Declaration Owner

Litex, Inc.
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Products

Architectural Window Systems:

- *Single Hung; Double Glazed*
- *Double Hung; Double Glazed*

Declared Unit

The declared unit is one square meter of Architectural Window System

EPD Number and Period of Validity

SCS-EPD-07185
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
2000 Powell Street, Ste. 600, Emeryville, CA 94608
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Declaration Owner:	Litex, Inc
Address:	2774 Product Drive, Rochester Hills, MI 48309
Declaration Number:	SCS-EPD-07185
Declaration Validity Period:	EPD Valid July 13, 2021 through July 12, 2026
Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
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	☐ internal ☒ external
LCA Reviewer:	Thomas Gloria, Ph.D., Industrial Ecology Consultants
Product Category Rule:	Earthsure PCR Cradle-to-Gate 30171600:2015. Now maintained by NSF Sustainability: https://www.nsf.org/standards-development/product-category-rules
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	☐ internal ☒ external
EPD Verifier:	Thomas Gloria, Ph.D., Industrial Ecology Consultants
Declaration Contents:	

Disclaimers: *This EPD conforms to ISO 14025, 14040, 14044 and 21930:2007.*

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. 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), aluminum extrusions, window balances, and various hardware, supplied by multiple regional suppliers. The products are packaged for distribution using corrugated board, rubber pads and wooden pallets.

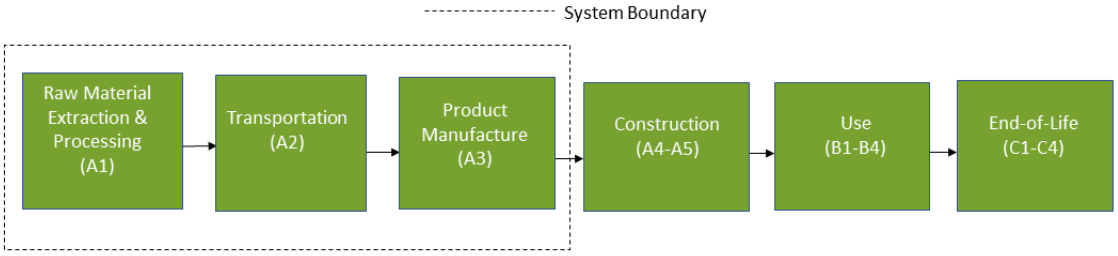
The products assessed include the following:

Product	UNSPSC Code	Product Description
Single Hung; Double Glazed	30171605	Single and double hung windows are vertically sliding windows in which either one sash [single hung] operates or both sash [double hung] operate. Our single and double hung windows are perfect for your new or retrofit application. We can provide applied, between the glass or profile exterior muntin grids to meet any design criteria. We can also provide custom designed extruded interior and exterior trim shapes to meet any historic requirements.
Double Hung; Double Glazed	30171604	

Impact results are presented as an average across products satisfying the variability criteria as specified in the PCR.

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), aluminum extrusions, window balances, and various hardware.

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

Material	Single Hung; Double Glazed	Double Hung; Double Glazed
Aluminum Extrusions	17.2	20.0
	29%	32%
Sealed Glass Units	40.8	40.4
	69%	64%
Hardware	8.50×10^{-2}	0.198
	0.14%	0.32%
Window Balances	1.22	2.44
	2.1%	3.9%
Total Product	**59.4**	**63.0**
	100%	**100%**

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^2 and as a percentage of total mass.*

Material	Single Hung; Double Glazed	Double Hung; Double Glazed
Cardboard	7.42×10^{-2}	7.87×10^{-2}
	2%	2%
Rubber Pads	1.48×10^{-2}	1.57×10^{-2}
	0.41%	0.41%
Wood	3.56	3.78
	98%	98%
Total Packaging	**3.65**	**3.87**
	100%	**100%**

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^2 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^2)
Single Hung; double glazed	1 m^2 of window, including frame	59.4
Double Hung; double glazed	1 m^2 of window, including frame	63.0

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 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

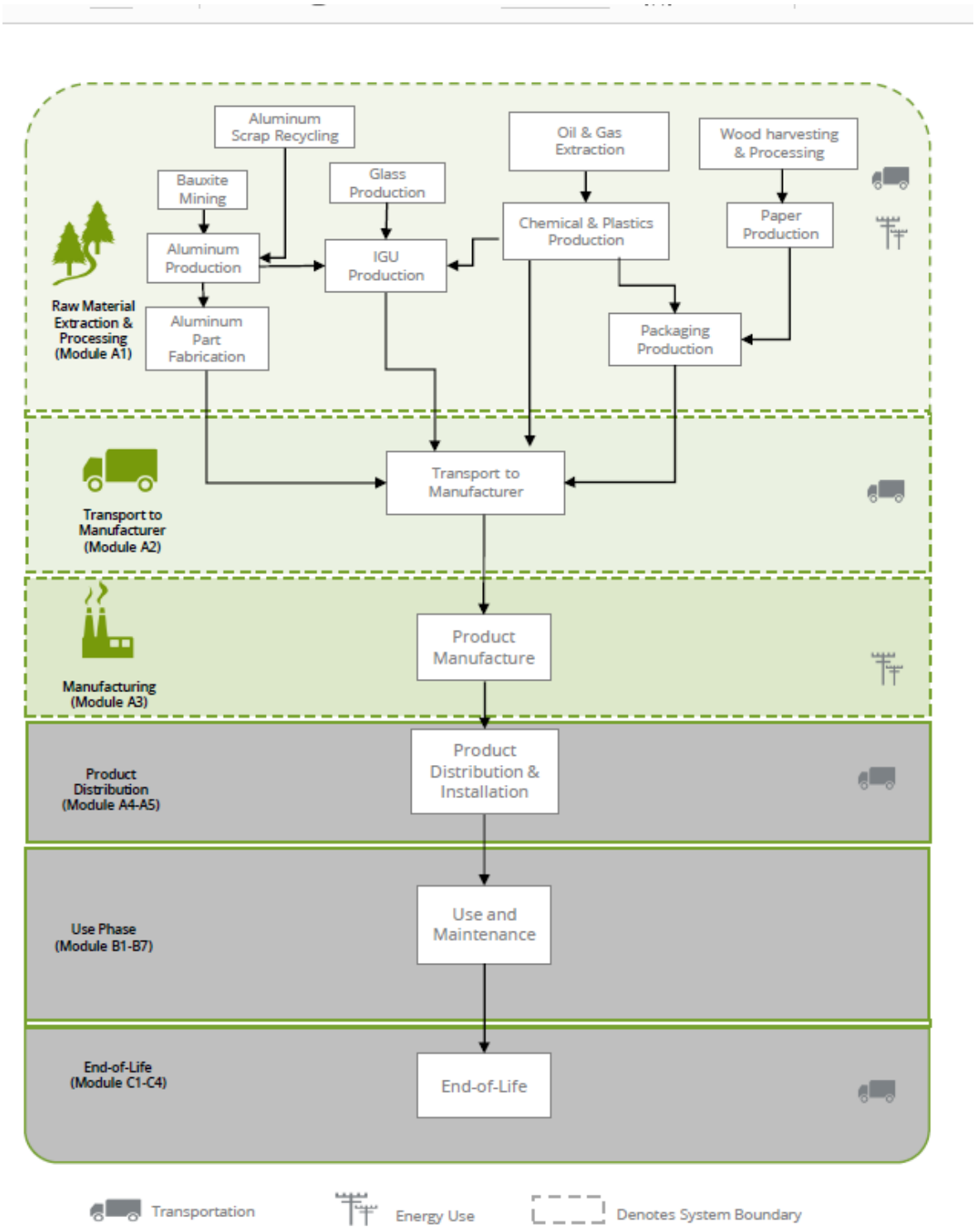


Figure 1. *Flow Diagram for the life cycle of the Litex product system.*

3.3 UNITS

All data and results are presented using SI units.

3.4 ESTIMATES AND ASSUMPTIONS

- Litex's 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
PRODUCT			
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[1]	Industry-Wide EPD	2016
Window Balances	polyethylene production, high density, granulate | polyethylene, high density, granulate | Cutoff, S/RoW; steel production, converter, low-alloyed | steel, low-alloyed | Cutoff, S/RoW	EI v3.7	2020
Bronze Hardware	bronze production | bronze | Cutoff, S/RoW	EI v3.7	2020
PACKAGING			
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		
RESOURCES			
Grid electricity	Electricity, medium voltage, per kWh - RFCM/RFCM	EI v3.7; eGRID	2020; 2018
Propane	heat production, propane, at industrial furnace >100kW | heat, district or industrial, other than natural gas | Cutoff, S/RoW	EI v3.7	2020
TRANSPORTATION			
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

[1] 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
Time-Related Coverage 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
Geographical Coverage 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.
Technology Coverage Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations.
Precision 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.
Completeness 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.
Representativeness 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.
Consistency 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.
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	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.
Sources of the Data 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.
Uncertainty of the Information 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_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 (SFP)	kg O_3 eq
Fossil Fuel Depletion Potential (ADP_{fossil})	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^3	-	-

The variability of indicator results were evaluated to determine whether the window system products assessed for the EPD could be averaged and reported as a single representative set of results for the product group. , the results within each product line considered satisfy the 10% variability requirement of the PCR and are therefore presented as a single set of results in this EPD.

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 **Single/Double Hung** Window system products. Results are shown per metric ton of product.*

Impact Indicator	Unit	Raw Materials	Transport	Manufacturing	Total
Global warming potential	kg CO_2 eq	230	2.59	3.17	236
	%	98%	1.1%	1.3%	100%
Ozone depletion potential	kg CFC-11 eq	1.51	$1.18x10^{-2}$	$1.58x10^{-2}$	1.53
	%	98%	0.77%	1%	100%
Acidification potential	kg SO_2 eq	0.241	$2.89x10^{-3}$	$1.72x10^{-2}$	0.261
	%	92%	1.1%	6.6%	100%
Eutrophication potential	kg N eq	15.8	0.285	0.235	16.3
	%	97%	1.7%	1.4%	100%
Smog formation potential	kg O_3 eq	$5.85x10^{-6}$	$6.04x10^{-7}$	$2.30x10^{-7}$	$6.69x10^{-6}$
	%	88%	9%	3.4%	100%
Fossil Fuel Depletion	MJ eq.	253	5.49	3.67	262
	%	97%	2.1%	1.4%	100%

Table 9. *Resource use and waste flows for the Litex **Single/Double Hung 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
Resources					
Renewable primary resources used as energy carrier	MJ	751	0.433	103	854
	%	88%	0.051%	12%	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	11.4	0.00	0.00	11.4
	%	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^3	4.89	$2.73x10^{-2}$	0.176	5.10
	%	96%	0.54%	3.4%	100%
Wastes					
Nonhazardous waste disposed	kg	46.1	1.84	1.61	49.5
	%	93%	3.7%	3.3%	100%
Hazardous waste disposed	kg	$1.46x10^{-2}$	$1.02x10^{-4}$	$4.34x10^{-5}$	$1.48x10^{-2}$
	%	99%	0.69%	0.29%	100%
High-level radioactive waste	kg	$1.31x10^{-4}$	$2.04x10^{-6}$	$1.38x10^{-5}$	$1.47x10^{-4}$
	%	89%	1.4%	9.4%	100%
Intermediate and low-level radioactive waste	kg	$1.90x10^{-3}$	$2.54x10^{-4}$	$1.21x10^{-4}$	$2.28x10^{-3}$
	%	84%	11%	5.3%	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

1. Life Cycle Assessment of Architectural Window Systems. SCS Global Services Report. Prepared for Litex. July 2021.
2. ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.
3. ISO 14040: 2006/Amd 1:2020 Environmental Management – Life cycle assessment – Principles and Framework.
4. ISO 14044: 2006/ Amd 1:2017/Amd 2:2020 Environmental Management – Life cycle assessment – Requirements and Guidelines.
5. ISO 21930: 2017 Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services.
6. Earthsure PCR Cradle-to-Gate 30171600:2015. Now maintained by NSF Sustainability: https://www.nsf.org/standards-development/product-category-rules.
7. SCS Type III Environmental Declaration Program: Program Operator Manual. V10.1 May 2021. SCS Global Services.
8. Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI). Dr. Bare, J., https://www.epa.gov/chemical-research/tool-reduction-and-assessment-chemicals-and-other-environmental-impacts-traci
9. Ecoinvent Centre (2020) ecoinvent data from v3.7. Swiss Center for Life Cycle Inventories, Dübendorf, 2020, http://www.ecoinvent.org
10. European Joint Research Commission. International Reference Life Cycle Data System handbook. *General guide for Life Cycle Assessment – Detailed Guidance.* © European Union, 2010.

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