

**Declaration Owner**

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Product

Feltworks Blades Acoustic Ceiling Panels

This EPD represents delivery of product to North American customers

UNSPSC Code 30161601

Functional Unit

The functional unit is one square foot (0.093 m²) of ceiling panel installed and maintained over a 75-year period

EPD Number and Period of Validity

SCS-EPD-08685
EPD Valid February 13, 2023 through February 12, 2028

Product Category Rule

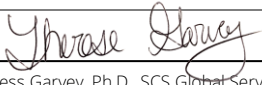
PCR Guidance for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Version 3.2. UL Environment. September 2018

PCR Guidance for Building-Related Products and Services Part B: Non-Metal Ceiling and Interior Wall Panel System EPD Requirements. Version 2.0. April 2021.

Program Operator

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| | |
|--|---|
| Declaration Owner: | Armstrong World Industries |
| Address: | 2500 Columbia Avenue, Lancaster, PA 17603 USA |
| Declaration Number: | SCS-EPD-08685 |
| Declaration Validity Period: | EPD Valid February 13, 2023 through February 12, 2028 |
| Program Operator: | SCS Global Services |
| Declaration URL Link: | https://www.scsglobalservices.com/certified-green-products-guide |
| LCA Practitioner: | Gerard Mansell, SCS Global Services |
| LCA Software: | openLCA v1.10.3 |
| Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071 | <input checked="" type="checkbox"/> internal <input type="checkbox"/> external |
| LCA Reviewer: |  Tess Garvey, Ph.D., SCS Global Services |
| Part A Product Category Rule: | PCR Guidance for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements. Version 3.2. UL Environment. September 2018 |
| Part A PCR Review conducted by: | Lindita Bushi, PhD (Chair); Hugues Imbeault-Tétreault, ing., M.Sc.A.; Jack Geibig |
| Part B Product Category Rule: | PCR Guidance for Building-Related Products and Services Part B: Non-Metal Ceiling and Interior Wall Panel System EPD Requirements. Version 2.0. April 2021 |
| Part B PCR Review conducted by: | Jack Geibig (Chair); Tom Gloria, PhD; and Thaddeus Owen |
| Independent verification of the declaration and data, according to ISO 14025 and the PCR | <input type="checkbox"/> internal <input checked="" type="checkbox"/> external |
| EPD Verifier: |  Thomas Gloria, Ph.D., Industrial Ecology Consultants |
| Declaration Contents: | 1. Armstrong World Industries 2. Product 3. LCA: Calculation Rules 4. LCA: Scenarios and Additional Technical Information 5. LCA: Results 6. LCA: Interpretation 7. Additional Environmental Information 8. References |

Disclaimers: This EPD conforms to ISO 14025, 14040, 14044, and 21930.

Scope of Results Reported: The PCR requirements limit the scope of the LCA metrics such that the results exclude environmental and social performance benchmarks and thresholds, and exclude impacts from the depletion of natural resources, land use ecological impacts, ocean impacts related to greenhouse gas emissions, risks from hazardous wastes and impacts linked to hazardous chemical emissions.

Accuracy of Results: Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy.

Comparability: The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.

In accordance with ISO 21930:2017, EPDs are comparable only if they comply with the core PCR, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

1. Armstrong World Industries

Armstrong World Industries, Inc. (AWI) is a leader in the design and manufacture of innovative commercial and residential ceiling, wall and suspension system solutions in the Americas. At home, at work, in healthcare facilities, classrooms, stores, or restaurants, Armstrong World Industries offers interior solutions that help to enhance comfort, save time, improve building efficiency and overall performance, and create beautiful spaces.

For more than 150 years, we have built our business on trust and integrity. It set us apart then, and it sets us apart now, along with our ability to collaborate with, and innovate for the people we're here to serve – our customers, our shareholders, our communities, and our employees.

We are committed to developing new and sustainable ceiling solutions, with design and performance possibilities that make a positive difference in spaces where we live, work, learn, heal, and play.

2. Product

2.1 PRODUCT DESCRIPTION

The acoustic ceiling panel products (UNSPSC Code 30161601) are manufactured at production facilities in Salt Lake City, UT. The primary material includes a PET felt, containing 50% post-consumer recycled content. Table 1 summarizes the products included in the EPD.

Table 1. *Armstrong Feltworks Blades Acoustic ceiling panel products included in the LCA scope.*

| Description |
|--|
| FELTWORKS™ Blades panels are vertical, acoustical felt panels designed to be suspended from aluminum suspension bars (Item 8230AB). FELTWORKS Blades panels are made from polyester felt (PET) fibers, with color throughout, and finished on all edges and surfaces |

2.2 PRODUCT FLOW DIAGRAM

A flow diagram illustrating the production processes and life cycle phases included in the scope of the EPD is provided below.



2.3 APPLICATION

The Armstrong Feltworks Blades ceiling panel products provide the primary function of sound attenuation and décor for interior applications.

2.4 DECLARATION OF METHODOLOGICAL FRAMEWORK

The scope of the EPD is cradle-to-grave, including raw material extraction and processing, transportation, product manufacture, product delivery, installation and use, and product disposal. The life cycle phases included in the product system boundary are shown below.

Cut-off and allocation procedures are described below and conform to the PCR and ISO standards.

Table 2. Life cycle phases included in the product system boundary.

| Product | | | Construction Process | | Use | | | | | | | End-of-life | | | | Benefits and loads beyond the system boundary |
|--|---------------------------|---------------|----------------------|-----------------------------|-----|-------------|--------|-------------|---------------|------------------------|-----------------------|---------------------------|-----------|------------------|----------|---|
| A1 | A2 | A3 | A4 | A5 | B1 | B1 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
| Raw material extraction and processing | Transport to manufacturer | Manufacturing | Transport | Construction - installation | Use | Maintenance | Repair | Replacement | Refurbishment | Operational energy use | Operational water use | Deconstruction demolition | Transport | Waste processing | Disposal | Reuse, recovery and/or recycling potential |
| X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | MND |

X = Module Included | MND = Module Not Declared

2.5 TECHNICAL DATA

Technical specifications of the products are summarized in Table 3. Additional product performance specifications can be found on the manufacturer's website <https://www.armstrongceilings.com/>.

Table 3. Product performance test results for the Blades acoustic ceiling panel products.

| Test | Value |
|---|-----------------|
| ASTM¹ C423 - Sound Absorption Characteristics | |
| Noise Reduction Coefficient (NCR) | 0.7 |
| ASTM E84 - Surface Burning Characteristics | |
| Flame spread | <25; Class A |
| Smoke developed | <450 |

¹ASTM International. <https://www.astm.org/>

2.6 MARKET PLACEMENT/APPLICATION RULES

The Armstrong Feltworks ceiling panel products are intended to provide sound attenuation and décor for interior applications and are available in a variety of colors and offered in various sizes. All dimensions and squareness are subject to a 2% tolerance. The products have been independently tested and meet the criteria for approved interior finishes as described in the 2015 International Building Code®.

2.7 PROPERTIES OF DECLARED PRODUCT AS DELIVERED

The Armstrong Feltworks acoustic ceiling panel products are delivered in the form of panels ready for installation.

2.8 MATERIAL COMPOSITION

The primary component materials include polyester felt.

Table 4. Product material composition per 1 ft² of *ceiling panel product*.

| Product | PET Felt |
|------------------|-----------------------------|
| Feltworks Blades | 0.174 (kg/ft ²) |

2.9 MANUFACTURING

The acoustic ceiling panel products (UNSPSC Code 30161601) are manufactured at production facilities in Salt Lake City, UT. The primary material includes PET felt, containing 50% post-consumer recycled content.

2.10 PACKAGING

The products are packaged for shipment using wood pallets (0.173 kg/ft² of product).

2.11 PRODUCT INSTALLATION

Installation of the ceiling panel products is accomplished manually using hand tools with no associated impacts. The products are manufacturing and delivered ready for installation with no scrap generated. The impacts associated with packaging disposal are included with the installation phase as per PCR requirements.

2.12 USE CONDITIONS

No special conditions of use are noted.

2.13 REFERENCE SERVICE LIFE

The Reference Service Life (RSL) of the acoustic ceiling panel products is 30 years.

2.14 RE-USE PHASE

The ceiling products are not typically reused at end-of-life.

2.15 DISPOSAL

Assumptions for the product and packaging end-of-life are based on regional statistics regarding municipal solid waste generation and disposal, including end-of-life recycling rates of packaging materials. Material recycling rates are based on the US EPA's disposal statistics for municipal solid waste (MSW) for 2018. For disposal of materials which are not recycled, it is assumed that 20% are incinerated and 80% go to a landfill. Transportation of waste materials at end of life assumes a 35 km average distance to disposal, consistent with PCR guidance.

2.16 FURTHER INFORMATION

Further information on the product can be found on the manufacturers' website at <https://www.armstrongceilings.com/>

3. LCA: Calculation Rules

3.1 FUNCTIONAL UNIT

The functional unit used in the study is defined as 1 ft² (0.093 m²) of ceiling panel installed for use over a 75-year period. Following PCR guidance, the reference service lifetime of the products is assumed to be 30 years. There are no impacts from the use and maintenance of the products. A total of 1.5 product replacements are required over the building service lifetime. The reference flows and functional unit for the product system are summarized below.

Table 6. Functional unit and reference flow for the Feltworks Blades ceiling panel products.

| Functional Unit | Reference flow (kg) | Nominal Thickness (cm) | Surface weight (kg/ft ²) | Reference Service Life – RSL (years) | # of Product replacements (Replacement cycle) |
|--|---------------------|------------------------|--------------------------------------|--------------------------------------|---|
| 0.093 m ² (1 ft ²) installed product for 75 years | 0.174 | 9.5 (3/8") | 0.174 | 30 | 1.5 |

3.2 SYSTEM BOUNDARY

The scope of the EPD is cradle-to-grave, including raw material extraction and processing, transportation, product manufacture, product delivery, installation and use, and product disposal. The life cycle phases included in the EPD scope are described in Table 7 and illustrated in Figure 1.

Table 7. The modules and unit processes included in the scope for the ceiling panel products.

| Module | Module description from the PCR | Unit Processes Included in Scope |
|--------|---|--|
| A1 | Extraction and processing of raw materials; any reuse of products or materials from previous product systems; processing of secondary materials; generation of electricity from primary energy resources; energy, or other, recovery processes from secondary fuels | Extraction and processing of raw materials for the product components. |
| A2 | Transport (to the manufacturer) | Transport of component materials to the manufacturing facilities |
| A3 | Manufacturing, including ancillary material production | Manufacturing of the ceiling panel products and packaging (including upstream unit processes) |
| A4 | Transport (to the building site) | Transport of product (including packaging) to the building site |
| A5 | Construction-installation process | The product is installed manually with no associated impacts. Only impacts from packaging disposal are included in this phase. |
| B1 | Product use | There are no impacts associated with the use of the products |
| B2 | Product maintenance | There are no impacts associated with the maintenance of the products over the 75-year ESL. |
| B3 | Product repair | The ceiling panels are not expected to require repair over its lifetime. |
| B4 | Product replacement | The materials and energy required for replacement of the product over the 75-year ESL of the assessment are included in this phase |
| B5 | Product refurbishment | The ceiling panels are not expected to require refurbishment over its lifetime. |
| B6 | Operational energy use by technical building systems | There is no operational energy use associated with the use of the product |
| B7 | Operational water use by technical building systems | There is no operational water use associated with the use of the product |
| C1 | Deconstruction, demolition | Demolition of the product is accomplished using hand tools with no associated emissions and negligible impacts |
| C2 | Transport (to waste processing) | Transport of product to waste treatment at end-of-life |
| C3 | Waste processing for reuse, recovery and/or recycling | The product is disposed of by landfilling which requires no waste processing |
| C4 | Disposal | Disposal of flooring product in municipal landfill or incineration |
| D | Reuse-recovery-recycling potential | Module Not Declared |

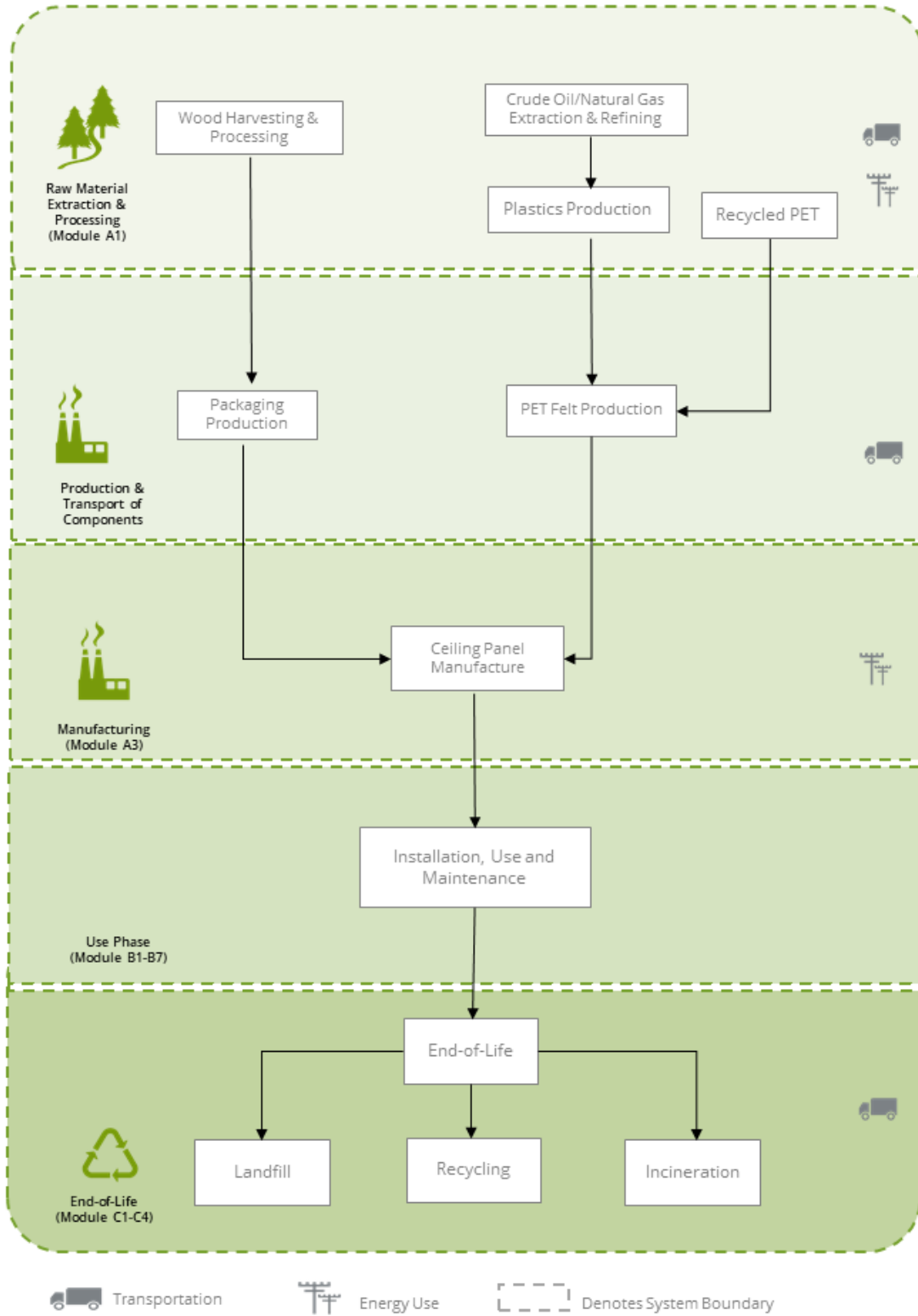


Figure 1. Flow Diagram for the life cycle of the Feltworks Blades acoustic ceiling panel product system.

3.3 PRODUCT SPECIFIC CALCULATION FOR USE PHASE

According to the PCR, there are no impacts associated with the use phase of the products.

3.4 UNITS

All data and results are presented using SI units.

3.5 ESTIMATES AND ASSUMPTIONS

- The manufacturing facility in Salt Lake City is located within the NWPP eGRID EPA subregion. Ecoinvent inventory datasets representing the NWPP eGRID electricity grid are used to estimate resource use and emissions from electricity use at the production facilities.
- Electricity and resource use at the manufacturing facility were allocated to the products based on product mass and annual production.
- Primary data for the fabrication of the PET felt were provided by the supplier, based on annual production, and used to develop the necessary inventory data for the product system modeling.
- Disposal of product and packaging materials is modeled based on 2018 statistics for municipal solid waste generation and disposal in the United States, from the US Environmental Protection Agency. This data supplies recycling rates for durable goods, as well as for packaging and containers.
- For final disposal of the product and packaging materials at end-of-life, all materials are assumed to be transported 35 km by diesel truck to either a landfill, incineration facility, or material reclamation facility (for recycling). Datasets representing disposal in a landfill and waste incineration are from Ecoinvent.
- Modeling of recycled materials follows the recycled content method (also known as 100-0 method or cut-off method) whereby only the burdens of reprocessing the waste material are allocated to the system from the use of the recycled material.

It should also be noted that LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

The PCR requires the results for several inventory flows related to construction products to be reported including energy and resource use and waste and outflows. These are aggregated inventory flows, and do not characterize any potential impact; results should be interpreted taking into account this limitation.

3.6 CUT-OFF RULES

According to the PCR, processes contributing greater than 1% of the total environmental impact indicator for each impact are included in the inventory. No data gaps were allowed which were expected to significantly affect the outcome of the indicator results. No known flows are deliberately excluded from this EPD.

3.7 DATA SOURCES

Primary data were provided by the manufacturer for its facility. The sources of secondary LCI data are the Ecoinvent database.

Table 8. Data sources for the product system.

| Material | Material Dataset | Data Source | Publication Date |
|----------------------------|--|--------------------------|------------------|
| PRODUCT MATERIALS | | | |
| Sola PET felt | polyethylene terephthalate, granulate, bottle grade, recycled to generic market for bottle grade PET granulate polyethylene terephthalate, granulate, bottle grade Cutoff, S/RoW polyethylene terephthalate production, granulate, amorphous polyethylene terephthalate, granulate, amorphous Cutoff, S/RoW; market group for electricity, medium voltage electricity, medium voltage Cutoff, S/CN; | Primary data; EI v3.8 | 2021 |
| PACKAGING MATERIALS | | | |
| Pallet | EUR-flat pallet production EUR-flat pallet Cutoff, S/RoW | EI v3.8 | 2021 |
| TRANSPORT | | | |
| Truck | transport, freight, lorry 16-32 metric ton, EURO4 transport, freight, lorry 16-32 metric ton, EURO4 Cutoff, S/RoW | EI v3.8 | 2021 |
| Ship | transport, freight, sea, container ship transport, freight, sea, container ship Cutoff, S/GLO | EI v3.8 | 2021 |
| RESOURCES | | | |
| Grid electricity | Electricity, medium voltage, per kWh – NWPP/NWPP | eGRID 2018; EI v3.8 | 2018; 2021 |
| Natural gas | heat production, natural gas, at boiler modulating >100kW heat, district or industrial, natural gas Cutoff, S/RoW | EI v3.8 | 2021 |
| Propane | propane, burned in building machine propane, burned in building machine Cutoff, S/GLO | EI v3.8 | 2021 |



3.8 DATA QUALITY

The data quality assessment addressed the following parameters: time-related coverage, geographical coverage, technological coverage, precision, completeness, representativeness, consistency, reproducibility, sources of data, and uncertainty.

Table 9. *Data quality assessment for the product system.*

| Data Quality Parameter | Data Quality Discussion |
|---|--|
| <p>Time-Related Coverage: Age of data and the minimum length of time over which data is collected</p> | <p>The most recent available data are used, based on other considerations such as data quality and similarity to the actual operations. Typically, these data are less than 5 years old (typically 2016). All of the data used represented an average of at least one year's worth of data collection, and up to three years in some cases. Manufacturer-supplied data (primary data) are based on annualized production for 2021.</p> |
| <p>Geographical Coverage: Geographical area from which data for unit processes is collected to satisfy the goal of the study</p> | <p>The data used in the analysis provide the best possible representation available with current data. Electricity use for product manufacture is modeled using representative data for the EPA NERC sub-regions. Surrogate data used in the assessment are representative of global or North American operations. Data representative of global operations are considered sufficiently similar to actual processes. Data representing product disposal are based on US statistics.</p> |
| <p>Technology Coverage: Specific technology or technology mix</p> | <p>For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations. Representative datasets, specific to the type of material, are used to represent the actual processes, as appropriate.</p> |
| <p>Precision: Measure of the variability of the data values for each data expressed</p> | <p>Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one or more years and over multiple operations, which is expected to reduce the variability of results.</p> |
| <p>Completeness: Percentage of flow that is measured or estimated</p> | <p>The LCA model included all known mass and energy flows for production of the ceiling panel products. In some instances, surrogate data used to represent upstream and downstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded.</p> |
| <p>Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest</p> | <p>Data used in the assessment represent typical or average processes as currently reported from multiple data sources and are therefore generally representative of the range of actual processes and technologies for production of these materials. Considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction.</p> |
| <p>Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis</p> | <p>The consistency of the assessment is considered to be high. Data sources of similar quality and age are used; with a bias towards EcoInvent v3.8 data where available. Different portions of the product life cycle are equally considered.</p> |
| <p>Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study</p> | <p>Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.</p> |
| <p>Sources of the Data: Description of all primary and secondary data sources</p> | <p>Data representing energy use at the manufacturing facilities represent an annual average and are considered of high quality due to the length of time over which these data are collected, as compared to a snapshot that may not accurately reflect fluctuations in production. For secondary LCI data, EcoInvent v3.8 LCI data are used.</p> |
| <p>Uncertainty of the Information: Uncertainty related to data, models, and assumptions</p> | <p>Uncertainty related to materials in the products and packaging is low. Actual supplier data for all upstream operations were not available and the study relied upon the use of existing representative datasets. These datasets contained relatively recent data (<10 years) but lacked geographical representativeness. Uncertainty related to the impact assessment methods used in the study are high. The impact assessment method required by the PCR includes impact potentials, which lack characterization of providing and receiving environments or tipping points.</p> |

3.9 PERIOD UNDER REVIEW

The period of review is calendar year 2021.

3.10 ALLOCATION

Manufacturing resource use was allocated to the products based on product mass as a fraction of total facility production. Impacts from transportation were allocated based on the mass of material and distance transported.

3.11 COMPARABILITY

The PCR this EPD was based on was not written to support comparative assertions. EPDs based on different PCRs, or different calculation models, may not be comparable. When attempting to compare EPDs or life cycle impacts of products from different companies, the user should be aware of the uncertainty in the final results, due to and not limited to, the practitioner's assumptions, the source of the data used in the study, and the specifics of the product modeled.

4. LCA: Scenarios and Additional Technical Information

Delivery and Installation stage (A4 - A5)

Distribution of the products to the point of installation is included in the assessment. Transportation parameters for modeling transport to product distribution centers are based on PCR guidance and summarized in Table 10.

Table 10. *Transport parameters, per reference flow.*

| Parameter | Value |
|--|-------|
| Diesel truck – Fuel utilization (L/100 km) | 18.7 |
| Diesel truck – Capacity utilization (%) | 76% |
| Diesel truck – Distance (km) | 800 |
| Gross mass of products transported (kg) | 0.347 |

The products are installed manually with negligible waste. As per PCR guidance, no impacts are associated with the use and maintenance of the products. Additionally, a 30-year reference service lifetime is assumed for the products requiring 1.5 product replacements to fulfill the functional unit for the product system.

The impacts associated with packaging disposal are included with the installation phase, as per PCR requirements. Recycling rates for packaging are used to estimate packaging weights disposed. A summary of waste disposed and biogenic carbon uptake and emissions for product packaging is provided in Table 11.

Table 11. *Installation parameters for the Armstrong Feltworks ceiling panel products, per 1 ft².*

| Parameter | Value |
|---|------------|
| Ancillary materials | - |
| Net freshwater consumption (m ³) | - |
| Electricity consumption (kWh) | - |
| Product loss per functional unit (kg) | negligible |
| Waste materials generated by product installation (kg) | negligible |
| Output materials resulting from on-site waste processing (kg) | na |
| Direct emissions (kg) | - |
| Mass of packaging waste (kg) | 0.173 |
| Biogenic carbon in packaging (kg CO ₂) | 0.305 |

Use and Maintenance stage (B1-B2)

No impacts are associated with the use and maintenance of the product over the Reference Service Lifetime.

Repair/Refurbishment stage (B3; B5)

Product repair and refurbishment are not relevant during the lifetime of the product.

Replacement stage (B4)

The materials and energy required for replacement of the product over the 75-year estimated service lifetime of the assessment are included in this stage. Modeling parameters for the product replacement stage are summarized in Table 12.

Table 12. Product replacement parameters for the flooring products, per 1 m².

| Parameter | Value | Units |
|------------------------|-------|-------|
| Reference service life | 30 | Years |
| Replacement cycle | 1.5 | - |
| Ancillary materials | - | kg |
| Replacement parts | 0.868 | kg |
| Direct emissions | - | kg |

Building operation stage (B6 - B7)

There is no operational energy or water use associated with the use of the product.

Disposal stage (C1 - C4)

The disposal stage includes demolition of the products (C1); transport of the products to waste treatment facilities (C2); waste processing (C3); and associated emissions as the product degrades in a landfill or is burned in an incinerator (C4). For the ceiling panel products, no emissions are generated during demolition (C1) while no waste processing (C3) is required for incineration or landfill disposal.

A material recycling rate for textiles of 13.7%, based on the US EPA's disposal statistics for municipal solid waste (MSW) for 2018, was assumed for the assessment. Transportation of waste materials at end-of-life (C2) assumes a 35 km (~22 mile) average distance to disposal, consistent with PCR guidance. For disposal of product materials which are not recycled, it is assumed that 20% are incinerated and 80% go to a landfill.

5. LCA: Results

Results of the Life Cycle Assessment are presented below. It is noted that LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

The following environmental impact category indicators are reported using characterization factors based on the U.S. EPA's Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts – TRACI 2.1:

| Impact Category | Unit |
|---------------------------------------|-----------------------|
| Global Warming Potential (GWP 100) | kg CO ₂ eq |
| Ozone Depletion Potential (ODP) | kg CFC 11 eq |
| Acidification Potential (AP) | kg SO ₂ eq |
| Eutrophication Potential (EP) | kg N eq |
| Smog Formation Potential (POCP) | kg O ₃ eq |
| Fossil Fuel Depletion Potential (FFD) | MJ Surplus, LHV |

The environmental impact category indicators are also reported based on the CML-IA characterization factors:

| Impact Category | Unit |
|---|-------------------------------------|
| Global Warming Potential (GWP 100) | kg CO ₂ eq |
| Depletion potential of the stratospheric ozone layer (ODP) | kg CFC 11 eq |
| Acidification Potential of soil and water (AP) | kg SO ₂ eq |
| Eutrophication Potential (EP) | kg PO ₄ ³⁻ eq |
| Photochemical Oxidant Creation Potential (POCP) | kg C ₂ H ₄ eq |
| Abiotic depletion potential (ADP-elements) for non-fossil resources | kg Sb eq |
| Abiotic depletion potential (ADP-fossil fuels) for fossil resources | MJ, LHV |

The following key life cycle inventory data parameters are taken from the PCR, which include resource use, output flows, and waste categories.

| Key Life Cycle Inventory Parameter | Acronym | Reporting Unit |
|--|-------------------|----------------|
| Use of renewable primary energy excluding renewable primary energy resources used as raw materials | RPR _E | MJ, LHV |
| Use of renewable primary energy resources used as raw materials | RPR _M | MJ, LHV |
| Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials | NRPR _E | MJ, LHV |
| Use of non-renewable primary energy resources used as raw materials | NRPR _M | MJ, LHV |
| Use of secondary material | SM | kg |
| Use of renewable secondary fuels | RSF | MJ, LHV |
| Use of non-renewable secondary fuels | NRSF | MJ, LHV |
| Use of net fresh water | FW | m ³ |
| Hazardous waste disposed | HWD | kg |
| Non-hazardous waste disposed | NHWD | kg |
| High-level radioactive waste disposed | HLRW | kg |
| Intermediate- and low-level radioactive waste disposed | ILLRW | kg |
| Components for re-use | CRU | kg |
| Materials for recycling | MR | kg |
| Materials for energy recovery | MER | kg |
| Exported energy | EE | MJ, LHV |

Modules B1-B3 and B5-B7 are not associated with any impact and are therefore declared as zero. In addition, module C1 and C3 are likewise not associated with any impact as the products are expected to be manually deconstructed. The ceiling panel products do not contain significant amounts of bio-based materials; biogenic carbon emissions and removals are not declared. Module D is not declared. In the interest of space and table readability, these modules are not included in the results presented below.

Table 13. Life Cycle Impact Assessment (LCIA) results for the **Feltworks Blades** acoustic ceiling panel products over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.

| Impact Category | A1 | A2 | A3 | A4 | A5 | B4 | C2 | C4 |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|
| TRACI 2.1 | | | | | | | | |
| GWP (kg CO ₂ eq) | 0.700 | 9.13x10 ⁻² | 8.62x10 ⁻² | 4.73x10 ⁻² | 1.68x10 ⁻² | 1.55 | 7.71x10 ⁻³ | 8.43x10 ⁻² |
| | 27% | 3.5% | 3.3% | 1.8% | 0.65% | 60% | 0.30% | 3.3% |
| AP (kg SO ₂ eq) | 2.97x10 ⁻³ | 1.16x10 ⁻³ | 4.50x10 ⁻⁴ | 2.16x10 ⁻⁴ | 6.08x10 ⁻⁵ | 7.49x10 ⁻³ | 4.44x10 ⁻⁵ | 9.73x10 ⁻⁵ |
| | 24% | 9.3% | 3.6% | 1.7% | 0.49% | 60% | 0.36% | 0.78% |
| EP (kg N eq) | 1.70x10 ⁻³ | 1.12x10 ⁻⁴ | 4.43x10 ⁻⁴ | 5.16x10 ⁻⁵ | 1.02x10 ⁻³ | 6.29x10 ⁻³ | 5.66x10 ⁻⁶ | 8.56x10 ⁻⁴ |
| | 16% | 1.1% | 4.2% | 0.49% | 9.7% | 60% | 0.05% | 8.2% |
| SFP (kg O ₃ eq) | 4.01x10 ⁻² | 2.29x10 ⁻² | 7.79x10 ⁻³ | 5.18x10 ⁻³ | 1.69x10 ⁻³ | 0.122 | 1.26x10 ⁻³ | 2.68x10 ⁻³ |
| | 20% | 11% | 3.8% | 2.5% | 0.83% | 60% | 0.62% | 1.3% |
| ODP (kg CFC-11 eq) | 1.32x10 ⁻⁶ | 2.05x10 ⁻⁸ | 7.83x10 ⁻⁹ | 1.10x10 ⁻⁸ | 2.28x10 ⁻⁹ | 2.05x10 ⁻⁶ | 1.78x10 ⁻⁹ | 9.01x10 ⁻¹⁰ |
| | 39% | 0.60% | 0.23% | 0.32% | 0.07% | 60% | 0.05% | 0.03% |
| FFD (MJ eq) | 1.24 | 0.186 | 0.114 | 0.100 | 2.12x10 ⁻² | 2.53 | 1.59x10 ⁻² | 1.14x10 ⁻² |
| | 29% | 4.4% | 2.7% | 2.4% | 0.50% | 60% | 0.38% | 0.27% |
| CML-IA | | | | | | | | |
| GWP (kg CO ₂ eq) | 0.712 | 9.13x10 ⁻² | 9.05x10 ⁻² | 4.73x10 ⁻² | 1.86x10 ⁻² | 1.60 | 7.71x10 ⁻³ | 9.78x10 ⁻² |
| | 27% | 3.4% | 3.4% | 1.8% | 0.70% | 60% | 0.29% | 3.7% |
| AP (kg SO ₂ eq) | 2.86x10 ⁻³ | 1.07x10 ⁻³ | 4.19x10 ⁻⁴ | 1.84x10 ⁻⁴ | 4.94x10 ⁻⁵ | 7.04x10 ⁻³ | 3.60x10 ⁻⁵ | 7.54x10 ⁻⁵ |
| | 24% | 9.1% | 3.6% | 1.6% | 0.42% | 60% | 0.31% | 0.64% |
| EP (kg (PO ₄) ₃ - eq) | 8.82x10 ⁻⁴ | 1.47x10 ⁻⁴ | 2.12x10 ⁻⁴ | 4.27x10 ⁻⁵ | 3.74x10 ⁻⁴ | 3.01x10 ⁻³ | 7.70x10 ⁻⁶ | 3.43x10 ⁻⁴ |
| | 18% | 2.9% | 4.2% | 0.85% | 7.5% | 60% | 0.15% | 6.8% |
| POCP (kg C ₂ H ₄ eq) | 1.54x10 ⁻⁴ | 2.94x10 ⁻⁵ | 3.74x10 ⁻⁵ | 6.29x10 ⁻⁶ | 3.63x10 ⁻⁶ | 3.73x10 ⁻⁴ | 1.19x10 ⁻⁶ | 1.70x10 ⁻⁵ |
| | 25% | 4.7% | 6.0% | 1.0% | 0.58% | 60% | 0.19% | 2.7% |
| ODP (kg CFC-11 eq) | 9.85x10 ⁻⁷ | 1.54x10 ⁻⁸ | 6.01x10 ⁻⁹ | 8.23x10 ⁻⁹ | 1.71x10 ⁻⁹ | 1.53x10 ⁻⁶ | 1.34x10 ⁻⁹ | 7.27x10 ⁻¹⁰ |
| | 39% | 0.60% | 0.24% | 0.32% | 0.07% | 60% | 0.05% | 0.03% |
| ADPE (kg Sb eq) | 4.59x10 ⁻⁶ | 2.50x10 ⁻⁷ | 5.26x10 ⁻⁷ | 1.64x10 ⁻⁷ | 1.30x10 ⁻⁸ | 8.35x10 ⁻⁶ | 6.79x10 ⁻⁹ | 1.97x10 ⁻⁸ |
| | 33% | 1.8% | 3.8% | 1.2% | 0.09% | 60% | 0.05% | 0.14% |
| ADPF (MJ eq) | 10.8 | 1.29 | 1.01 | 0.701 | 0.144 | 21.1 | 0.106 | 8.46x10 ⁻² |
| | 31% | 3.7% | 2.9% | 2.0% | 0.41% | 60% | 0.30% | 0.24% |

Table 14. Resource use and waste flows for the **Feltworks Blades** acoustic ceiling panel products over a 75-yr time horizon. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.

| Parameter | A1 | A2 | A3 | A4 | A5 | B4 | C2 | C4 |
|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Resources | | | | | | | | |
| RPR _E (MJ) | 0.585 | 1.28x10 ⁻² | 4.68 | 8.01x10 ⁻³ | 1.13x10 ⁻³ | 7.93 | 4.03x10 ⁻⁴ | 2.60x10 ⁻³ |
| | 4.4% | 0.10% | 35% | 0.06% | 0.01% | 60% | 0.00% | 0.02% |
| RPR _M (MJ) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NRPR _E (MJ) | INA | INA | INA | INA | INA | INA | INA | INA |
| NRPR _M (MJ) | INA | INA | INA | INA | INA | INA | INA | INA |
| SM (kg) | 8.70x10 ⁻² | 0.00 | 0.00 | 0.00 | 0.00 | 0.131 | 0.00 | 0.00 |
| | 40% | 0.00% | 0.00% | 0.00% | 0.00% | 60% | 0.00% | 0.00% |
| RSF/NRSF (MJ) | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| RE (MJ) | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| FW (m ³) | 2.75x10 ⁻² | 7.63x10 ⁻⁴ | 3.65x10 ⁻³ | 4.90x10 ⁻⁴ | 9.22x10 ⁻⁵ | 4.93x10 ⁻² | 3.34x10 ⁻⁵ | 3.09x10 ⁻⁴ |
| | 33% | 0.93% | 4.4% | 0.60% | 0.11% | 60% | 0.04% | 0.38% |
| Wastes | | | | | | | | |
| HWD (kg) | 1.52x10 ⁻⁵ | 2.74x10 ⁻⁶ | 1.73x10 ⁻⁶ | 1.88x10 ⁻⁶ | 3.51x10 ⁻⁷ | 3.36x10 ⁻⁵ | 2.88x10 ⁻⁷ | 1.99x10 ⁻⁷ |
| | 27% | 4.9% | 3.1% | 3.4% | 0.63% | 60% | 0.51% | 0.36% |
| NHWD (kg) | 9.08x10 ⁻² | 4.63x10 ⁻² | 4.77x10 ⁻² | 3.61x10 ⁻² | 0.140 | 0.725 | 5.38x10 ⁻⁴ | 0.122 |
| | 7.5% | 3.8% | 4.0% | 3.0% | 12% | 60% | 0.04% | 10% |
| HLRW (kg) | 2.11x10 ⁻⁶ | 5.51x10 ⁻⁸ | 2.25x10 ⁻⁷ | 3.60x10 ⁻⁸ | 5.17x10 ⁻⁹ | 3.67x10 ⁻⁶ | 1.67x10 ⁻⁹ | 1.31x10 ⁻⁸ |
| | 35% | 0.90% | 3.7% | 0.59% | 0.08% | 60% | 0.03% | 0.21% |
| ILLRW (kg) | 1.47x10 ⁻⁵ | 8.63x10 ⁻⁶ | 2.87x10 ⁻⁶ | 4.61x10 ⁻⁶ | 9.55x10 ⁻⁷ | 4.91x10 ⁻⁵ | 7.47x10 ⁻⁷ | 2.36x10 ⁻⁷ |
| | 18% | 11% | 3.5% | 5.6% | 1.2% | 60% | 0.91% | 0.29% |
| CRU (kg) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| MR (kg) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.58x10 ⁻² | 0.00 | 2.38x10 ⁻² |
| | 0.00% | 0.00% | 0.00% | 0.00% | 0.00% | 60% | 0.00% | 40% |
| MER (kg) | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |
| EE (MJ) | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. | Neg. |

INA = Indicator not assessed | Neg. = Negligible

6. LCA: Interpretation

With few exceptions, the contributions to total impact indicator results are dominated by the raw material extraction followed by upstream transport and product manufacturing. Downstream impacts are minimal.

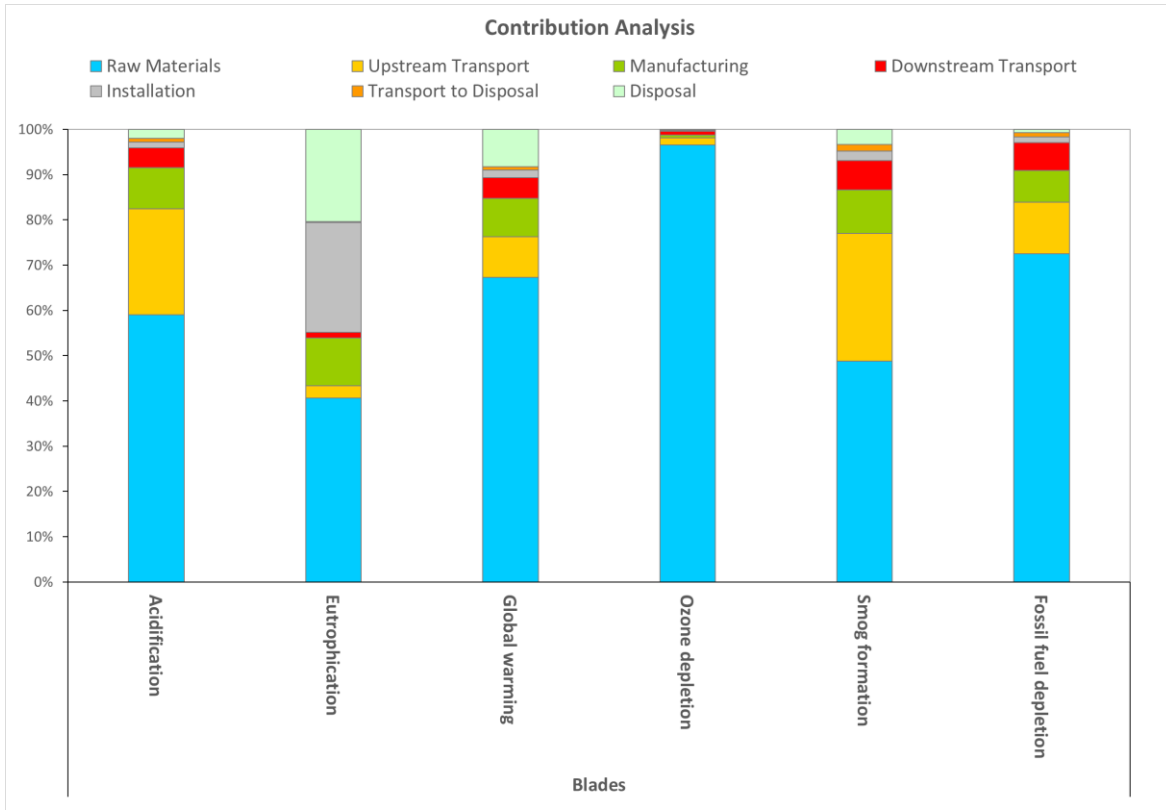


Figure 2. Contribution analysis for the *Feltworks Blades* product system (excluding replacements) – TRACI

7. Additional Environmental Information

For more information on Armstrong World Industries' certifications and environmental initiatives please view the website at <https://www.armstrongceilings.com/>.

8. References

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