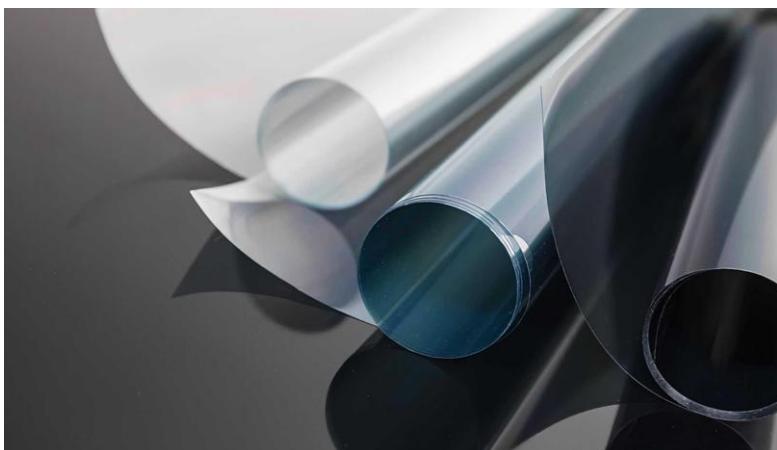




# ENVIRONMENTAL PRODUCT DECLARATION

## IN ACCORDANCE WITH EN 15804+A2 & ISO 14025/ ISO 21930

Heat-shielding window film, ahead film  
ahead Co., Ltd



### EPD HUB, HUB-4885

Published on 23.01.2026, last updated on 23.01.2026, valid until 22.01.2031

Life Cycle Assessment study has been performed in accordance with the requirements of EN 15804, EPD Hub PCR version 1.2 (24 Mar 2025) and JRC characterization factors EF 3.1.



Created with One Click LCA

**ahead**

# 一般情報 - GENERAL INFORMATION

## メーカー

### MANUFACTURER

|                           |   |
|---------------------------|---|
| メーカー名<br>Manufacturer     | ahead Co., Ltd  |
| 住所<br>Address             | Tokyo Myrtle Court Kojimachi #1306, 3-9-11, Kudanminami, Chiyoda-ku, Tokyo, 102-0074, Japan |
| 問い合わせ先<br>Contact details | tada@aheadfilm.com  |
| ウェブサイト<br>Website         | <a href="https://aheadfilm.com/company/">https://aheadfilm.com/company/</a>                 |

This EPD is intended for business-to-business and/or business-to-consumer communication. The manufacturer has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programs may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804 and if they are not compared in a building context.

## EPD 規格、スコープ、認証機関

### EPD STANDARDS, SCOPE AND VERIFICATION

|                                |  |
|--------------------------------|--|
| プログラムオペレータ<br>Program operator | EPD Hub, hub@epdhub.com  |
| 参照規格<br>Reference standard     | EN 15804:2012+A2:2019/AC:2021 and ISO 14025  |
| PCR<br>PCR                     | EPD Hub Core PCR Version 1.2, 24 Mar 2025  |
| 製品カテゴリ<br>Sector               | Construction product   |
| EPD カテゴリ<br>Category of EPD    | Design phase EPD   |
| 親 EPD 番号<br>Parent EPD number  | -  |
| EPD のスコープ<br>Scope of the EPD  | Cradle to gate with modules C1-C4, D   |
| EPD 申請者<br>EPD author          | Yasuhiko Tada  |
| EPD 検証<br>EPD verification     | Independent verification of this EPD and data, according to ISO 14025:<br><input type="checkbox"/> Internal verification <input checked="" type="checkbox"/> External verification |
| EPD 検証<br>EPD verifier         | Vera Durão, as an authorised verifier acting for EPD Hub Limited   |

**製品 - PRODUCT**

|   |   |
|---|---|
| 製品名<br>Product name   | Heat-shielding window film,<br>ahead film |
| 追加ラベル<br>Additional labels                                      | -   |
| 参照製品<br>Product reference                                       | AS-87C, AS-80C                            |
| 原材料の原産地<br>Place(s) of raw material origin                      | South Korea                               |
| 製造地<br>Place of production                                      | Goyong-si, Gyeonggi-do, South Korea       |
| 設置場所および使用場所<br>Place(s) of installation and use                 | Japan                                     |
| データ取得年<br>Period for data                                       | 2024/01-2024/12                           |
| EPD 平均化<br>Averaging in EPD                                     | Multiple products                         |
| A1-A3 の GWP-fossil 変動率<br>Variation in GWP-fossil for A1-A3 (%) | ±0.92                                     |
| 国際貿易商品番号<br>Global Trade Item Number (GTIN)                     | -   |
| ノルウェー建築製品データベース<br>Norwegian Building Product Database (NOBB)   | -   |
| A1-A3 特定データ (%)<br>A1-A3 Specific data (%)                      | 16.2                                      |

**環境影響データ概要 - ENVIRONMENTAL DATA SUMMARY**

|  |                 |
|--|-----------------|
| 宣言単位<br>Declared unit                            | 1m <sup>2</sup> |
| 宣言単位あたりの質量<br>Declared unit mass                 | 0.0732 kg       |
| 包装の質量<br>Mass of packaging                       | 0.0515 kg       |
| GWP-fossil, A1-A3 (kgCO2e)                       | 1.15            |
| GWP-fossil, A1-A3 (kgCO2e)                       | 1.15            |
| GWP-total, A1-A3 (kgCO2e)                        | 1.15            |
| GWP-total, A1-A3 (kgCO2e)                        | 1.15            |
| 副資材の投入(%)<br>Secondary material, inputs (%)      | 4.53            |
| 副資材のアウトプット(%)<br>Secondary material, outputs (%) | 0               |
| エネルギー使用量計, A1-A3 (kWh)                           | 4.3             |
| Total energy use, A1-A3 (kWh)                    | 0.01            |
| 水使用量計, A1-A3 (m <sup>3</sup> )                   | 0.01            |
| Net fresh water use, A1-A3 (m <sup>3</sup> )     |                 |

## 製品とメーカー -PRODUCT AND MANUFACTURER

### メーカーの概要 - ABOUT THE MANUFACTURER

Ahead was founded as a heat-shielding expert company to solve problems related to climate change. Recent extreme heat is causing increased air conditioning usage, rising electricity costs, CO2 emissions, and stressful work environments with significant negative impacts on many companies and individuals.

We offer a lineup of various heat-shielding products, including high-performance window films that are applied to the inside of windows. These solutions meet our customers heat-shielding needs and SDGs-oriented management needs.

We actively pursue data analysis essential for future SDGs-oriented management, including various experiments by third-party organizations and measurement of heat-shielding effects through product combinations. Our approach also includes simulation analyses and measurement of environmental impact.

### 製品説明 - PRODUCT DESCRIPTION

Ahead Film is a high-performance window film that thoroughly blocks heat and ultraviolet rays while remaining transparent.

In addition to its outstanding heat-shielding performance through infrared (IR) blocking, it achieves a 0.0% transmission rate across the entire ultraviolet (UV) wavelength range, including UV-A. By blocking infrared rays over a wide range, everyone can feel the heat-shielding effect, suppress excessive indoor temperature increases, and reduce the operational load on air conditioning equipment.

Furthermore, by preventing even 1% of ultraviolet rays from penetrating, it protects interior furnishings and flooring materials from deterioration and protects skin from UV damage. It is a window film that creates a bright and comfortable space by thoroughly blocking ultraviolet and infrared rays while allowing only visible light to pass through.

The product is tested using the methods described below. The main technical characteristics evaluated include Ultraviolet Transmission, Visible Light Transmission, and TSER (Total Solar Energy Rejected). The testing procedures are based on JIS A 5759:2016 Adhesive films for glazings, the Japanese Industrial Standard for architectural window films. For TSER, the measurements follow the KS L 2016 and ISO 9050 standards.

| Technical Datasheet<br>applied to a clear 3 mm glass |                           | ahead<br>AS-87C | ahead<br>AS-80C |
|--|---------------------------|-----------------|-----------------|
| Ultraviolet Transmission (300-380) (%)               |                           | 0               | 0               |
| Ultraviolet Transmission (300-UVA 400) (%)           |                           | 0               | 0               |
| Visible Light Transmission(%)                        |                           | 88.1            | 81.3            |
| Infra-red Rays Transmission(%)                       |                           | 17.1            | 9.2             |
| TSER : Total solar energy rejected                   |                           | 30.5            | 45.8            |
| SOLAR RATIO  | Solar Energy Reflection   | 9.3             | 8.2             |
|  | Solar Energy Absorption   | 28.2            | 52.2            |
|  | Solar Energy Transmission | 62.5            | 39.6            |
| Shading coefficient                                  |                           | 0.83            | 0.66            |
| heat transfer coefficient                            |                           | 5.9             | 6               |
| Solar heat gain coefficient / Shading Coefficient    |                           | 0.72            | 0.57            |
| PRODUCT SPEC   | Thickness (μm)            | 50              | 50              |

Further information can be found at:  
<https://aheadfilm.com/company/>

### 主な原材料構成 - PRODUCT RAW MATERIAL MAIN COMPOSITION

| 原材料カテゴリ<br>Raw material category | 量、質量 - %<br>Amount, mass- % | 原材料源<br>Material origin |
|----------------------------------|-----------------------------|-------------------------|
| 金属<br>Metals                     | 0                           | -                       |
| 鉱物<br>Minerals                   | 0                           | -                       |
| 化石原料<br>Fossil materials         | 100                         | South Korea             |
| バイオマス原料<br>Bio-based materials   | 0                           | -                       |

#### 生物起源 CO2 含有量 - BIOGENIC CARBON CONTENT

Product's biogenic carbon content at the factory gate

|  |        |
|--|--------|
| 製品の生物起源 CO2 含有量、kg C<br>Biogenic carbon content in product, kg C   | 0      |
| 梱包の生物起源 CO2 含有量、kg C<br>Biogenic carbon content in packaging, kg C | 0.0136 |

#### 機能単位と耐用年数 - FUNCTIONAL UNIT AND SERVICE LIFE

|                                      |                 |
|--------------------------------------|-----------------|
| 宣言単位<br>Declared unit                | 1m <sup>2</sup> |
| 宣言単位あたりの質量<br>Mass per declared unit | 0,0732 kg       |
| 機能単位<br>Functional unit              | -               |
| 参照耐用年数<br>Reference service life     | -               |

#### 化学物質、REACH 高懸念物質 - SUBSTANCES, REACH - VERY HIGH CONCERN

The product does not contain any REACH SVHC substances in amounts greater than 0,1 % (1000 ppm).

# 製品のライフサイクル - PRODUCT LIFE-CYCLE

## システム境界 - SYSTEM BOUNDARY

This EPD covers the life-cycle modules listed in the following table.

| Product stage |           |               | Assembly stage |          | Use stage |             |        |             |               |                        |                       | End of life stage |           |                  |          | Beyond the system boundaries |          |           |
|---------------|-----------|---------------|----------------|----------|-----------|-------------|--------|-------------|---------------|------------------------|-----------------------|-------------------|-----------|------------------|----------|------------------------------|----------|-----------|
| A1            | A2        | A3            | A4             | A5       | B1        | B2          | B3     | B4          | B5            | B6                     | B7                    | C1                | C2        | C3               | C4       | D                            |          |           |
| x             | x         | x             | ND             | ND       | ND        | ND          | ND     | ND          | ND            | ND                     | ND                    | x                 | x         | x                | x        | x                            |          |           |
| Raw materials | Transport | Manufacturing | Transport      | Assembly | Use       | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | Deconstr./demol.  | Transport | Waste processing | Disposal | Reuse                        | Recovery | Recycling |

Not declared = ND.

## 製造と梱包 - MANUFACTURING AND PACKAGING (A1-A3)

The environmental impacts considered for the product stage cover the manufacturing of raw materials used in the production as well as packaging materials and other ancillary materials. Also, fuels used by machines, and handling of waste formed in the production processes at the manufacturing facilities are included in this stage. The study also considers the material losses occurring during the manufacturing processes as well as losses during electricity transmission.

A market-based approach is used in modelling the electricity mix utilized in the factory.

This product consists of a PET base material laminated with a UV-cutting PET material using urethane adhesive, with a hard-coat surface treatment. The glass-adhering surface has adhesive applied and is layered with a liner film (separator) to cover the adhesive surface.

All materials, including the PET materials, are sourced entirely within South Korea and transported to the factory via truck. The main manufacturing process includes applying a hard-coat layer to the surface-side PET substrate and urethane adhesion with the UV-cutting PET material. The process continues with application of transparent adhesive and lamination with the liner film, and finally roll winding to complete the product.

The manufacturing process requires electricity, heat, and water for operating each piece of equipment. In addition to the PET substrate as the main material, the product also contains adhesives, liner films, and other components. The final rolled products are packaged in cardboard boxes for shipping.

In this calculation, manufacturing losses and VOC emissions during the manufacturing process are included. Of the manufacturing losses, PET waste is disposed of by landfill. Ancillary materials are incinerated with energy recovery and subsequently landfilled. The transport distances of manufacturing waste to the designated waste treatment facilities are determined based on measured data.

## 輸送と据付 - TRANSPORT AND INSTALLATION (A4-A5)

This EPD excludes the A4-A5 stage and all the packaging wastes are considered in the EOL stage.

## 製品使用とメンテナンス - PRODUCT USE AND MAINTENANCE (B1-B7)

This EPD excludes the use stage.

### 製品の廃棄・リサイクル段階 - PRODUCT END OF LIFE (C1-C4, D)

In this EPD, end-of-life scenarios are developed for each material categories. Deconstruction (C1) is a manual process. As a consequence, no inputs were modelled in this step and transportation distance and method to the treatment facility (C2) is assumed to be 50km by a truck in all scenarios.

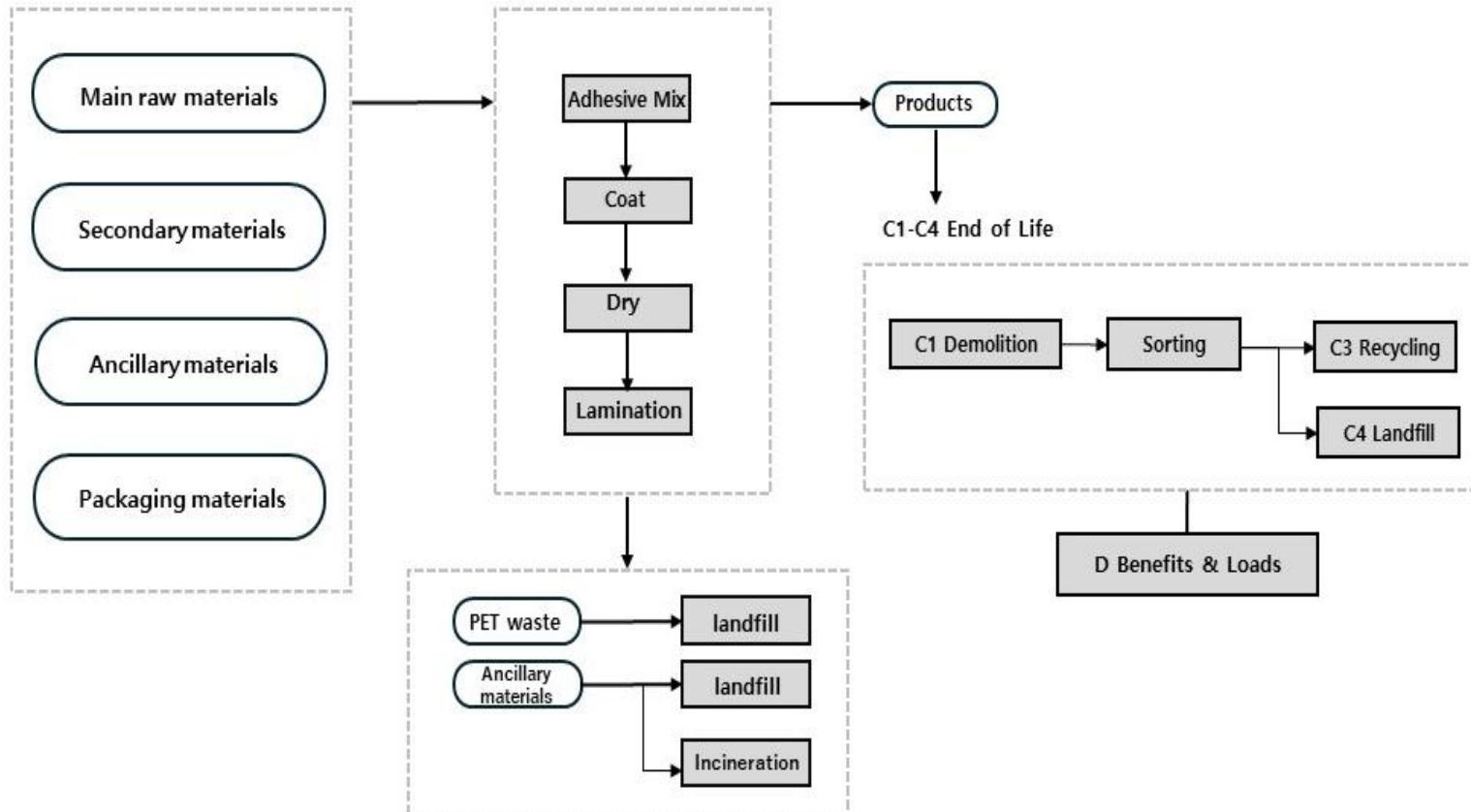
#### Window film:

The heat-shielding film remains attached to the window and is manually removed together with the window during dismantling. Since both the window glass and the film are disposed of 100% in landfill, the film is also assumed to be landfilled entirely.

## 製造プロセス - SYSTEM DIAGRAM

### Life Cycle Flow Diagram \_ Architectural window film

A1\_Procurement of raw materials    A2\_Transport    A3\_Production stage



# ライフサイクルアセスメント .

## - LIFE-CYCLE ASSESSMENT

### カットオフ基準 - CUT-OFF CRITERIA

The study does not exclude any modules or processes which are stated mandatory in the reference standard and the applied PCR. The study does not exclude any hazardous materials or substances. The study includes all major raw material and energy consumption. All inputs and outputs of the unit processes, for which data is available for, are included in the calculation. There is no neglected unit process more than 1% of total mass or energy flows. The module specific total neglected input and output flows also do not exceed 5% of energy usage or mass.

The production of capital equipment, construction activities, and infrastructure, maintenance and operation of capital equipment, personnel-related activities, energy and water use related to company management and sales activities are excluded.

### データの検証- VALIDATION OF DATA

Data collection for production, transport, and packaging was conducted using time and site-specific information, as defined in the general information section on page 1 and 2. Upstream process calculations rely on generic data as defined in the Bibliography section. Manufacturer-provided specific and generic data were used for the product's manufacturing stage. The analysis was performed in One Click LCA EPD Generator, with the 'Cut-Off, EN 15804+A2' allocation method, and characterization factors according to EN 15804:2012+A2:2019/AC:2021 and JRC EF 3.1.

### 配分、推定 - ALLOCATION, ESTIMATES AND ASSUMPTIONS

Allocation is required if some material, energy, and waste data cannot be measured separately for the product under investigation. All allocations are done as per the reference standards and the applied PCR. In this study, allocation has been done in the following ways:

| データタイプ - Data type                              | 配分 - Allocation             |
|---|-----------------------------|
| 原材料 - Raw materials                             | No allocation               |
| 梱包材 - Packaging materials                       | No allocation               |
| 補助材料 - Ancillary materials                      | Allocated by mass or volume |
| 製造エネルギーと廃棄物<br>- Manufacturing energy and waste | Allocated by mass or volume |

### 製品と製造拠点のグループ化 - PRODUCT & MANUFACTURING SITES GROUPING

|  |                                   |
|--|-----------------------------------|
| グループ化の種類 - Type of grouping  | Multiple products                 |
| グループ化方法 - Grouping method  | Based on a representative product |
| A1-A3 における GWP-fossil の変動率 - Variation in GWP-fossil for A1-A3 (%) | ±1.77                             |

This EPD covers two products, 87C and 80C. These two types of products are manufactured at the same production site, undergo the same manufacturing process.

87C is an extremely transparent film with high visible light transmittance, while blocking 100% of UV rays and up to 99% of infrared rays. 80C is a

product designed to provide higher shading performance by having lower transparency than 87C. It also achieves an ultraviolet transmission of 0.0%, the same as 87C.

This EPD declares the LCA data for 87C, which is the flagship product of ahead film, as the representative product.

#### **LCA ソフトウェアと参考文献 - LCA SOFTWARE AND BIBLIOGRAPHY**

This EPD has been created using One Click LCA EPD Generator for EPD Hub V3 and EPD Process Certification v3.2.3. The LCA and EPD have been prepared according to the reference standards and ISO 14040/14044. Ecoinvent v3.10.1 and One Click LCA databases were used as sources of environmental data. Allocation used in Ecoinvent 3.10.1 environmental data sources follow the methodology 'allocation, Cut-off, EN 15804+A2'.

## 環境影響データ - ENVIRONMENTAL IMPACT DATA

The estimated impact results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks.

### 主要環境影響指標 - CORE ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, EF 3.1

| Impact category                     | Unit                   | A1       | A2       | A3       | A1-A3    | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1       | C2       | C3       | C4        | D        |
|-------------------------------------|------------------------|----------|----------|----------|----------|----|----|----|----|----|----|----|----|----|----------|----------|----------|-----------|----------|
| GWP – total <sup>1)</sup>           | kg CO <sub>2</sub> e   | 7.92E-01 | 2.14E-02 | 3.35E-01 | 1.15E+00 | ND | 0.00E+00 | 5.71E-04 | 0.00E+00 | 6.01E-03  | 0.00E+00 |
| GWP – fossil                        | kg CO <sub>2</sub> e   | 7.90E-01 | 2.14E-02 | 3.34E-01 | 1.15E+00 | ND | 0.00E+00 | 5.70E-04 | 0.00E+00 | 6.83E-03  | 0.00E+00 |
| GWP – biogenic                      | kg CO <sub>2</sub> e   | 8.18E-04 | 0.00E+00 | 0.00E+00 | 8.18E-04 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | -8.18E-04 | 0.00E+00 |
| GWP – LULUC                         | kg CO <sub>2</sub> e   | 8.55E-04 | 1.15E-05 | 6.65E-04 | 1.53E-03 | ND | 0.00E+00 | 2.61E-07 | 0.00E+00 | 5.62E-07  | 0.00E+00 |
| Ozone depletion pot.                | kg CFC-11e             | 1.80E-06 | 2.99E-10 | 1.03E-08 | 1.81E-06 | ND | 0.00E+00 | 8.31E-12 | 0.00E+00 | 2.13E-11  | 0.00E+00 |
| Acidification potential             | mol H <sup>+</sup> e   | 3.51E-03 | 8.85E-05 | 1.53E-03 | 5.12E-03 | ND | 0.00E+00 | 2.59E-06 | 0.00E+00 | 6.20E-06  | 0.00E+00 |
| EP-freshwater <sup>2)</sup>         | kg Pe                  | 1.87E-04 | 1.96E-06 | 6.98E-05 | 2.59E-04 | ND | 0.00E+00 | 4.54E-08 | 0.00E+00 | 9.16E-08  | 0.00E+00 |
| EP-marine                           | kg Ne                  | 6.33E-04 | 2.02E-05 | 4.54E-04 | 1.11E-03 | ND | 0.00E+00 | 9.73E-07 | 0.00E+00 | 1.54E-04  | 0.00E+00 |
| EP-terrestrial                      | mol Ne                 | 6.58E-03 | 2.22E-04 | 2.86E-03 | 9.67E-03 | ND | 0.00E+00 | 1.06E-05 | 0.00E+00 | 2.48E-05  | 0.00E+00 |
| POCP ("smog") <sup>3)</sup>         | kg NMVOCe              | 3.12E-03 | 9.05E-05 | 1.11E-02 | 1.44E-02 | ND | 0.00E+00 | 3.66E-06 | 0.00E+00 | 9.90E-06  | 0.00E+00 |
| ADP-minerals & metals <sup>4)</sup> | kg Sbe                 | 8.19E-06 | 8.89E-08 | 7.40E-07 | 9.02E-06 | ND | 0.00E+00 | 1.83E-09 | 0.00E+00 | 1.87E-09  | 0.00E+00 |
| ADP-fossil resources                | MJ                     | 1.54E+01 | 2.90E-01 | 5.10E+00 | 2.08E+01 | ND | 0.00E+00 | 8.13E-03 | 0.00E+00 | 1.84E-02  | 0.00E+00 |
| Water use <sup>5)</sup>             | m <sup>3</sup> e depr. | 2.49E-01 | 1.47E-03 | 1.29E+00 | 1.54E+00 | ND | 0.00E+00 | 3.91E-05 | 0.00E+00 | 9.43E-05  | 0.00E+00 |

1) GWP = Global Warming Potential; 2) EP = Eutrophication potential. Required characterisation method and data are in kg P-eq. Multiply by 3,07 to get PO4e; 3) POCP = Photochemical ozone formation; 4) ADP = Abiotic depletion potential;

5) EN 15804+A2 disclaimer for Abiotic depletion and Water use and optional indicators except Particulate matter and Ionizing radiation, human health. The results of these environmental impact indicators shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

### 追加(オプション)の環境影響指標 - ADDITIONAL (OPTIONAL) ENVIRONMENTAL IMPACT INDICATORS – EN 15804+A2, EF 3.1

| Impact category                  | Unit      | A1       | A2       | A3       | A1-A3    | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1       | C2       | C3       | C4       | D        |
|----------------------------------|-----------|----------|----------|----------|----------|----|----|----|----|----|----|----|----|----|----------|----------|----------|----------|----------|
| Particulate matter               | Incidence | 3.77E-08 | 1.15E-09 | 1.32E-08 | 5.20E-08 | ND | 0.00E+00 | 5.48E-11 | 0.00E+00 | 1.34E-10 | 0.00E+00 |
| Ionizing radiation <sup>6)</sup> | kBq U235e | 3.66E-02 | 2.68E-04 | 1.14E-02 | 4.82E-02 | ND | 0.00E+00 | 6.93E-06 | 0.00E+00 | 1.97E-05 | 0.00E+00 |
| Ecotoxicity (freshwater)         | CTUe      | 1.23E+01 | 1.02E-01 | 1.40E+00 | 1.38E+01 | ND | 0.00E+00 | 1.28E-03 | 0.00E+00 | 2.54E-01 | 0.00E+00 |
| Human toxicity, cancer           | CTUh      | 6.61E-10 | 3.84E-12 | 6.24E-11 | 7.27E-10 | ND | 0.00E+00 | 1.40E-13 | 0.00E+00 | 8.14E-13 | 0.00E+00 |
| Human tox. non-cancer            | CTUh      | 9.20E-09 | 1.69E-10 | 4.27E-09 | 1.36E-08 | ND | 0.00E+00 | 5.61E-12 | 0.00E+00 | 1.64E-10 | 0.00E+00 |
| SQP <sup>7)</sup>                | -         | 2.23E+00 | 1.16E-01 | 4.64E+00 | 6.99E+00 | ND | 0.00E+00 | 6.08E-03 | 0.00E+00 | 4.25E-02 | 0.00E+00 |

6) EN 15804+A2 disclaimer for Ionizing radiation, human health. This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator; 7) SQP = Land use related impacts/soil quality.

### 天然資源の利用 - USE OF NATURAL RESOURCES

| Impact category                    | Unit           | A1       | A2       | A3       | A1-A3    | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1       | C2       | C3       | C4        | D        |
|------------------------------------|----------------|----------|----------|----------|----------|----|----|----|----|----|----|----|----|----|----------|----------|----------|-----------|----------|
| Renew. PER as energy <sup>8)</sup> | MJ             | 6.51E-01 | 4.93E-03 | 6.24E-01 | 1.28E+00 | ND | 0.00E+00 | 1.15E-04 | 0.00E+00 | 3.05E-04  | 0.00E+00 |
| Renew. PER as material             | MJ             | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  | 0.00E+00 |
| Total use of renew. PER            | MJ             | 6.51E-01 | 4.93E-03 | 6.24E-01 | 1.28E+00 | ND | 0.00E+00 | 1.15E-04 | 0.00E+00 | 3.05E-04  | 0.00E+00 |
| Non-re. PER as energy              | MJ             | 1.14E+01 | 2.90E-01 | 2.50E+00 | 1.42E+01 | ND | 0.00E+00 | 8.13E-03 | 0.00E+00 | -2.64E+00 | 0.00E+00 |
| Non-re. PER as material            | MJ             | 3.99E+00 | 0.00E+00 | 0.00E+00 | 3.99E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | -3.99E+00 | 0.00E+00 |
| Total use of non-re. PER           | MJ             | 1.54E+01 | 2.90E-01 | 2.50E+00 | 1.82E+01 | ND | 0.00E+00 | 8.13E-03 | 0.00E+00 | -6.63E+00 | 0.00E+00 |
| Secondary materials                | kg             | 3.31E-03 | 1.53E-04 | 2.32E-03 | 5.79E-03 | ND | 0.00E+00 | 3.63E-06 | 0.00E+00 | 6.61E-06  | 0.00E+00 |
| Renew. secondary fuels             | MJ             | 5.41E-05 | 1.89E-06 | 7.94E-03 | 8.00E-03 | ND | 0.00E+00 | 4.60E-08 | 0.00E+00 | 1.24E-07  | 0.00E+00 |
| Non-ren. secondary fuels           | MJ             | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00  | 0.00E+00 |
| Use of net fresh water             | m <sup>3</sup> | 5.93E-03 | 4.04E-05 | 2.71E-03 | 8.68E-03 | ND | 0.00E+00 | 1.14E-06 | 0.00E+00 | -2.71E-04 | 0.00E+00 |

8) PER = Primary energy resources.

### 廃棄・リサイクル段階 - 廃棄 - END OF LIFE - WASTE

| Impact category     | Unit | A1       | A2       | A3       | A1-A3    | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1       | C2       | C3       | C4       | D        |
|---------------------|------|----------|----------|----------|----------|----|----|----|----|----|----|----|----|----|----------|----------|----------|----------|----------|
| Hazardous waste     | kg   | 4.99E-02 | 6.02E-04 | 1.26E-02 | 6.31E-02 | ND | 0.00E+00 | 1.42E-05 | 0.00E+00 | 3.30E-05 | 0.00E+00 |
| Non-hazardous waste | kg   | 1.40E+00 | 1.16E-02 | 7.92E-01 | 2.21E+00 | ND | 0.00E+00 | 2.67E-04 | 0.00E+00 | 3.64E-01 | 0.00E+00 |
| Radioactive waste   | kg   | 9.21E-06 | 6.57E-08 | 2.73E-06 | 1.20E-05 | ND | 0.00E+00 | 1.70E-09 | 0.00E+00 | 4.82E-09 | 0.00E+00 |

### 廃棄・リサイクル段階 - 出力フロー - END OF LIFE - OUTPUT FLOWS

| Impact category               | Unit | A1       | A2       | A3       | A1-A3    | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1       | C2       | C3       | C4       | D        |
|-------------------------------|------|----------|----------|----------|----------|----|----|----|----|----|----|----|----|----|----------|----------|----------|----------|----------|
| Components for re-use         | kg   | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Materials for recycling       | kg   | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Materials for energy rec      | kg   | 0.00E+00 | 0.00E+00 | 4.30E-05 | 4.30E-05 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Exported energy               | MJ   | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Exported energy - Electricity | MJ   | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Exported energy - Heat        | MJ   | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | ND | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

### 環境影響 - ENVIRONMENTAL IMPACTS – EN 15804+A1, CML

| Impact category      | Unit                               | A1       | A2       | A3       | A1-A3    | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1       | C2       | C3       | C4       | D        |
|----------------------|------------------------------------|----------|----------|----------|----------|----|----|----|----|----|----|----|----|----|----------|----------|----------|----------|----------|
| Global Warming Pot.  | kg CO <sub>2</sub> e               | 7.84E-01 | 2.13E-02 | 3.33E-01 | 1.14E+00 | ND | 0.00E+00 | 5.67E-04 | 0.00E+00 | 6.54E-03 | 0.00E+00 |
| Ozone depletion Pot. | kg CFC-11e                         | 1.45E-06 | 2.39E-10 | 8.87E-09 | 1.46E-06 | ND | 0.00E+00 | 6.63E-12 | 0.00E+00 | 1.70E-11 | 0.00E+00 |
| Acidification        | kg SO <sub>2</sub> e               | 2.91E-03 | 7.14E-05 | 1.27E-03 | 4.26E-03 | ND | 0.00E+00 | 1.92E-06 | 0.00E+00 | 4.59E-06 | 0.00E+00 |
| Eutrophication       | kg PO <sub>4</sub> <sup>3-</sup> e | 8.23E-03 | 1.29E-05 | 2.08E-03 | 1.03E-02 | ND | 0.00E+00 | 4.72E-07 | 0.00E+00 | 7.75E-06 | 0.00E+00 |
| POCP ("smog")        | kg C <sub>2</sub> H <sub>4</sub> e | 2.83E-04 | 5.16E-06 | 8.01E-05 | 3.68E-04 | ND | 0.00E+00 | 1.60E-07 | 0.00E+00 | 1.32E-06 | 0.00E+00 |
| ADP-elements         | kg Sbe                             | 9.62E-06 | 8.65E-08 | 7.25E-07 | 1.04E-05 | ND | 0.00E+00 | 1.78E-09 | 0.00E+00 | 1.82E-09 | 0.00E+00 |
| ADP-fossil           | MJ                                 | 1.48E+01 | 2.86E-01 | 4.94E+00 | 2.00E+01 | ND | 0.00E+00 | 8.02E-03 | 0.00E+00 | 1.81E-02 | 0.00E+00 |

## 環境影響 - ENVIRONMENTAL IMPACTS

| Impact category            | Unit | A1       | A2       | A3       | A1-A3    | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1       | C2       | C3       | C4       | D        |
|----------------------------|------|----------|----------|----------|----------|----|----|----|----|----|----|----|----|----|----------|----------|----------|----------|----------|
| Radioactive waste, high    | kg   | 2.78E-06 | 1.99E-08 | 7.01E-07 | 3.50E-06 | ND | 0.00E+00 | 5.04E-10 | 0.00E+00 | 1.38E-09 | 0.00E+00 |
| Radioactive waste, int/low | kg   | 6.43E-06 | 4.58E-08 | 2.05E-06 | 8.53E-06 | ND | 0.00E+00 | 1.19E-09 | 0.00E+00 | 3.44E-09 | 0.00E+00 |

## 環境影響 - ENVIRONMENTAL IMPACTS – GWP-GHG

| Impact category       | Unit                 | A1       | A2       | A3       | A1-A3    | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1       | C2       | C3       | C4       | D        |
|-----------------------|----------------------|----------|----------|----------|----------|----|----|----|----|----|----|----|----|----|----------|----------|----------|----------|----------|
| GWP-GHG <sup>9)</sup> | kg CO <sub>2</sub> e | 7.91E-01 | 2.14E-02 | 3.35E-01 | 1.15E+00 | ND | 0.00E+00 | 5.71E-04 | 0.00E+00 | 6.83E-03 | 0.00E+00 |

9) This indicator includes all greenhouse gases excluding biogenic carbon dioxide uptake and emissions and biogenic carbon stored in the product. In addition, the characterisation factors for the flows – CH<sub>4</sub> fossil, CH<sub>4</sub> biogenic and Dinitrogen monoxide – were updated in line with the guidance. This indicator is identical to the GWP-total of EN 15804:2012+A2:2019 except that the characterisation factor for biogenic CO<sub>2</sub> is set to zero.

## シナリオドキュメント- SCENARIO DOCUMENTATION

### 製造エネルギー・シナリオドキュメント - Manufacturing energy scenario documentation

| Scenario parameter                       | Value   |
|--|---|
| Electricity data source and quality      | Electricity, consumption mix w/o renewables, South Korea, One Click LCA |
| Electricity CO <sub>2</sub> e / kWh      | 0.97 kg CO <sub>2</sub> e / kWh   |
| District heating data source and quality | -   |
| District heating CO <sub>2</sub> e / kWh | -   |

### 廃棄・リサイクル段階のシナリオドキュメント-End of life scenario documentation

| Scenario information                               | Value                                  |
|--|--|
| Collection process – kg collected separately       | Film: 0.0732kg                         |
| Collection process – kg collected with mixed waste | -                                      |
| Recovery process – kg for re-use                   | -                                      |
| Recovery process – kg for recycling                | -                                      |
| Recovery process – kg for energy recovery          | -                                      |
| Disposal (total) – kg for final deposition         | Film: 0.0732kg                         |
| Scenario assumptions e.g. transportation           | Transported 50 km by lorry to landfill |

### 檢証報告 - THIRD-PARTY VERIFICATION STATEMENT

EPD Hub declares that this EPD is verified in accordance with ISO 14025 by an independent, third-party verifier. The project report on the Life Cycle Assessment and the report(s) on features of environmental relevance are filed at EPD Hub. EPD Hub PCR and ECO Platform verification checklist are used.

EPD Hub is not able to identify any unjustified deviations from the PCR and EN 15804+A2 in the Environmental Product Declaration and its project report.

EPD Hub maintains its independence as a third-party body; it was not involved in the execution of the LCA or in the development of the declaration and has no conflicts of interest regarding this verification.

The company-specific data and upstream and downstream data have been examined as regards plausibility and consistency. The publisher is responsible for ensuring the factual integrity and legal compliance of this declaration.

The software used in creation of this LCA and EPD is verified by EPD Hub to conform to the procedural and methodological requirements outlined in ISO 14025:2010, ISO 14040/14044, EN 15804+A2, and EPD Hub Core Product Category Rules and General Program Instructions.

#### Verified tools

Tool verifier: Magaly Gonzalez Vazquez

Tool verification validity: 27 March 2025 - 26 March 2028

Vera Durão, as an authorised verifier acting for EPD Hub Limited

23.01.2026

