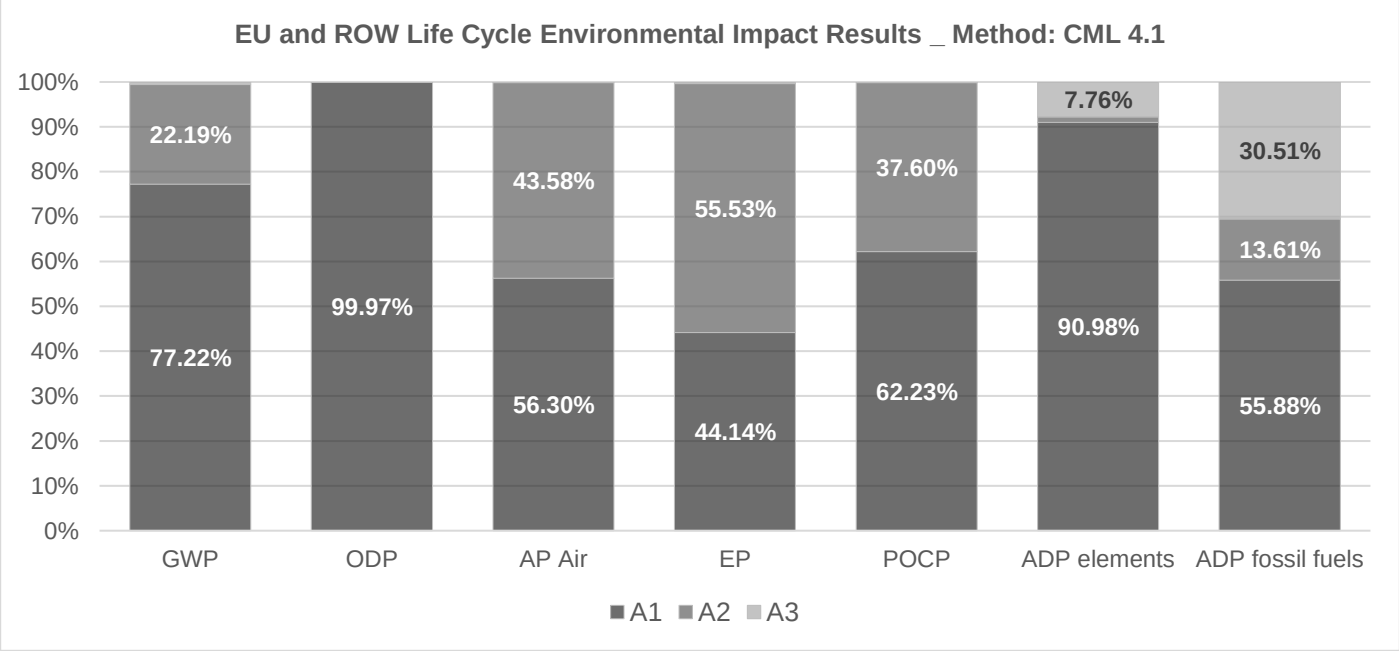


Analysis on relative contribution (%) from each impact category indicates that:

- GWP has a very high share in A1 Module with 77% ratio, following that GWP has 22% share in A2 Module. In Module A1, 46% of GWP is caused by mineral wool and 39% of GWP is caused by coating. To reduce GWP, the amount of mineral wool and coating may be reduced if it does not affect the product quality. In addition, more sustainable transport strategies may be planned to reduce GWP.
- Almost all ODP is caused by Module A1. The majority of AP Air and POCP are caused by Module A1 followed by Module A2. The majority of EP is caused by Module A2 followed by Module A1. Since these impacts are very low as against GWP, it is more logical to develop scenarios for decreasing GWP, and accordingly ODP, AP Air, EP, POCP will already have decreased by GWP scenarios.
- ADP elements are mostly caused by Module A1 with 91% and Module A3 with 8%. Besides, Module A1, Module A3 and Module A2 are the sources of ADP fossil fuels with 56%, 30.5% and 13.5%. In addition to the strategies that is suggested to reduce GWP, renewable energy sources may be preferred in production to reduce ADP elements and ADP fossil fuels in Module A3.

**Sensitivity Analysis**

When the LCA results are evaluated, it is determined that the suggested strategies to reduce GWP will already have reduced the other impacts. For this reason, considering the fact that GWP is an impact category that should be evaluated as a priority, sensitivity analysis is conducted in order to reduce GWP. Mineral wool and coating used as raw materials are the major sources of GWP. Reducing both mineral wool and coating by 15% (each), decreases the GWP of 1 $m^2$ of product by 9.9%.

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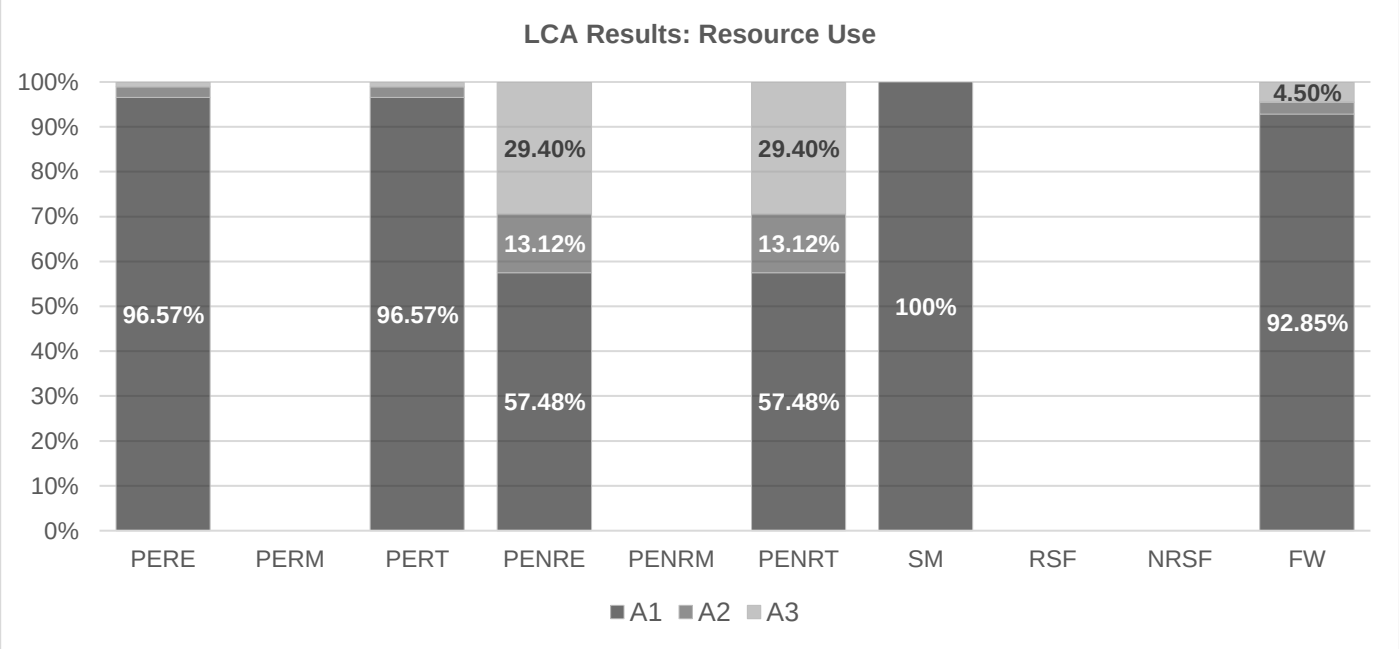


Analysis on relative contribution (%) from each impact category indicates that:

- Although PERE is consumed low as against PENRE, almost all PERE is consumed in Module A1. Besides, PENRE is consumed 57.5%, 29.5%, 13% in Module A1, Module A3, Module A2, respectively. Since PERM and PENRM are not consumed PERT and PENRT are identical to PERE and PENRE.
- The waste paper used as raw material which is considered under Module A1 is the only secondary material in the study.
- Module A1 has the highest share in FW with 93%, followed by Module A3 with 4.5%.

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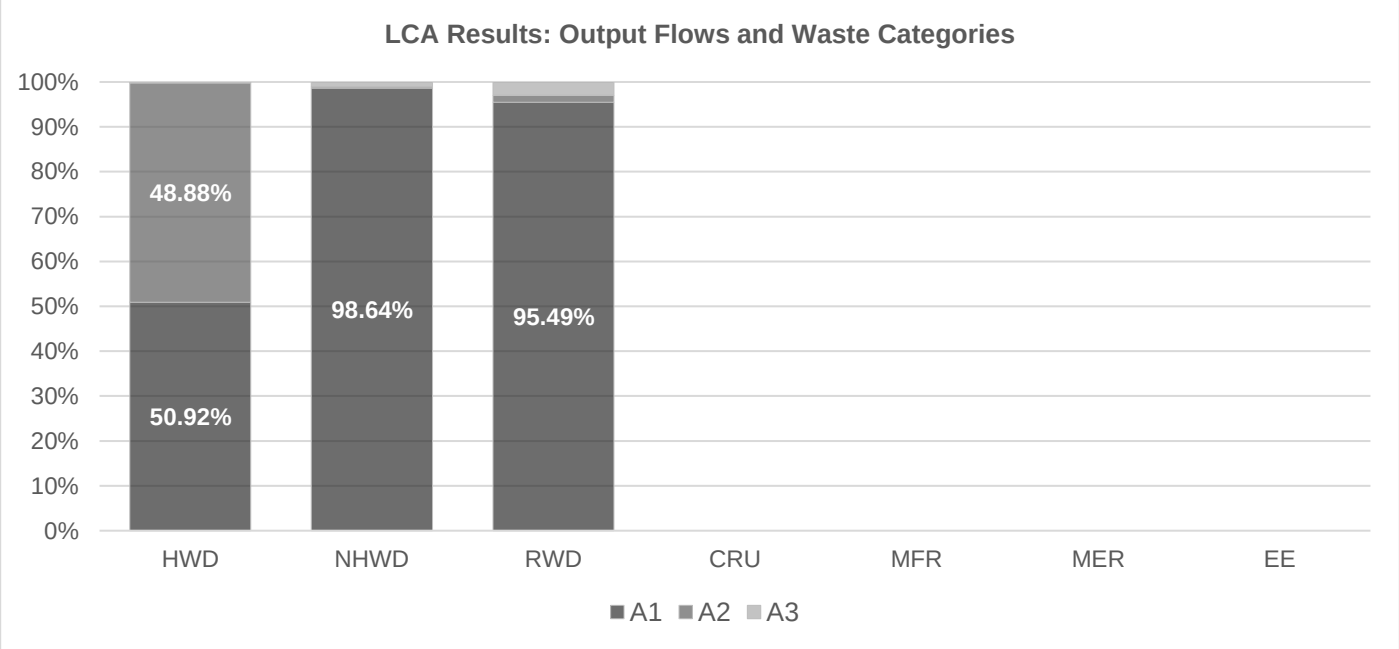


Analysis on relative contribution (%) from each impact category indicates that:

- Module A1 and Module A2 respectively cause 51% and 49% of HWD while almost all of NHWD and RWD are caused by Module A1.

## 6. References

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# ENVIRONMENTAL PRODUCT DECLARATION

**USG ME**
**Radar™ ClimaPlus & Olympia Micro™ ClimaPlus**
**Acoustical Ceiling Panels**

According to ISO 14025


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