



#### Declaration Owner

*Litex, Inc.*

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Rochester Hills, MI 48309

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#### Products

Architectural Window Systems:

- Fixed Windows; Double Glazed
- Fixed Windows; Triple Glazed

#### Declared Unit

The declared unit is one square meter of Architectural Window System

#### EPD Number and Period of Validity

SCS-EPD-07184

EPD Valid July 13, 2021 through July 12, 2026

#### Product Category Rule

Earthsure PCR Cradle-to-Gate 30171600:2015.

NSF Sustainability

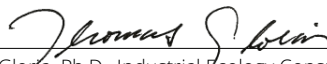

#### Program Operator

SCS Global Services

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|   |  |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
|---|--|----------------------|---|-----------------|---|---------------------------------|---|----------------------|----|------------------------------|----|--------------------|----|
| Declaration Owner:  | Litex, Inc   |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| Address:  | 2774 Product Drive, Rochester Hills, MI 48309  |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| Declaration Number:   | SCS-EPD-07184  |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| Declaration Validity Period:  | EPD Valid July 13, 2021 through July 12, 2026  |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| Program Operator:   | SCS Global Services  |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| Declaration URL Link:   | <a href="https://www.scsglobalservices.com/certified-green-products-guide">https://www.scsglobalservices.com/certified-green-products-guide</a>  |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| LCA Practitioner:   | Gerard Mansell, Ph.D., SCS Global Services   |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| LCA Software and LCI database:  | OpenLCA 1.10 software and the Ecoinvent v3.7 database  |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| Product RSL:  | n/a  |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| Markets of Applicability:   | Global   |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| EPD Type:   | Product-Specific   |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| EPD Scope:  | Cradle-to-Gate   |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| LCIA Method and Version:  | TRACI 2.1  |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071   | <input type="checkbox"/> internal <input checked="" type="checkbox"/> external   |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| LCA Reviewer:   | <br>Thomas Gloria, Ph.D., Industrial Ecology Consultants   |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| Product Category Rule:  | Earthsure PCR Cradle-to-Gate 30171600:2015. Now maintained by NSF Sustainability: <a href="https://www.nsf.org/standards-development/product-category-rules">https://www.nsf.org/standards-development/product-category-rules</a>  |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| PCR Review conducted by:  | Tom Gloria, LCACP Industrial Ecology Consultants, Chair; Adolf Merl, ThinkStep GmBH; Philip Moser, Simpson Gumpertz & Heger Inc.   |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| 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:   | <br>Thomas Gloria, Ph.D., Industrial Ecology Consultants   |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
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| 1. About Litex .....  | 2  |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| 2. Product.....   | 2  |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| 3. LCA: Calculation Rules .....   | 4  |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| 4. LCA: Results.....  | 11   |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| 5. LCA: Interpretation .....  | 14   |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| 6. References.....  | 15   |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |
| <p><b>Disclaimers:</b> This EPD conforms to ISO 14025, 14040, 14044 and 21930:2007.</p> <p><b>Scope of Results Reported:</b> 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.</p> <p><b>Accuracy of Results:</b> Due to PCR constraints, this EPD provides estimations of potential impacts that are inherently limited in terms of accuracy.</p> <p><b>Comparability:</b> 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.</p> <p>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.</p> |  |                      |   |                 |   |                                 |   |                      |    |                              |    |                    |    |

## 1. About Litex

We are a custom manufacturer of aluminum framed windows used in the architectural division of the fenestration industry. We bid projects such as schools, universities, hospitals and large housing complexes. Our windows are designed and manufactured to withstand the harshest environments.

## 2. Product

### 2.1 PRODUCT DESCRIPTION

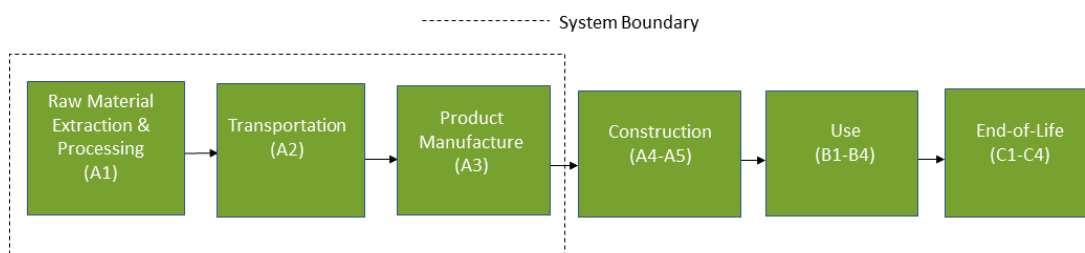
The product systems assessed include Litex's architectural window system products manufactured at the company's production facility in Michigan. The products are assembled primarily from pre-fabricated components, including a sealed, or insulated, glass unit (IGU) and aluminum extrusions, supplied by multiple regional suppliers. The products are packaged for distribution using corrugated board, rubber pads and wooden pallets.

The products assessed include the following:

| Product                      | UNSPSC Code | Product Description  |
|------------------------------|-------------|--|
| Fixed Windows: Double Glazed | 30171609    | One of our most versatile window series our fixed windows are available with an offset glass face or flush glass face configuration that also comes with and without horizontal and vertical posts in order to match surrounding conditions. These windows can accept sealed insulated glass, dual glazing, triple glazing, integral blinds, architectural panels and translucent panel glazing. |
| Fixed Windows: Triple Glazed |             |  |

### 2.2 PRODUCT FLOW DIAGRAM

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



### 2.3 APPLICATION

The Litex Architectural Window System products are intended for use in institutional and commercial building construction applications to provide lighting, ventilation and protection from the elements.

### 2.4 DECLARATION OF METHODOLOGICAL FRAMEWORK

The scope of the EPD is "cradle-to-gate", including raw material extraction, processing of raw materials, material transport and product manufacture, including packaging. 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 1.** Life cycle phases included in the Litex 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             | MND                  | MND                         | MND | MND         | MND    | MND         | MND           | MND                    | MND                   | MND                       | MND       | MND              | MND      | MND   |

X = Module Included | MND = Module Not Declared

The EPD conforms to ISO 14040/44 and the PCR. Impact category indicators are estimated using the TRACI 2.1 characterization methodology, as specified by the PCR. The core impact indicators considered for the assessment include:

- Global Warming Potential
- Acidification Potential
- Eutrophication Potential
- Photochemical Ozone (Smog) Formation Potential
- Ozone Depletion Potential
- Fossil Fuel Depletion Potential

## 2.5 TECHNICAL DATA

Technical specifications of the products included in the LCA scope, as well as product performance testing results are available on the manufacturer's website (<https://www.litex.com/>).

## 2.6 MATERIAL COMPOSITION

The products are assembled primarily from pre-fabricated components, including a sealed, or insulated, glass unit (IGU) and aluminum extrusions.

**Table 2.** Material content for the Litex products in kg per square meter and percent of total mass.

| Material             | Fixed Windows Double Glazed | Fixed Windows Triple Glazed |
|----------------------|-----------------------------|-----------------------------|
| Aluminum Extrusions  | 8.62                        | 10.4                        |
|                      | 16%                         | 13%                         |
| Sealed Glass Units   | 45.8                        | 70.8                        |
|                      | 84%                         | 87%                         |
| <b>Total Product</b> | <b>54.4</b>                 | <b>81.2</b>                 |
|                      | <b>100%</b>                 | <b>100%</b>                 |

No substances required to be reported as hazardous are associated with the production of the products.

## 2.7 MANUFACTURING

The Litex architectural window system products are manufactured at the company's production facility in Hillsdale, Michigan. Resource use at the production facility is allocated to the product based on area.

Electricity use at the manufacturer's facility is modeled based on the regional electricity supply mix using the USEPA eGRID emissions database. Electricity and resources (e.g., diesel, propane) used at the manufacturing facility are allocated to the products based on annualized production data for the April 2020 – March 2021 period.

## 2.8 PACKAGING

The products are packaged for shipment using corrugated board, rubber pads and wooden pallets.

**Table 3.** Material content for the product packaging in kg/m<sup>2</sup> and as a percentage of total mass.

| Material               | Fixed Windows Double Glazed | Fixed Windows Triple Glazed |
|------------------------|-----------------------------|-----------------------------|
| Cardboard              | 6.80x10 <sup>-2</sup>       | 0.101                       |
|                        | 2%                          | 2%                          |
| Rubber Pads            | 1.36x10 <sup>-2</sup>       | 2.03x10 <sup>-2</sup>       |
|                        | 0.41%                       | 0.41%                       |
| Wood                   | 3.27                        | 4.87                        |
|                        | 98%                         | 98%                         |
| <b>Total Packaging</b> | <b>3.35</b>                 | <b>4.99</b>                 |
|                        | <b>100%</b>                 | <b>100%</b>                 |

## 2.9 FURTHER INFORMATION

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

# 3. LCA: Calculation Rules

## 3.1 DECLARED UNIT

The declared unit used in the study is defined as 1 m<sup>2</sup> of window system product including the window frame. The reference flows and declared unit for each product are summarized in Table 4.

**Table 4.** Declared unit and reference flows for the Litex products

| Product Name                 | Declared Unit                               | Reference flow (kg/m <sup>2</sup> ) |
|------------------------------|---|-------------------------------------|
| Fixed Windows; Double Glazed | 1 m <sup>2</sup> of window, including frame | 54.5                                |
| Fixed Windows; Triple Glazed | 1 m <sup>2</sup> of window, including frame | 81.2                                |

## 3.2 SYSTEM BOUNDARY

The scope of the EPD is cradle-to-gate, including raw material extraction, processing of raw materials, material transport, and product manufacture, including packaging. The life cycle phases included in the EPD scope are described in Table 5 and illustrated in Figure 1.

**Table 5.** *The modules and unit processes included in the scope for the Litex window product system.*

| 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 architectural window system components. |
| A2     | Transport (to the manufacturer)   | Transport of component materials to the manufacturing facilities                           |
| A3     | Manufacturing, including ancillary material production  | Manufacturing of products and packaging (incl. upstream unit processes)                    |
| A4     | Transport (to the building site)  | Module Not Declared  |
| A5     | Construction-installation process   | Module Not Declared  |
| B1     | Product use   | Module Not Declared  |
| B2     | Product maintenance   | Module Not Declared  |
| B3     | Product repair  | Module Not Declared  |
| B4     | Product replacement   | Module Not Declared  |
| B5     | Product refurbishment   | Module Not Declared  |
| B6     | Operational energy use by technical building systems  | Module Not Declared  |
| B7     | Operational water uses by technical building systems  | Module Not Declared  |
| C1     | Deconstruction, demolition  | Module Not Declared  |
| C2     | Transport (to waste processing)   | Module Not Declared  |
| C3     | Waste processing for reuse, recovery and/or recycling   | Module Not Declared  |
| C4     | Disposal  | Module Not Declared  |
| D      | Reuse-recovery-recycling potential  | Module Not Declared  |

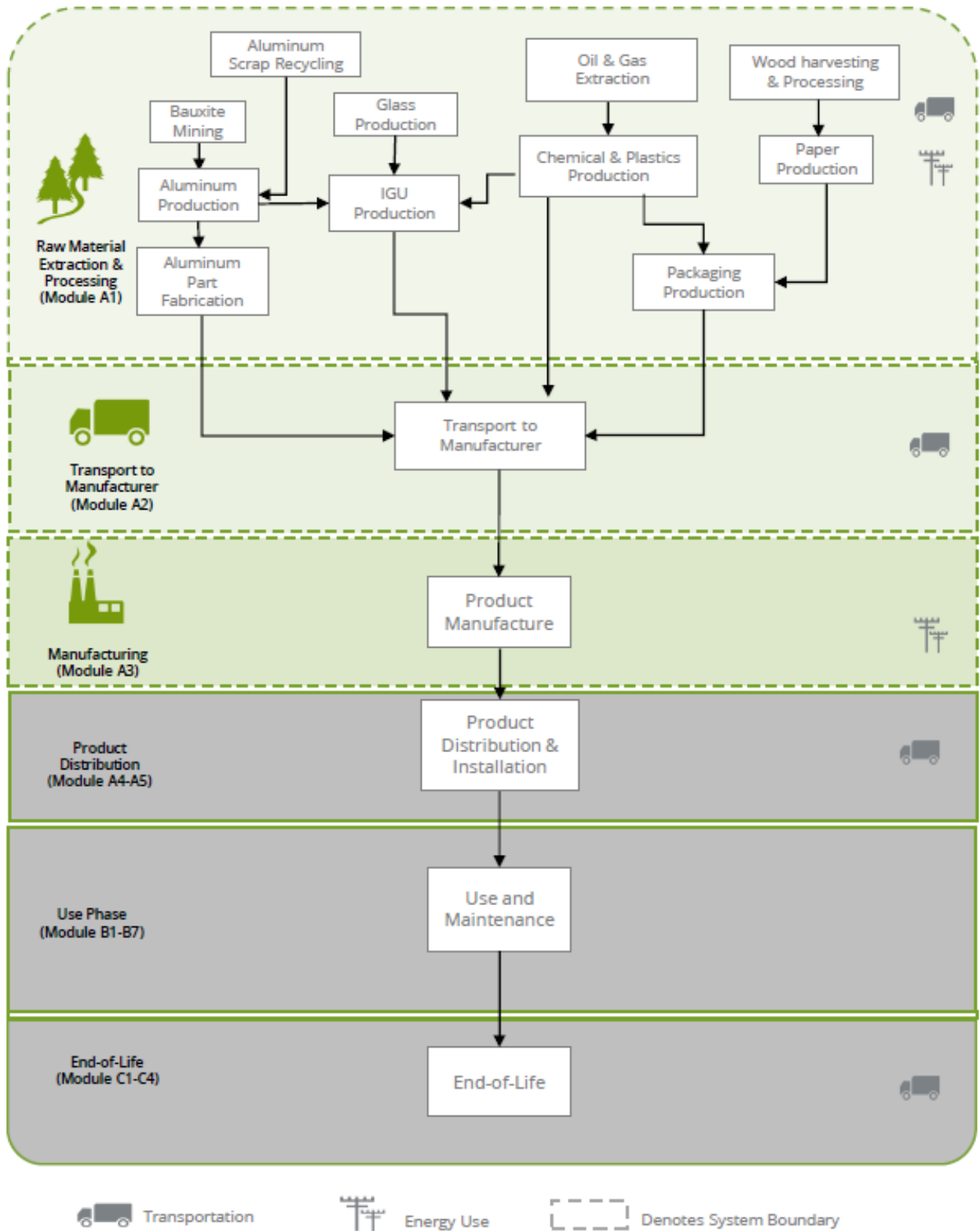


Figure 1. Flow Diagram for the life cycle of the Litex product system.

### 3.3 UNITS

All data and results are presented using SI units.

### 3.4 ESTIMATES AND ASSUMPTIONS

- The Litex manufacturing facility is located in Hillsdale, Michigan. Ecoinvent inventory datasets for the applicable eGRID electricity grid mix was used to model resource use and emissions from electricity use at the manufacturing facility.
- Electricity and resource use at the production facility were allocated to the products based on product area utilizing annualized production data for 2020-21 provided by the manufacturer. Impacts are allocated to the product based on area.
- Primary data for the sealed glass units used in the products were not available. While the manufacturer provided the total mass of the unit as a whole, the material component materials and amounts were not provided. Typical sealed, or insulated, glass units (IGUs) are comprised of annealed, tempered, or laminated glass, a spacer bar, desiccant, sealants and an inert gas. Lacking specific information, the percent mass of the individual IGU material components were estimated based on a review of relevant published literature which provided a range of mass percentages for these components. For the Litex window products assessed, the sealed glass units are conservatively assumed to be comprised of coated glass (92% by weight), an aluminum spacer (5%), a PUR sealant (3%) and argon gas (<1%). Other components (desiccant, coatings) are <~1% and excluded from the assessment. Ecoinvent LCI datasets are used to model these materials.
- Although primary data for the extruded aluminum components were not available, the manufacturer's aluminum material supplier has published an Industry Wide EPD for their aluminum extrusions containing ~60% recycled content. While detailed LCI data were not included, midpoint impact indicator results were provided and used for the current assessment.
- Primary data for other component materials were not available. Representative LCI datasets from the ecoinvent LCI database and published literature were used as appropriate.

It should 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 considering this limitation.

### 3.5 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.

### 3.6 DATA SOURCES

Primary data were provided by Litex for their manufacturing facility. The sources of secondary LCI data are the Ecoinvent database and published literature.



**Table 6.** Data sources for the Litex product system.

| Component             | Dataset   | Data Source       | Publication Date |
|-----------------------|---|-------------------|------------------|
| <b>PRODUCT</b>        |   |                   |                  |
| Sealed Glass Units    |   |                   |                  |
| Glass                 | flat glass production, coated   flat glass, coated   Cutoff, S/RoW  | EI v3.7           | 2020             |
| Aluminum spacer       | market for aluminium, primary, ingot   aluminium, primary, ingot   Cutoff, S/IAI Area, North America                          | EI v3.7           | 2020             |
| Sealant               | polyurethane production, flexible foam   polyurethane, flexible foam   Cutoff, S/RoW  | EI v3.7           | 2020             |
| Argon gas             | argon to generic market for inert gas for discharge lamps   inert gas for discharge lamps   Cutoff, S/GLO                     | EI v3.7           | 2020             |
| Aluminum Extrusions   | Extruded aluminum – Aluminum Extruders Council EPD <sup>1</sup>   | Industry-Wide EPD | 2016             |
| <b>PACKAGING</b>      |   |                   |                  |
| Corrugated            | containerboard production, linerboard, kraftliner   containerboard, linerboard   Cutoff, S/RoW                                | EI v3.7           | 2020             |
| Rubber pads           | synthetic rubber production   synthetic rubber   Cutoff, S/RoW  |                   |                  |
| Wood                  | EUR-flat pallet production   EUR-flat pallet   Cutoff, S/RoW  |                   |                  |
| <b>RESOURCES</b>      |   |                   |                  |
| Grid electricity      | Electricity, medium voltage, per kWh - RFCM/RFCM  | EI v3.7; eGRID    | 2020;<br>2018    |
| Propane               | heat production, propane, at industrial furnace >100kW   heat, district or industrial, other than natural gas   Cutoff, S/RoW | EI v3.7           | 2020             |
| <b>TRANSPORTATION</b> |   |                   |                  |
| Road transport        | transport, freight, lorry 16-32 metric ton, EURO4   transport, freight, lorry 16-32 metric ton, EURO4   Cutoff, S/RoW         | EI v3.7           | 2020             |

<sup>1</sup> <https://litex.com/sites/default/files/Environmental%20Product%20Declaration.pdf>

### 3.7 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 7.** Data quality assessment for the Litex product system.

| Data Quality Parameter   | Data Quality Discussion  |
|--|--|
| <b>Time-Related Coverage</b><br>Age of data and the minimum length of time over which data should be collected   | 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 annual production for 2020-21  |
| <b>Geographical Coverage</b><br>Geographical area from which data for unit processes should be collected to satisfy the goal of the study  | 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 regional electricity mix. Surrogate data used in the assessment are representative of global or US and North American operations. Data representative of global operations are considered sufficiently similar to actual processes.   |
| <b>Technology Coverage</b><br>Specific technology or technology mix  | For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations.   |
| <b>Precision</b><br>Measure of the variability of the data values for each data expressed (e.g. variance)  | 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.   |
| <b>Completeness</b><br>Percentage of flow that is measured or estimated  | The LCA model included all known mass and energy flows for production of the products. In some instances, surrogate data used to represent upstream 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.   |
| <b>Representativeness</b><br>Qualitative assessment of the degree to which the data set reflects the true population of interest (i.e. geographical coverage, time period, and technology coverage)              | 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.  |
| <b>Consistency</b><br>Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis   | The consistency of the assessment is considered to be high. Data sources of similar quality and age are used; with a bias towards Ecoinvent v3.7 data where available. Different portions of the product life cycle are equally considered.  |
| <b>Reproducibility</b><br>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 | 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.   |
| <b>Sources of the Data</b><br>Description of all primary and secondary data sources  | Data representing energy use at Litex's manufacturing facility 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 datasets Ecoinvent v3.7 LCI data are used.  |
| <b>Uncertainty of the Information</b><br>Uncertainty related to data, models, and assumptions  | Uncertainty related to materials in the product and packaging is low. Actual supplier data for upstream operations was not available for all suppliers 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. |

### 3.8 PERIOD UNDER REVIEW

The period of review is April 2020 – March 2021.

### 3.9 ALLOCATION

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

The product system includes some recycled materials, which were allocated using the recycled content allocation method (also known as the 100-0 cut-off method). Using the recycled content allocation approach, system inputs with recycled content do not receive any burden from the previous life cycle other than reprocessing of the waste material. At end-of-life, materials which are recycled leave the system boundaries with no additional burden.

### 3.10 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: 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. All LCA results are stated to three significant figures in agreement with the PCR for this flooring product and therefore the sum of the total values may not exactly equal 100%.

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.

| TRACI 2.1 Impact Category                                | Unit                  |
|--|-----------------------|
| Global Warming Potential (GWP)                           | kg CO <sub>2</sub> eq |
| Ozone Depletion Potential (ODP)                          | kg CFC 11 eq          |
| Acidification Potential (AP)                             | kg SO <sub>2</sub> eq |
| Eutrophication Potential (EP)                            | kg N eq               |
| Smog Formation Potential (SFP)                           | kg O <sub>3</sub> eq  |
| Fossil Fuel Depletion Potential (ADP <sub>fossil</sub> ) | MJ Surplus, LHV       |

These impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes.

The following inventory parameters, specified by the PCR, are also reported.

| Resources  | Unit           | Waste and Outflows  | Unit    |
|--|----------------|---|---------|
| Renewable primary resources used as energy carrier (fuel)            | MJ, LHV        | Hazardous waste disposed  | kg      |
| Renewable primary resources with energy content used as material     | MJ, LHV        | Non-hazardous waste disposed  | kg      |
| Non-renewable primary resources used as an energy carrier (fuel)     | MJ, LHV        | High-level radioactive waste, conditioned, to final repository                  | kg      |
| Non-renewable primary resources with energy content used as material | MJ, LHV        | Intermediate- and low-level radioactive waste, conditioned, to final repository | kg      |
| Secondary materials  | MJ, LHV        | Components for re-use   | kg      |
| Renewable secondary fuels  | MJ, LHV        | Materials for recycling   | kg      |
| Non-renewable secondary fuels  | MJ, LHV        | Materials for energy recovery   | kg      |
| Recovered energy   | MJ, LHV        | Recovered energy exported from the product system                               | MJ, LHV |
| Use of net freshwater resources                                      | m <sup>3</sup> | -   | -       |

Life cycle impact assessment results for the architectural window system products are presented below. Note that Modules A4, A5, B1-B7, C1-C4 and D are not declared. In the interest of space and table readability, these modules are not included in the results presented below.

**Table 8.** Life Cycle Impact contribution analysis for the Litex **Fixed Windows Double Glazed** window system products. Results are shown per metric ton of product.

| Impact Indicator          | Unit                  | Raw Materials         | Transport             | Manufacturing         | Total                 |
|---------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Global warming potential  | kg CO <sub>2</sub> eq | 150                   | 1.60                  | 3.02                  | 154                   |
|                           | %                     | 97%                   | 1%                    | 2%                    | 100%                  |
| Ozone depletion potential | kg CFC-11 eq          | 1.04                  | 7.27x10 <sup>-3</sup> | 1.48x10 <sup>-2</sup> | 1.06                  |
|                           | %                     | 98%                   | 0.68%                 | 1.4%                  | 100%                  |
| Acidification potential   | kg SO <sub>2</sub> eq | 0.185                 | 1.78x10 <sup>-3</sup> | 1.67x10 <sup>-2</sup> | 0.204                 |
|                           | %                     | 91%                   | 0.87%                 | 8.2%                  | 100%                  |
| Eutrophication potential  | kg N eq               | 11.1                  | 0.176                 | 0.217                 | 11.5                  |
|                           | %                     | 97%                   | 1.5%                  | 1.9%                  | 100%                  |
| Smog formation potential  | kg O <sub>3</sub> eq  | 6.24x10 <sup>-6</sup> | 3.73x10 <sup>-7</sup> | 2.11x10 <sup>-7</sup> | 6.83x10 <sup>-6</sup> |
|                           | %                     | 91%                   | 5.5%                  | 3.1%                  | 100%                  |
| Fossil Fuel Depletion     | MJ eq.                | 168                   | 3.39                  | 3.41                  | 175                   |
|                           | %                     | 96%                   | 1.9%                  | 1.9%                  | 100%                  |

**Table 9.** Life Cycle Impact contribution analysis for the Litex **Fixed Windows Triple Glazed** window system products. Results are shown per metric ton of product.

| Impact Indicator          | Unit                  | Raw Materials         | Transport             | Manufacturing         | Total                 |
|---------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Global warming potential  | kg CO <sub>2</sub> eq | 207                   | 2.24                  | 3.62                  | 213                   |
|                           | %                     | 97%                   | 1.1%                  | 1.7%                  | 100%                  |
| Ozone depletion potential | kg CFC-11 eq          | 1.46                  | 1.01x10 <sup>-2</sup> | 1.86x10 <sup>-2</sup> | 1.49                  |
|                           | %                     | 98%                   | 0.68%                 | 1.2%                  | 100%                  |
| Acidification potential   | kg SO <sub>2</sub> eq | 0.283                 | 2.49x10 <sup>-3</sup> | 1.88x10 <sup>-2</sup> | 0.304                 |
|                           | %                     | 93%                   | 0.82%                 | 6.2%                  | 100%                  |
| Eutrophication potential  | kg N eq               | 15.6                  | 0.245                 | 0.287                 | 16.2                  |
|                           | %                     | 97%                   | 1.5%                  | 1.8%                  | 100%                  |
| Smog formation potential  | kg O <sub>3</sub> eq  | 9.64x10 <sup>-6</sup> | 5.21x10 <sup>-7</sup> | 2.87x10 <sup>-7</sup> | 1.04x10 <sup>-5</sup> |
|                           | %                     | 92%                   | 5%                    | 2.8%                  | 100%                  |
| Fossil Fuel Depletion     | MJ eq.                | 237                   | 4.74                  | 4.45                  | 246                   |
|                           | %                     | 96%                   | 1.9%                  | 1.8%                  | 100%                  |

**Table 10.** Resource use and waste flows for the Litex **Fixed Windows Double Glazed** window system products by life cycle phase. Results are shown per metric ton of product. Results reported in MJ are calculated using lower heating values.

| Parameter  | Unit           | Raw Materials         | Transport             | Manufacturing         | Total                 |
|--|----------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <b>Resources</b>   |                |                       |                       |                       |                       |
| Renewable primary resources used as energy carrier               | MJ             | 426                   | 0.268                 | 91.4                  | 518                   |
|  | %              | 82%                   | 0.052%                | 18%                   | 100%                  |
| Renewable primary resources with energy content used as material | MJ             | 0.00                  | 0.00                  | 0.00                  | 0.00                  |
|  | %              | 0%                    | 0%                    | 0%                    | 0%                    |
| Non-renewable primary resources used as an energy carrier        | MJ             | INA                   | INA                   | INA                   | INA                   |
| Renewable primary resources with energy content used as material | MJ             | INA                   | INA                   | INA                   | INA                   |
| Secondary materials  | kg             | 5.30                  | 0.00                  | 0.00                  | 5.30                  |
|  | %              | 100%                  | 0%                    | 0%                    | 100%                  |
| Renewable secondary fuels  | MJ             | Neg.                  | Neg.                  | Neg.                  | Neg.                  |
| Non-renewable secondary fuels                                    | MJ             | Neg.                  | Neg.                  | Neg.                  | Neg.                  |
| Recovered energy   | MJ             | Neg.                  | Neg.                  | Neg.                  | Neg.                  |
| Use of net fresh water   | m <sup>3</sup> | 45.7                  | 2.77                  | 3.40                  | 51.8                  |
|  | %              | 88%                   | 5.4%                  | 6.6%                  | 100%                  |
| <b>Wastes</b>  |                |                       |                       |                       |                       |
| Nonhazardous waste disposed                                      | kg             | 27.1                  | 1.14                  | 1.57                  | 29.8                  |
|  | %              | 91%                   | 3.8%                  | 5.3%                  | 100%                  |
| Hazardous waste disposed   | kg             | 7.07x10 <sup>-3</sup> | 6.31x10 <sup>-5</sup> | 3.99x10 <sup>-5</sup> | 7.17x10 <sup>-3</sup> |
|  | %              | 99%                   | 0.88%                 | 0.56%                 | 100%                  |
| High-level radioactive waste                                     | kg             | 1.21x10 <sup>-4</sup> | 1.26x10 <sup>-6</sup> | 1.34x10 <sup>-5</sup> | 1.35x10 <sup>-4</sup> |
|  | %              | 89%                   | 0.93%                 | 9.9%                  | 100%                  |
| Intermediate and low-level radioactive waste                     | kg             | 2.02x10 <sup>-3</sup> | 1.57x10 <sup>-4</sup> | 1.14x10 <sup>-4</sup> | 2.29x10 <sup>-3</sup> |
|  | %              | 88%                   | 6.9%                  | 5%                    | 100%                  |
| Components for re-use  | kg             | 0.00                  | 0.00                  | 0.00                  | 0.00                  |
| Materials for recycling  | kg             | 0.00                  | 0.00                  | 0.00                  | 0.00                  |
| Materials for energy recovery                                    | kg             | Neg.                  | Neg.                  | Neg.                  | Neg.                  |
| Exported energy  | MJ             | Neg.                  | Neg.                  | Neg.                  | Neg.                  |

INA = Indicator Not Assessed | Neg. = Negligible

**Table 11.** Resource use and waste flows for the Litex **Fixed Windows Triple Glazed** window system products by life cycle phase. Results are shown per metric ton of product. Results reported in MJ are calculated using lower heating values.

| Parameter  | Unit           | Raw Materials         | Transport             | Manufacturing         | Total                 |
|--|----------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <b>Resources</b>   |                |                       |                       |                       |                       |
| Renewable primary resources used as energy carrier               | MJ             | 562                   | 0.374                 | 136                   | 698                   |
|  | %              | 80%                   | 0.054%                | 19%                   | 100%                  |
| Renewable primary resources with energy content used as material | MJ             | 0.00                  | 0.00                  | 0.00                  | 0.00                  |
|  | %              | 0%                    | 0%                    | 0%                    | 0%                    |
| Non-renewable primary resources used as an energy carrier        | MJ             | INA                   | INA                   | INA                   | INA                   |
| Renewable primary resources with energy content used as material | MJ             | INA                   | INA                   | INA                   | INA                   |
| Secondary materials  | kg             | 6.42                  | 0.00                  | 0.00                  | 6.42                  |
|  | %              | 100%                  | 0%                    | 0%                    | 100%                  |
| Renewable secondary fuels  | MJ             | Neg.                  | Neg.                  | Neg.                  | Neg.                  |
| Non-renewable secondary fuels                                    | MJ             | Neg.                  | Neg.                  | Neg.                  | Neg.                  |
| Recovered energy   | MJ             | Neg.                  | Neg.                  | Neg.                  | Neg.                  |
| Use of net fresh water   | m <sup>3</sup> | 45.7                  | 2.77                  | 3.40                  | 51.8                  |
|  | %              | 88%                   | 5.4%                  | 6.6%                  | 100%                  |
| <b>Wastes</b>  |                |                       |                       |                       |                       |
| Nonhazardous waste disposed                                      | kg             | 36.5                  | 1.59                  | 1.72                  | 39.8                  |
|  | %              | 92%                   | 4%                    | 4.3%                  | 100%                  |
| Hazardous waste disposed   | kg             | 8.76x10 <sup>-3</sup> | 8.81x10 <sup>-5</sup> | 5.38x10 <sup>-5</sup> | 8.90x10 <sup>-3</sup> |
|  | %              | 98%                   | 0.99%                 | 0.6%                  | 100%                  |
| High-level radioactive waste                                     | kg             | 1.86x10 <sup>-4</sup> | 1.76x10 <sup>-6</sup> | 1.53x10 <sup>-5</sup> | 2.03x10 <sup>-4</sup> |
|  | %              | 92%                   | 0.87%                 | 7.5%                  | 100%                  |
| Intermediate and low-level radioactive waste                     | kg             | 3.11x10 <sup>-3</sup> | 2.19x10 <sup>-4</sup> | 1.41x10 <sup>-4</sup> | 3.47x10 <sup>-3</sup> |
|  | %              | 90%                   | 6.3%                  | 4.1%                  | 100%                  |
| Components for re-use  | kg             | 0.00                  | 0.00                  | 0.00                  | 0.00                  |
| Materials for recycling  | kg             | 0.00                  | 0.00                  | 0.00                  | 0.00                  |
| Materials for energy recovery                                    | kg             | Neg.                  | Neg.                  | Neg.                  | Neg.                  |
| Exported energy  | MJ             | Neg.                  | Neg.                  | Neg.                  | Neg.                  |

INA = Indicator Not Assessed | Neg. = Negligible

## 5. LCA: Interpretation

The interpretation phase conforms to ISO 14044 with further guidance from the ILCD General Guide for Life Cycle Assessment. The interpretation included the use of evaluation and sensitivity checks to steer the iterative process during the assessment, and a final evaluation including completeness, sensitivity, and consistency checks, at the end of the study.

With the exception of the Ozone Depletion Potential, the raw material and processing phase (A1) is the primary contributor to estimated impacts for all products and impact indicators assessed. Impacts from upstream material transport (A2) are generally the next highest contributor followed by product manufacturing (A3). Impacts from the raw material extraction and processing stage are approximately equally split between the sealed glass units and the extruded aluminum product components.

## 6. References

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