



**Declaration Owner**

Cardinal Acoustics  
2941 Donnylane Blvd.  
Columbus, OH 43235  
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**Product:**

Acoustic Panels  
5/8", 1", and 1.5" thickness products

EPD represents delivery of product to customers globally.

**Functional Unit**

The functional unit is one square meter of acoustic paneling over a 75-year period

**EPD Number and Period of Validity**

SCS-EPD-06486  
EPD Valid October 20, 2020 through October 19, 2025

**Product Category Rule**

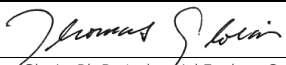
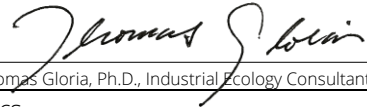
PCR Guidance for Version 3.2. UL Environment. Sept. 2018

PCR Guidance for Building-Related Products and Services Part B: Non-Metal Ceiling Panel EPD Requirements v1. UL Environment. October 2015.

**Program Operator**

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Declaration URL Link:	<a href="https://www.scsglobalservices.com/certified-green-products-guide">https://www.scsglobalservices.com/certified-green-products-guide</a>														
LCA Practitioner:	Tess Garvey, Ph.D., SCS Global Services														
LCA Software and LCI database:	OpenLCA 1.10 software and the Ecoinvent v3.6 database														
Product RSL:	50 years														
Markets of Applicability:	Global														
EPD Type:	Product-Specific														
EPD Scope:	Cradle-to-Grave														
LCIA Method and Version:	CML-IA and 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:	 Thomas Gloria, Ph.D., Industrial Ecology Consultants														
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. Sept. 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 Panel EPD Requirements v1. UL Environment. October 2015.														
Part B PCR Review conducted by:	Lindita Bushi, PhD (Chair); Thomas Gloria, PhD; Philip Moser, P.E. (MA), LEED AP														
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:	<table border="0"> <tr> <td>1. Cardinal Acoustics .....</td> <td>2</td> </tr> <tr> <td>2. Products.....</td> <td>2</td> </tr> <tr> <td>3. LCA: Calculation Rules.....</td> <td>5</td> </tr> <tr> <td>4. LCA: Scenarios and Additional Technical Information .....</td> <td>10</td> </tr> <tr> <td>5. LCA: Results.....</td> <td>12</td> </tr> <tr> <td>6. LCA: Interpretation .....</td> <td>19</td> </tr> <tr> <td>7. References.....</td> <td>21</td> </tr> </table>	1. Cardinal Acoustics .....	2	2. Products.....	2	3. LCA: Calculation Rules.....	5	4. LCA: Scenarios and Additional Technical Information .....	10	5. LCA: Results.....	12	6. LCA: Interpretation .....	19	7. References.....	21
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<p><b>Disclaimers:</b> This EPD conforms to ISO 14025, 14040, 14044, and ISO 21930.</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. Cardinal Acoustics

Cardinal Acoustics is a family owned and operated business headquartered in Columbus, Ohio – experts in the acoustical industry for over 40 years. Their fabrication plant, located in Dayton, Ohio, uses only the finest materials in the manufacturing process, to be certain of consistent quality and function.

## 2. Products

### 2.1 PRODUCT DESCRIPTIONS

Cardinal Acoustics panels are composed of poplar wood fiber, with a magnesium oxide cementlike binder, and are formed in an individual batch process using heat and pressure. The resulting product is durable, attractive, easily decorated and Class A/Class I rated with a flame spread and smoke spread of 0, in accordance with ASTM E-84. Wood fiber acoustical panels which hold up in high impact situations available as lay ins, direct attached to walls or ceilings, suspended as clouds and baffles or designed into shapes. These wood fiber acoustical panels are easy to install and work with – perfect for every environment from new construction to remodeling – anywhere acoustic absorption, toughness and flexible design is needed. Cardinal Acoustics panels efficiently absorb up to 100% of sound and stand up to daily abuse in high traffic, high use areas.

### 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

Cardinal Acoustics manufactures wood fiber panels to be used as lay ins, directly attached to walls or ceilings, or suspended as clouds and baffles to control sound. They are frequently used within the world of education, at schools and colleges globally, at busy businesses, in community and government buildings, and churches, and can be found anywhere sound needs to be better controlled.

### 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 1.** Life cycle phases included in the Cardinal Acoustics acoustic panel 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 for the acoustic panels are summarized in Table 2.

**Table 2.** Product specifications for the Cardinal Acoustic Panels

Name	Value	Unit
<b>Fire Rating</b> ASTM E84-18 for Surface Burning Characteristics of Building Materials	Class 'A'	N/A
<b>Reduction Coefficient (NRC)</b> Test Method C423	0.50	Sound Absorption Average
	0.60	Noise Reduction Coefficient for 1-inch thick A Mounted
<b>Light Reflection</b> ASTM E1477 Luminous Reflectance for Painted Acoustical Wall and Ceiling Panel	Average: 89.94	Luminous Reflectance factor

## 2.6 MARKET PLACEMENT/APPLICATION RULES

Cardinal Acoustics Panels meet Standard Classification for Acoustical Ceiling Products; ASTM E-1264 Type XIV pattern L, Class A.

## 2.7 DELIVERY STATUS

The panels are delivered as panels and shape is specific to the client's application/needs.

## 2.8 MATERIAL COMPOSITION

The primary materials include polymer yarn, backings, coatings and other fillers.

**Table 3.** Material component summary for the Cardinal Acoustics acoustic panel product by mass (per 1 m<sup>2</sup>) and as a percentage of total mass.

Component/ Material	Unit	5/8" Panel (1.59 cm thickness)		1" Panel (2.54 cm thickness)		1.5" Panel (3.81 cm thickness)	
		kg	% of total	kg	% of total	kg	% of total
<b>Product</b>							
Poplar wood wool fiber	kg (%)	4.16	55.0%	5.91	55.0%	9.13	55.0%
Water	kg (%)	1.66	22.0%	2.36	22.0%	3.65	22.0%
Magnesium oxide	kg (%)	0.757	10.0%	1.07	10.0%	1.66	10.0%
Silicon dioxide	kg (%)	0.454	6.00%	0.644	6.00%	0.996	6.00%
Magnesium sulphate	kg (%)	0.416	5.50%	0.591	5.50%	0.913	5.50%
Aluminum oxide	kg (%)	0.114	1.50%	0.161	1.50%	0.249	1.50%
Product Total	kg (%)	7.57	100%	10.7	100%	16.6	100%
<b>Packaging</b>							
Wood pallet	kg (%)	0.00763	1.92%	0.0118	1.90%	0.0183	1.96%
Cardboard	kg (%)	0.390	98.1%	0.610	98.1%	0.915	98.0%
Packaging total	kg (%)	0.398	100%	0.622	100%	0.934	100%

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

## 2.9 MANUFACTURING

The Cardinal Acoustics panels are manufactured in the facility in Dayton, Ohio.

## 2.10 PACKAGING

The products are packaged for shipment using cardboard and wood pallets, see Table 4.

## 2.11 PRODUCT INSTALLATION

Installation of the product is accomplished using hand tools with negligible impacts and waste. 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 or considerations for environment and health during use.

## 2.13 PRODUCT REFERENCE SERVICE LIFE AND BUILDING ESTIMATED SERVICE LIFE

The Reference Service Life (RSL) of the panel product is based on the manufacturer's assumption and is summarized in Table 5 below. The building Estimated Service Life (ESL) is 75 years, consistent with the PCR.

## 2.14 RE-USE PHASE

The panel products are not reused at end-of-life.

## 2.15 DISPOSAL

At end-of-life, the products may be disposed of in a landfill or via incineration. In accordance with the PCR, It is assumed that no components of the product are recycled at end-of-life.

## 2.16 FURTHER INFORMATION

Further information on the product can be found on the manufacturers' website at [www.cardinalacoustics.com](http://www.cardinalacoustics.com)

## 3. LCA: Calculation Rules

### 3.1 FUNCTIONAL UNIT

The functional unit used in the study is defined as 1 m<sup>2</sup> of Cardinal Acoustic Panel installed for use over a 75-year period. The corresponding reference flow for each product system is presented in Table 5. For the present assessment, a reference service lifetime (RSL) corresponding to the manufacturer's conservative assumption of lifetime is used. The total number of required product lifecycles during the 75-year period over which the product system is modeled is also summarized for the product in Table 5.

**Table 4.** Reference flows and RSL for the Cardinal Acoustic Panels.

Product Thickness (cm)	Reference Flow (kg/m <sup>2</sup> )	Reference Service Life - RSL (years)	Replacement Cycle (ESL/RSL-1)
Cardinal Acoustic Panel	1.59	7.57	50 years
	2.54	10.7	
	3.81	16.6	
			0.5

**Table 5.** The modules and unit processes included in the scope for the Cardinal Acoustic Panels.

Module	Module Description	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 panel products and packaging (incl. upstream unit processes for packaging*)
A4	Transport (to the building site)	Transport of product (including packaging) to the building site
A5	Construction-installation process	Impacts from the installation of product are assumed. Only impacts from packaging disposal are included in this phase
B1	Product use	Use of the product in a commercial building setting. There are no associated emissions or impacts from the use of the product.
B2	Product maintenance	Maintenance of products over the 75-year ESL, including periodic cleaning.
B3	Product repair	The product is 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 product is 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 uses 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 the product to waste treatment at end-of-life
C3	Waste processing for reuse, recovery and/or recycling	The products are disposed of by recycling, landfilling or incineration which require no waste processing
C4	Disposal	Disposal of the product
D	Reuse-recovery-recycling potential	Module Not Declared

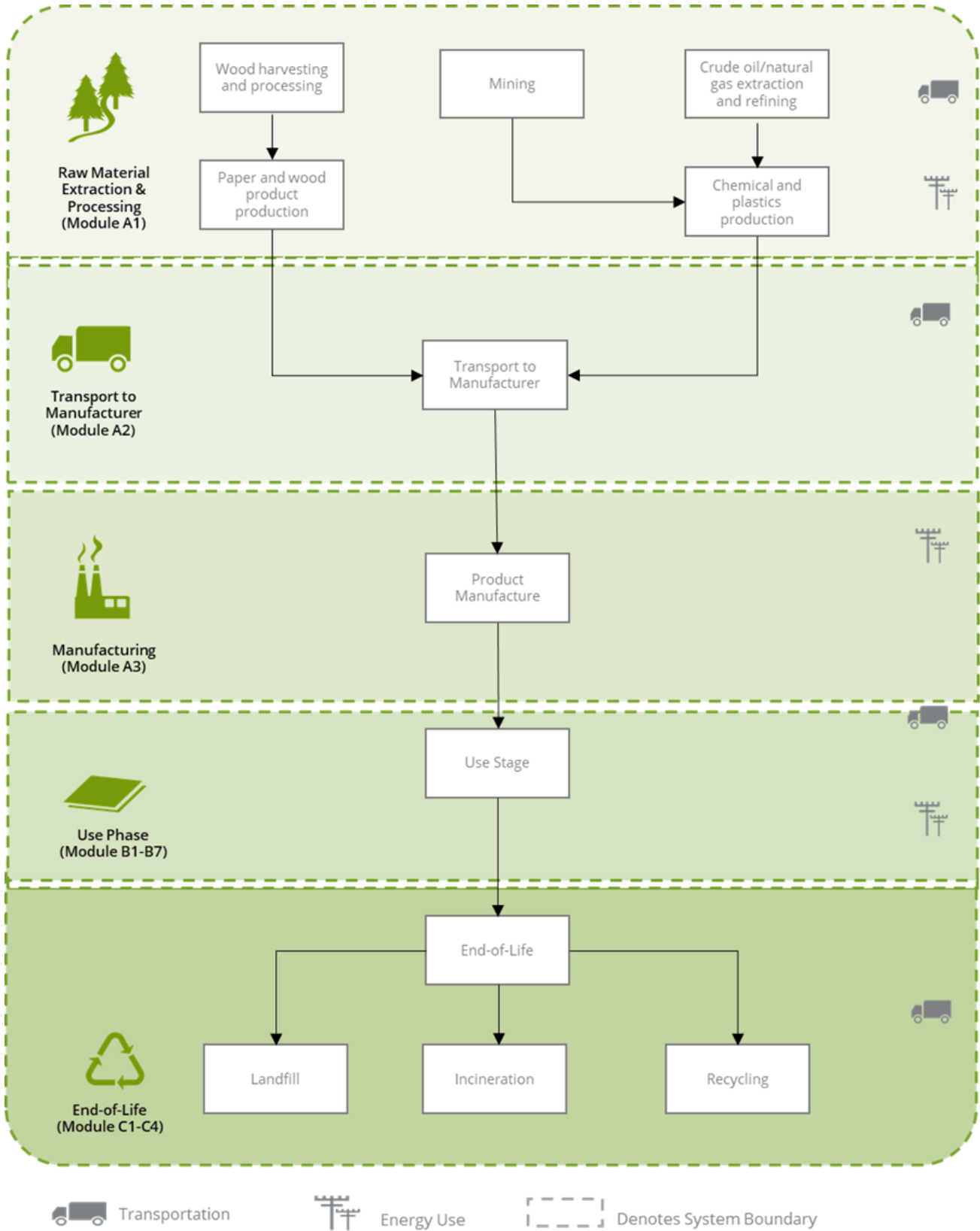


Figure 1. Flow Diagram for the life cycle of the Cardinal Acoustics panel product system.

### 3.3 PRODUCT SPECIFIC CALCULATION FOR USE PHASE

The recommended cleaning regime is highly dependent on the premises where the panels are installed. For the purposes of this EPD, the cleaning regimen is considered negligible, as no specific cleaning procedures are recommended.

### 3.4 UNITS

All data and results are presented using SI units.

### 3.5 ESTIMATES AND ASSUMPTIONS

- Electricity and resource use for manufacturing at the Cardinal Acoustics facility was allocated to the products based on the mass as a fraction of the total production undergoing those processes separately.
- The Cardinal Acoustics facility under review is located in Dayton, Ohio. An Ecoinvent inventory dataset for the eGRID region grid mix was modified to model the RFCW subregion for resource use and emissions from electricity use at the manufacturing facility.
- The Reference Service Life (RSL) of the products was modeled based on information provided by the manufacturer assuming the products are installed and maintained as recommended and used for the specific application noted.
- The distance for distribution was modeled based on average distribution distances provided by the manufacturer.
- In the absence of primary data, other downstream transport, transport to waste processing and installation and deconstruction was modeled based on assumptions in the PCR.
- The maintenance phase of the product life cycle was modeled based on information provided by the manufacturer including recommended installation and cleaning methods.
- For the product end-of-life, disposal of product and product packaging is modeled based on the PCR guidance regarding recycling rates of product and packaging materials.
- For final disposal of the packaging material and panel products at end-of-life, all materials are assumed to be transported 20 miles by diesel truck to either a landfill or material reclamation facility (for recycling). Datasets representing disposal in a landfill and waste incineration are from Ecoinvent.

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.

### 3.6 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 Cardinal Acoustics for their manufacturing facility. The sources of secondary LCI data are the Ecoinvent database.



**Table 6.** Data sources for the Cardinal Acoustics acoustic panel products.

Material Component	Material Dataset	Data Source	Publication Date
<b>PRODUCT COMPONENT</b>			
Wood wool fiber	wood wool production   wood wool   Cutoff, U - CA-QC	Ecoinvent 3.6	2019
Magnesium oxide	magnesium oxide production   magnesium oxide   Cutoff, U - RoW	Ecoinvent 3.6	2019
Silicon dioxide	market for silica sand   silica sand   Cutoff, U - GLO	Ecoinvent 3.6	2019
Magnesium sulphate	magnesium sulfate production   magnesium sulfate   Cutoff, U - RoW	Ecoinvent 3.6	2019
Aluminum dioxide	market for aluminium oxide, non-metallurgical   aluminium oxide, non-metallurgical   Cutoff, U - RoW	Ecoinvent 3.6	2019
Water	tap water production, conventional treatment   tap water   Cutoff, U - RoW	Ecoinvent 3.6	2019
<b>PACKAGING</b>			
Cardboard	corrugated board box production   corrugated board box   Cutoff, U - RoW	Ecoinvent 3.6	2019
Wood pallets	EUR-flat pallet production   EUR-flat pallet   Cutoff, U - RoW	Ecoinvent 3.6	2019
<b>RESOURCES</b>			
Regional electricity mix	electricity voltage transformation from high to medium voltage   electricity, medium voltage   Cutoff, U - RFC	Ecoinvent 3.6	2019
Natural gas	market for heat, central or small-scale, natural gas   heat, central or small-scale, natural gas   Cutoff, U - RoW	Ecoinvent 3.6	2019
<b>TRANSPORTATION</b>			
Truck	transport, freight, lorry 16-32 metric ton, EURO4   transport, freight, lorry 16-32 metric ton, EURO4   Cutoff, U - RoW	Ecoinvent 3.6	2019

### 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 7.** Data quality assessment for the Cardinal Acoustics acoustic panel product system.

Data Quality Parameter	Data Quality Discussion
<p><b>Time-Related Coverage:</b> 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 10 years old (typically 2015 or more recent). 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 2019.</p>
<p><b>Geographical Coverage:</b> 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. Actual processes for upstream operations are primarily North American. Surrogate data used in the assessment are representative of North American operations. Data representative of European operations are considered sufficiently similar to actual processes. Data representing product disposal are based on regional statistics.</p>
<p><b>Technology Coverage:</b> 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.</p>
<p><b>Precision:</b> 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><b>Completeness:</b> Percentage of flow that is measured or estimated</p>	<p>The LCA model included all known mass and energy flows for production of the acoustic 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><b>Representativeness:</b> 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><b>Consistency:</b> 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 v3.6 data where available. Different portions of the product life cycle are equally considered; however, it must be noted that final disposition of the product is based on assumptions of current average practices in Europe and the United States.</p>
<p><b>Reproducibility:</b> 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><b>Sources of the Data:</b> Description of all primary and secondary data sources</p>	<p>Data representing energy use at the Cardinal Acoustics 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. The Ecoinvent database is used for secondary LCI datasets.</p>
<p><b>Uncertainty of the Information:</b> Uncertainty related to data, models, and assumptions</p>	<p>Uncertainty related to materials in the panel products 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 (&lt;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 January 01, 2019 through December 31, 2019.

### 3.10 ALLOCATION

Manufacturing resource use was allocated to the products based on mass. 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 Cardinal Acoustic panels to the point of installation is included in the assessment. Transportation parameters for modeling product distribution are summarized in Table 9. Transport distances for international product distribution were calculated as a production-weighted average of typical shipping distances. Transport of the products to the point of installation is also included based on PCR guidance.

**Table 9.** Product and packaging material distribution parameters, per 1 m<sup>2</sup> (A4).

Transport Mode	5/8"	1"	1.5"
	1.59-cm thick panel	2.54-cm thick panel	3.81-cm thick panel
Diesel truck – Fuel utilization (L/100 km)		42	
Diesel truck – Capacity utilization (%)		76%	
Diesel truck – Distance (km)		450	
Gross mass of product and packaging transported (kg)	7.97	11.3	17.5

The impacts associated with the product installation are assumed negligible. The impacts associated with packaging disposal are included with the installation phase as per PCR requirements.

**Table 10.** Installation parameters for the flooring products, per 1 m<sup>2</sup> (A5).

Parameter	5/8"	1"	1.5"	
	1.59-cm thick panel	2.54-cm thick panel	3.81-cm thick panel	
Ancillary materials (kg)	negligible	negligible	negligible	
Net freshwater consumption (m <sup>3</sup> )	-	-	-	
Electricity consumption (kWh)	-	-	-	
Product loss per functional unit (kg)	negligible	negligible	negligible	
Waste materials generated by product installation (kg)	negligible	negligible	negligible	
Output materials resulting from on-site waste processing (kg)	n/a	n/a	n/a	
Mass of packaging waste (kg)	Paper/Corrugated	0.0975	0.153	0.229
	Plastic	0.0763	0.119	0.183

**Use stage (B1)**

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

**Maintenance stage (B2)**

According to the manufacturer, periodic cleaning may be necessary, as needed. The present assessment assumes these impacts are negligible.

**Repair/Refurbishment stage (B3; B5)**

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

**Replacement stage (B4)**

The materials and energy required for replacement of the products over the 75-year RSL of the assessment are included in this stage.

**Building operation stage (B6 – B7)**

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

**Disposal stage (C1 - C4)**

The disposal stage includes removal of the products (C1); transport of the acoustic panel 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 panel products, no emissions are generated during demolition (C1) while no waste processing (C3) is required for incineration or landfill disposal.

Transportation of waste materials at end-of-life (C2) assumes a 20 mile (~32 km) average distance to disposal, consistent with assumptions used in the US EPA WARM model. At end-of-life, the product is assumed to be disposed in a landfill per PCR requirements. Assumed recycling rates for packaging component materials are based on the PCR. For the packaging materials, 75% of paper and pulp materials are recycled. Of the material not recycled, 20% is incinerated and 80% is assumed landfilled. No recycling of the product materials is assumed at end-of-life. The relevant disposal statistics used for the packaging are summarized in Table 12.

**Table 12.** End-of-life disposal scenario parameters for the panel products.

Parameter		1.59 cm thick panel	2.54 cm thick panel	3.81 cm thick panel
		Value		
Assumptions for scenario development		100% landfill		
Collection process	Collected with mixed construction waste (kg)	7.57	10.7	16.6
Recovery	n/a	0.0	0.0	0.0
Disposal	Landfill (kg)	7.57	10.7	16.6

## 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 and CML-IA.

CML-IA Impact Category	Unit	TRACI 2.1 Impact Category	Unit
Global Warming Potential (GWP)	kg CO <sub>2</sub> eq	Global Warming Potential (GWP)	kg CO <sub>2</sub> eq
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11 eq	Ozone Depletion Potential (ODP)	kg CFC 11 eq
Acidification Potential of soil and water (AP)	kg SO <sub>2</sub> eq	Acidification Potential (AP)	kg SO <sub>2</sub> eq
Eutrophication Potential (EP)	kg PO <sub>4</sub> <sup>3-</sup> eq	Eutrophication Potential (EP)	kg N eq
Photochemical Oxidant Creation Potential (POCP)	kg C <sub>2</sub> H <sub>4</sub> eq	Smog Formation Potential (SFP)	kg O <sub>3</sub> eq
Abiotic depletion potential (ADP-elements) for non-fossil resources	kg Sb eq	Fossil Fuel Depletion Potential (FFD)	MJ Surplus, LHV
Abiotic depletion potential (ADP-fossil fuels) for fossil resources	MJ, 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
RPR <sub>E</sub> : Renewable primary resources used as energy carrier (fuel)	MJ, LHV	HWD: Hazardous waste disposed	kg
RPR <sub>M</sub> : Renewable primary resources with energy content used as material	MJ, LHV	NHWD: Non-hazardous waste disposed	kg
NRPR <sub>E</sub> : Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	HLRW: High-level radioactive waste, conditioned, to final repository	kg
NRPR <sub>M</sub> : Non-renewable primary resources with energy content used as material	MJ, LHV	ILLRW: Intermediate- and low-level radioactive waste, conditioned, to final repository	kg
SM: Secondary materials	MJ, LHV	CRU: Components for re-use	kg
RSF: Renewable secondary fuels	MJ, LHV	MR: Materials for recycling	kg
NRSF: Non-renewable secondary fuels	MJ, LHV	MER: Materials for energy recovery	kg
RE: Recovered energy	MJ, LHV	EE: Recovered energy exported from the product system	MJ, LHV
FW: Use of net freshwater resources	m <sup>3</sup>	-	-

Modules B1, B2, B3, B5, B6, and B7 are not associated with any impact and are therefore declared as zero. In addition, module C1 is likewise not associated with any impact as the products are expected to be manually deconstructed. Module D is not declared. In the interest of space and table readability, these modules are not included in the results presented below.

**Table 14.** Life Cycle Impact Assessment (LCIA) results for Cardinal Acoustics 5/8" (1.59-cm thick) panel 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
<b>CML-IA</b>								
GWP (kg CO <sub>2</sub> eq)	1.42	0.126	10.4	0.626	0.0057	6.31	0.0225	0.0419
	7.49%	0.663%	54.8%	3.30%	0.0298%	33.3%	0.119%	0.221%
AP (kg SO <sub>2</sub> eq)	0.00391	2.50x10 <sup>-4</sup>	0.0279	0.00125	2.33x10 <sup>-5</sup>	0.0167	4.56x10 <sup>-5</sup>	8.68x10 <sup>-5</sup>
	7.79%	0.498%	55.6%	2.49%	0.0463%	33.3%	0.0908%	0.173%
EP (kg (PO <sub>4</sub> ) <sup>3-</sup> eq)	0.00131	5.34x10 <sup>-5</sup>	0.0159	2.70x10 <sup>-4</sup>	5.81x10 <sup>-6</sup>	0.00878	9.53x10 <sup>-6</sup>	2.50x10 <sup>-5</sup>
	4.97%	0.202%	60.3%	1.02%	0.0221%	33.3%	0.0362%	0.0949%
POCP (kg C <sub>2</sub> H <sub>4</sub> eq)	2.80x10 <sup>-4</sup>	1.69x10 <sup>-5</sup>	0.00151	8.40x10 <sup>-5</sup>	8.35x10 <sup>-7</sup>	9.50x10 <sup>-4</sup>	2.95x10 <sup>-6</sup>	9.56x10 <sup>-6</sup>
	9.81%	0.591%	52.9%	2.94%	0.0292%	33.3%	0.103%	0.335%
ODP (kg CFC-11 eq)	4.80x10 <sup>-8</sup>	2.31x10 <sup>-8</sup>	9.03x10 <sup>-7</sup>	1.15x10 <sup>-7</sup>	9.43x10 <sup>-10</sup>	5.50x10 <sup>-7</sup>	4.28x10 <sup>-9</sup>	6.04x10 <sup>-9</sup>
	2.90%	1.40%	54.7%	6.98%	0.0571%	33.3%	0.259%	0.366%
ADPE (kg Sb eq)	2.70x10 <sup>-9</sup>	1.68x10 <sup>-10</sup>	1.12x10 <sup>-7</sup>	8.38x10 <sup>-10</sup>	6.99x10 <sup>-12</sup>	5.79x10 <sup>-8</sup>	2.47x10 <sup>-11</sup>	5.31x10 <sup>-11</sup>
	1.55%	0.10%	64.48%	0.48%	0.004%	33.3%	0.0142%	0.0306%
ADPF (MJ eq)	7.60	1.88	117	9.38	0.0813	68.5	0.348	0.546
	3.70%	0.917%	57.0%	4.57%	0.0396%	33.3%	0.170%	0.266%
<b>TRACI 2.1</b>								
GWP (kg CO <sub>2</sub> eq)	1.41	0.125	10.3	0.624	0.00563	6.25	0.0224	0.0417
	7.51%	0.668%	54.8%	3.33%	0.0300%	33.3%	0.120%	0.222%
AP (kg SO <sub>2</sub> eq)	0.00403	2.40x10 <sup>-4</sup>	0.0276	0.00119	2.74x10 <sup>-5</sup>	0.0166	4.39x10 <sup>-5</sup>	8.44x10 <sup>-5</sup>
	8.093%	0.48%	55.4%	2.390%	0.055%	33.3%	0.0881%	0.1695%
EP (kg N eq)	0.00274	1.20x10 <sup>-4</sup>	0.0350	5.80x10 <sup>-4</sup>	7.27x10 <sup>-6</sup>	0.0192	2.06x10 <sup>-5</sup>	5.36x10 <sup>-5</sup>
	4.75%	0.208%	60.6%	1.01%	0.0126%	33.3%	0.0357%	0.0929%
SFP (kg O <sub>3</sub> eq)	0.0537	0.00240	0.238	0.0120	6.60x10 <sup>-4</sup>	0.154	4.60x10 <sup>-4</sup>	8.90x10 <sup>-4</sup>
	11.6%	0.519%	51.5%	2.59%	0.143%	33.3%	0.0995%	0.192%
ODP (kg CFC-11 eq)	6.24x10 <sup>-8</sup>	3.07x10 <sup>-8</sup>	1.13x10 <sup>-6</sup>	1.53x10 <sup>-7</sup>	1.25x10 <sup>-9</sup>	6.97x10 <sup>-7</sup>	5.69x10 <sup>-9</sup>	8.03x10 <sup>-9</sup>
	2.98%	1.47%	54.2%	7.32%	0.0599%	33.3%	0.272%	0.384%
FFD (MJ eq)	0.613	0.275	11.3	1.37	0.0114	6.83	0.0508	0.0732
	2.99%	1.34%	55.0%	6.68%	0.0558%	33.3%	0.248%	0.357%

**Table 15.** Resource use and waste flows for Cardinal Acoustics 5/8" (1.59-cm thick) panel 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	B2	B4	C2	C4
<b>Resources</b>									
RPR <sub>E</sub> (MJ)	15.1	0.0272	16.6	0.135	0.00115	16.0	0.00447	0.0140	15.1
	31.6%	0.0567%	34.7%	0.283%	0.00240%	33.3%	0.00933%	0.0293%	31.6%
RPR <sub>M</sub> (MJ)	52.2	0.0	10.4	0.0	0.0	31.3	0.0	0.0	52.2
	55.6%	0.0%	11.0%	0.0%	0.0%	33.3%	0.0%	0.0%	55.6%
NRPR <sub>E</sub> (MJ)	8.28	1.92	162	9.58	0.0827	91.2	0.355	0.567	8.28
NRPR <sub>M</sub> (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SM (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RSF/NRSF (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RE (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FW (m <sup>3</sup> )	1.50	0.0743	25.2	0.370	0.00447	13.6	0.0139	0.0362	1.50
	3.67%	0.180%	61.8%	0.910%	0.0100%	33.3%	0.0300%	0.0900%	3.67%
<b>Wastes</b>									
HWD (kg)	4.44x10 <sup>-5</sup>	5.04x10 <sup>-6</sup>	7.78x10 <sup>-5</sup>	2.51x10 <sup>-5</sup>	2.19x10 <sup>-7</sup>	7.74x10 <sup>-5</sup>	8.61x10 <sup>-7</sup>	1.28x10 <sup>-6</sup>	4.44x10 <sup>-5</sup>
	19.1%	2.17%	33.5%	10.8%	0.0943%	33.3%	0.371%	0.553%	19.1%
NHWD (kg)	0.222	0.0913	2.40	0.455	0.0884	5.52	0.0307	7.75	0.222
	1.34%	0.551%	14.5%	2.75%	0.534%	33.3%	0.185%	46.8%	1.34%
HLRW (kg)	2.37x10 <sup>-5</sup>	1.30x10 <sup>-5</sup>	5.40x10 <sup>-4</sup>	6.47x10 <sup>-5</sup>	5.22x10 <sup>-7</sup>	3.30x10 <sup>-4</sup>	2.40x10 <sup>-6</sup>	3.41x10 <sup>-6</sup>	2.37x10 <sup>-5</sup>
	2.43%	1.33%	55.2%	6.61%	0.0534%	33.8%	0.245%	0.349%	2.43%
ILLRW (kg)	3.96x10 <sup>-6</sup>	1.40x10 <sup>-7</sup>	1.30x10 <sup>-4</sup>	6.95x10 <sup>-7</sup>	5.52x10 <sup>-9</sup>	6.57x10 <sup>-5</sup>	2.49x10 <sup>-8</sup>	8.41x10 <sup>-8</sup>	3.96x10 <sup>-6</sup>
	1.97%	0.0695%	64.8%	0.346%	0.00275%	32.8%	0.0124%	0.0419%	1.97%
CRU (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MR (kg)	0.0	0.0	0.0	0.0	0.521	0.261	0.0	0.0	0.0
	0.0%	0.0%	0.0%	0.0%	66.6%	33.3%	0.0%	0.0%	0.0%
MER (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EE (MJ)	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.

Neg. = Negligible

**Table 16.** Life Cycle Impact Assessment (LCIA) results for Cardinal Acoustics 1" (2.54-cm thick) panel 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
<b>CML-IA</b>								
GWP (kg CO <sub>2</sub> eq)	2.01	0.178	14.8	0.896	0.00881	9.19	0.0793	0.0594
	7.39%	0.655%	54.3%	3.29%	0.0324%	33.8%	0.291%	0.218%
AP (kg SO <sub>2</sub> eq)	0.00555	3.60x10 <sup>-4</sup>	0.0398	0.00179	3.62x10 <sup>-5</sup>	0.0243	2.90x10 <sup>-4</sup>	1.20x10 <sup>-4</sup>
	7.68%	0.498%	55.1%	2.48%	0.0501%	33.7%	0.401%	0.166%
EP (kg (PO <sub>4</sub> ) <sup>3-</sup> eq)	0.00186	7.57x10 <sup>-5</sup>	0.0227	3.80x10 <sup>-4</sup>	9.06x10 <sup>-6</sup>	0.0127	7.04x10 <sup>-5</sup>	3.55x10 <sup>-5</sup>
	4.92%	0.200%	60.0%	1.01%	0.0240%	33.6%	0.186%	0.0939%
POCP (kg C <sub>2</sub> H <sub>4</sub> eq)	4.00x10 <sup>-4</sup>	2.39x10 <sup>-5</sup>	0.00215	1.20x10 <sup>-4</sup>	1.30x10 <sup>-6</sup>	0.00139	1.09x10 <sup>-5</sup>	1.36x10 <sup>-5</sup>
	9.74%	0.583%	52.4%	2.92%	0.0317%	33.8%	0.266%	0.330%
ODP (kg CFC-11 eq)	6.81x10 <sup>-8</sup>	3.28x10 <sup>-8</sup>	1.29x10 <sup>-6</sup>	1.65x10 <sup>-7</sup>	1.47x10 <sup>-9</sup>	8.51x10 <sup>-7</sup>	1.34x10 <sup>-8</sup>	8.58x10 <sup>-9</sup>
	2.80%	1.35%	53.0%	6.80%	0.0606%	35.1%	0.554%	0.353%
ADPE (kg Sb eq)	3.83x10 <sup>-9</sup>	2.39x10 <sup>-10</sup>	1.59x10 <sup>-7</sup>	1.20x10 <sup>-9</sup>	1.09x10 <sup>-11</sup>	8.88x10 <sup>-8</sup>	9.83x10 <sup>-11</sup>	7.54x10 <sup>-11</sup>
	1.51%	0.0943%	62.8%	0.474%	0.00430%	35.1%	0.0388%	0.0298%
ADPF (MJ eq)	10.8	2.67	167	13.4	0.127	98.9	1.15	0.775
	3.66%	0.907%	56.6%	4.56%	0.0430%	33.6%	0.389%	0.263%
<b>TRACI 2.1</b>								
GWP (kg CO <sub>2</sub> eq)	2.04	0.181	14.9	0.911	0.00896	9.11	0.0806	0.0604
	7.47%	0.664%	54.6%	3.33%	0.0328%	33.3%	0.295%	0.221%
AP (kg SO <sub>2</sub> eq)	0.00583	0.000347	0.0401	0.00174	4.35x10 <sup>-5</sup>	0.0243	3.37x10 <sup>-4</sup>	1.22x10 <sup>-4</sup>
	8.01%	0.476%	55.1%	2.39%	0.0597%	33.3%	0.462%	0.168%
EP (kg N eq)	0.00396	1.73x10 <sup>-4</sup>	0.0508	8.47x10 <sup>-4</sup>	1.16x10 <sup>-5</sup>	0.0280	9.89x10 <sup>-5</sup>	7.76x10 <sup>-5</sup>
	4.71%	0.206%	60.5%	1.01%	0.0138%	33.3%	0.118%	0.0924%
SFP (kg O <sub>3</sub> eq)	0.0777	0.00348	0.348	0.0175	0.00105	0.229	0.00758	0.00129
	11.3%	0.507%	50.8%	2.55%	0.153%	33.3%	1.11%	0.187%
ODP (kg CFC-11 eq)	9.03x10 <sup>-8</sup>	4.45x10 <sup>-8</sup>	1.65x10 <sup>-6</sup>	2.23x10 <sup>-7</sup>	1.99x10 <sup>-9</sup>	1.02x10 <sup>-6</sup>	1.82x10 <sup>-8</sup>	1.16x10 <sup>-8</sup>
	2.96%	1.46%	53.9%	7.31%	0.0652%	33.3%	0.596%	0.381%
FFD (MJ eq)	0.888	0.398	16.4	2.00	0.0182	9.99	0.165	0.106
	2.96%	1.33%	54.7%	6.67%	0.0607%	33.3%	0.551%	0.353%



**Table 17.** Resource use and waste flows for Cardinal Acoustics 1" (2.54-cm thick) panel 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	B2	B4	C2	C4
<b>Resources</b>									
RPR <sub>E</sub> (MJ)	21.5	0.0386	25.3	0.194	0.00178	23.5	0.0151	0.0199	21.5
	30.5%	0.0546%	35.8%	0.275%	0.00252%	33.3%	0.0214%	0.0282%	30.5%
RPR <sub>M</sub> (MJ)	80.2	0.0	16.2	0.0	0.0	48.2	0.0	0.0	80.2
	55.5%	0.0%	11.2%	0.0%	0.0%	33.3%	0.0%	0.0%	55.5%
NRPR <sub>E</sub> (MJ)	11.8	2.73	230	13.7	0.129	130	1.17	0.804	11.8
NRPR <sub>M</sub> (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SM (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RSF/NRSF (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RE (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FW (m <sup>3</sup> )	2.13	0.105	35.9	0.530	0.00733	19.4	0.0452	0.0513	2.13
	3.65%	0.180%	61.7%	0.910%	0.0100%	33.3%	0.0800%	0.0900%	3.65%
<b>Wastes</b>									
HWD (kg)	6.30x10 <sup>-5</sup>	7.16x10 <sup>-6</sup>	1.10x10 <sup>-4</sup>	3.60x10 <sup>-5</sup>	3.41x10 <sup>-7</sup>	1.10x10 <sup>-4</sup>	3.14x10 <sup>-6</sup>	1.82x10 <sup>-6</sup>	6.30x10 <sup>-5</sup>
	19.0%	2.16%	33.2%	10.8%	0.103%	33.2%	0.949%	0.549%	19.0%
NHWD (kg)	0.315	0.130	3.42	0.651	0.138	7.85	0.0449	11.0	0.315
	1.34%	0.550%	14.5%	2.76%	0.585%	33.3%	0.191%	46.7%	1.34%
HLRW (kg)	3.37x10 <sup>-5</sup>	1.84x10 <sup>-5</sup>	7.70x10 <sup>-4</sup>	9.26x10 <sup>-5</sup>	8.29x10 <sup>-7</sup>	4.70x10 <sup>-4</sup>	7.46x10 <sup>-6</sup>	4.84x10 <sup>-6</sup>	3.37x10 <sup>-5</sup>
	2.41%	1.32%	55.1%	6.6%	0.0593%	33.6%	0.534%	0.346%	2.41%
ILLRW (kg)	5.62x10 <sup>-6</sup>	1.98x10 <sup>-7</sup>	1.80x10 <sup>-4</sup>	9.95x10 <sup>-7</sup>	1.14x10 <sup>-8</sup>	9.34x10 <sup>-5</sup>	7.02x10 <sup>-8</sup>	1.19x10 <sup>-7</sup>	5.62x10 <sup>-6</sup>
	2.01%	0.0706%	64.2%	0.355%	0.00405%	33.3%	0.0250%	0.0426%	2.01%
CRU (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MR (kg)	0.0	0.0	0.0	0.0	0.814	0.407	0.0	0.0	0.0
	0.0%	0.0%	0.0%	0.0%	66.6%	33.3%	0.0%	0.0%	0.0%
MER (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EE (MJ)	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.

Neg. = Negligible

**Table 18.** Life Cycle Impact Assessment (LCIA) results for Cardinal Acoustics 1.5" (3.81-cm thick) panel 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
<b>CML-IA</b>								
GWP (kg CO <sub>2</sub> eq)	3.11	0.275	22.8	1.38	0.0132	13.9	0.0509	0.0761
	7.47%	0.662%	54.9%	3.32%	0.0317%	33.3%	0.122%	0.183%
AP (kg SO <sub>2</sub> eq)	0.00858	5.50x10 <sup>-4</sup>	0.0615	0.00276	5.43x10 <sup>-5</sup>	0.0369	1.80x10 <sup>-4</sup>	1.20x10 <sup>-4</sup>
	7.76%	0.497%	55.6%	2.50%	0.0491%	33.3%	0.163%	0.109%
EP (kg (PO <sub>4</sub> ) <sup>3-</sup> eq)	0.00287	1.20x10 <sup>-4</sup>	0.0350	5.90x10 <sup>-4</sup>	1.35x10 <sup>-5</sup>	0.0193	4.29x10 <sup>-5</sup>	2.81x10 <sup>-5</sup>
	4.95%	0.207%	60.3%	1.02%	0.0232%	33.3%	0.074%	0.0484%
POCP (kg C <sub>2</sub> H <sub>4</sub> eq)	6.20x10 <sup>-4</sup>	3.70x10 <sup>-5</sup>	0.00333	1.90x10 <sup>-4</sup>	1.87x10 <sup>-6</sup>	0.00209	6.64x10 <sup>-6</sup>	1.19x10 <sup>-5</sup>
	9.86%	0.588%	53.0%	3.02%	0.0297%	33.2%	0.106%	0.189%
ODP (kg CFC-11 eq)	1.05x10 <sup>-7</sup>	5.07x10 <sup>-8</sup>	1.99x10 <sup>-6</sup>	2.55x10 <sup>-7</sup>	2.24x10 <sup>-9</sup>	1.21x10 <sup>-6</sup>	9.33x10 <sup>-9</sup>	1.35x10 <sup>-8</sup>
	2.90%	1.40%	54.7%	7.01%	0.0616%	33.3%	0.257%	0.372%
ADPE (kg Sb eq)	5.91x10 <sup>-9</sup>	3.69x10 <sup>-10</sup>	2.46x10 <sup>-7</sup>	1.85x10 <sup>-9</sup>	1.79x10 <sup>-11</sup>	1.27x10 <sup>-7</sup>	4.54x10 <sup>-11</sup>	2.26x10 <sup>-10</sup>
	1.55%	0.0968%	64.5%	0.486%	0.00469%	33.3%	0.0119%	0.0593%
ADPF (MJ eq)	16.7	4.13	258	20.7	0.191	151	0.78	1.04
	3.69%	0.914%	57.0%	4.59%	0.0422%	33.3%	0.172%	0.231%
<b>TRACI 2.1</b>								
GWP (kg CO <sub>2</sub> eq)	3.09	0.275	22.6	1.378	0.01317	13.75	0.0507	0.0759
	7.50%	0.666%	54.8%	3.34%	0.0319%	33.3%	0.123%	0.184%
AP (kg SO <sub>2</sub> eq)	0.00885	5.30x10 <sup>-4</sup>	0.0608	0.00263	6.40x10 <sup>-5</sup>	0.0366	2.10x10 <sup>-4</sup>	1.20x10 <sup>-4</sup>
	8.06%	0.483%	55.4%	2.40%	0.0583%	33.3%	0.191%	0.109%
EP (kg N eq)	0.00600	2.60x10 <sup>-4</sup>	0.0769	0.00129	1.66x10 <sup>-5</sup>	0.0423	5.71x10 <sup>-5</sup>	6.19x10 <sup>-5</sup>
	4.73%	0.205%	60.6%	1.02%	0.0131%	33.3%	0.045%	0.0488%
SFP (kg O <sub>3</sub> eq)	0.118	0.00528	0.527	0.0265	0.00156	0.342	0.00481	0.00118
	11.5%	0.515%	51.4%	2.58%	0.152%	33.3%	0.47%	0.115%
ODP (kg CFC-11 eq)	1.37x10 <sup>-7</sup>	6.74x10 <sup>-8</sup>	2.49x10 <sup>-6</sup>	3.38x10 <sup>-7</sup>	2.97x10 <sup>-9</sup>	1.53x10 <sup>-6</sup>	1.24x10 <sup>-8</sup>	1.78x10 <sup>-8</sup>
	2.97%	1.46%	54.2%	7.34%	0.0646%	33.3%	0.270%	0.387%
FFD (MJ eq)	1.35	0.603	24.8	3.03	0.0270	15.1	0.112	0.153
	2.98%	1.34%	55.0%	6.70%	0.0599%	33.3%	0.247%	0.340%

**Table 19.** Resource use and waste flows for Cardinal Acoustics 1.5" (3.81-cm thick) panel 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
<b>Resources</b>								
RPR <sub>E</sub> (MJ)	33.2	0.0596	38.9	0.299	0.00327	36.3	0.00851	0.0777
	31%	0.0547%	35.7%	0.275%	0.00300%	33.3%	0.00782%	0.0714%
RPR <sub>M</sub> (MJ)	115	0.0	24.6	0.0	0.0	69.6	0.0	0.0
	54.9%	0.0%	11.8%	0.0%	0.0%	33.3%	0.0%	0.0%
NRPR <sub>E</sub> (MJ)	18.2	4.22	356	21.2	0.195	201	0.790	1.13
NRPR <sub>M</sub> (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SM (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
RSF/NRSF (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RE (MJ)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FW (m <sup>3</sup> )	3.28	0.163	55.5	0.817	0.0110	29.9	0.0306	0.0793
	3.66%	0.180%	61.8%	0.910%	0.0100%	33.3%	0.0300%	0.0900%
<b>Wastes</b>								
HWD (kg)	9.74x10 <sup>-5</sup>	1.11x10 <sup>-5</sup>	1.70x10 <sup>-4</sup>	5.55x10 <sup>-5</sup>	5.09x10 <sup>-7</sup>	1.70x10 <sup>-4</sup>	1.89x10 <sup>-6</sup>	2.81x10 <sup>-6</sup>
	19.1%	2.17%	33.4%	10.9%	0.0999%	33.4%	0.371%	0.553%
NHWD (kg)	0.487	0.200	5.29	1.00	0.209	12.1	0.0673	17.0
	1.34%	0.550%	14.5%	2.76%	0.576%	33.3%	0.185%	46.7%
HLRW (kg)	5.21x10 <sup>-5</sup>	2.85 x10 <sup>-5</sup>	0.00119	1.40x10 <sup>-4</sup>	1.26x10 <sup>-6</sup>	7.20x10 <sup>-4</sup>	5.26x10 <sup>-6</sup>	7.48x10 <sup>-6</sup>
	2.43%	1.33%	55.5%	6.53%	0.0589%	33.6%	0.245%	0.349%
ILLRW (kg)	8.69x10 <sup>-6</sup>	3.06x10 <sup>-7</sup>	2.80x10 <sup>-4</sup>	1.54x10 <sup>-6</sup>	1.74x10 <sup>-8</sup>	1.40x10 <sup>-4</sup>	5.45x10 <sup>-8</sup>	1.84x10 <sup>-7</sup>
	2.02%	0.0710%	65.0%	0.356%	0.00403%	32.5%	0.0127%	0.0428%
CRU (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MR (kg)	0.0	0.0	0.0	0.0	1.24	0.618	0.0	0.0
	0.0%	0.0%	0.0%	0.0%	66.6%	33.3%	0.0%	0.0%
MER (kg)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EE (MJ)	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.

Neg. = Negligible

## 6. LCA: Interpretation

The contributions to total impact indicator results are dominated by the product manufacturing phase (A3), followed by the product replacement stage (B4). Other life cycle phase contributions are minimal.

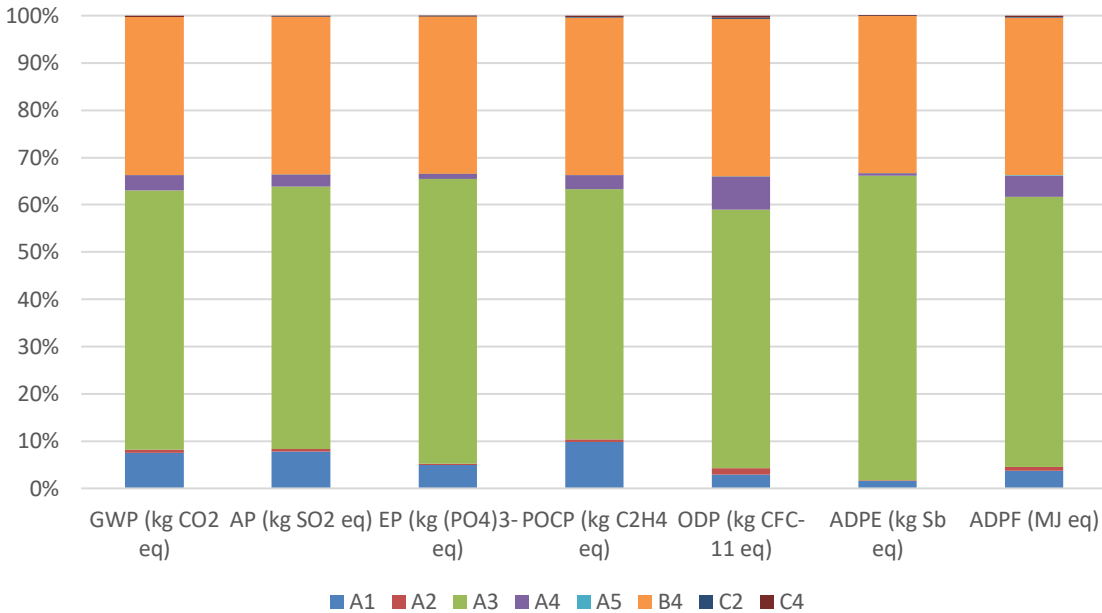


Figure 3. Contribution analysis for the 5/8 inch (1.59 cm) thick acoustic panel.

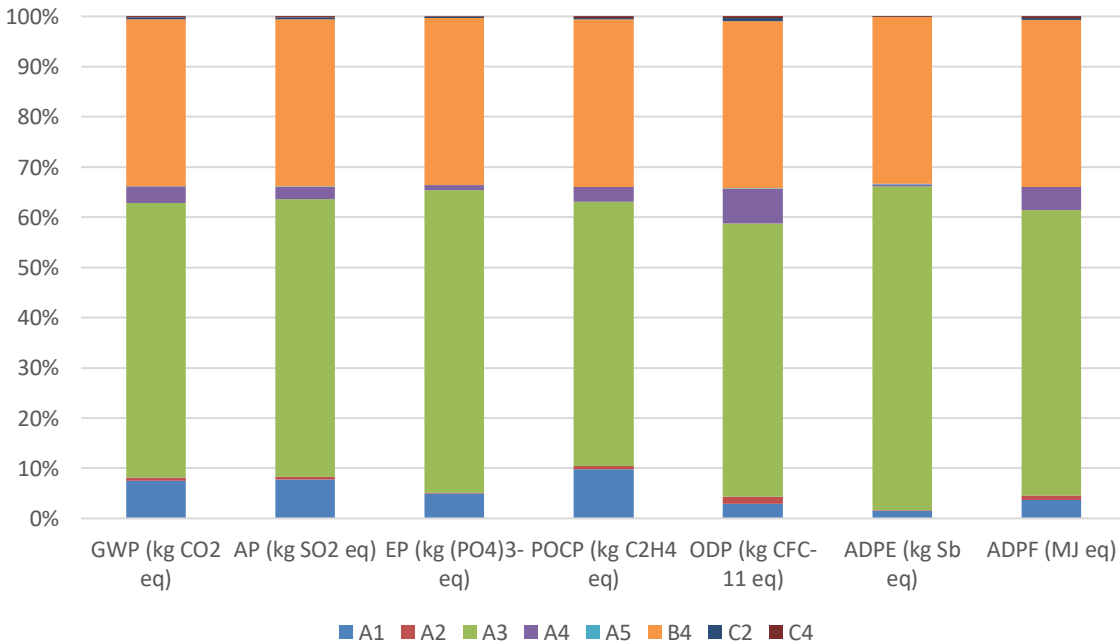


Figure 4. Contribution analysis for the 1 inch (2.54 cm) thick acoustic panel.

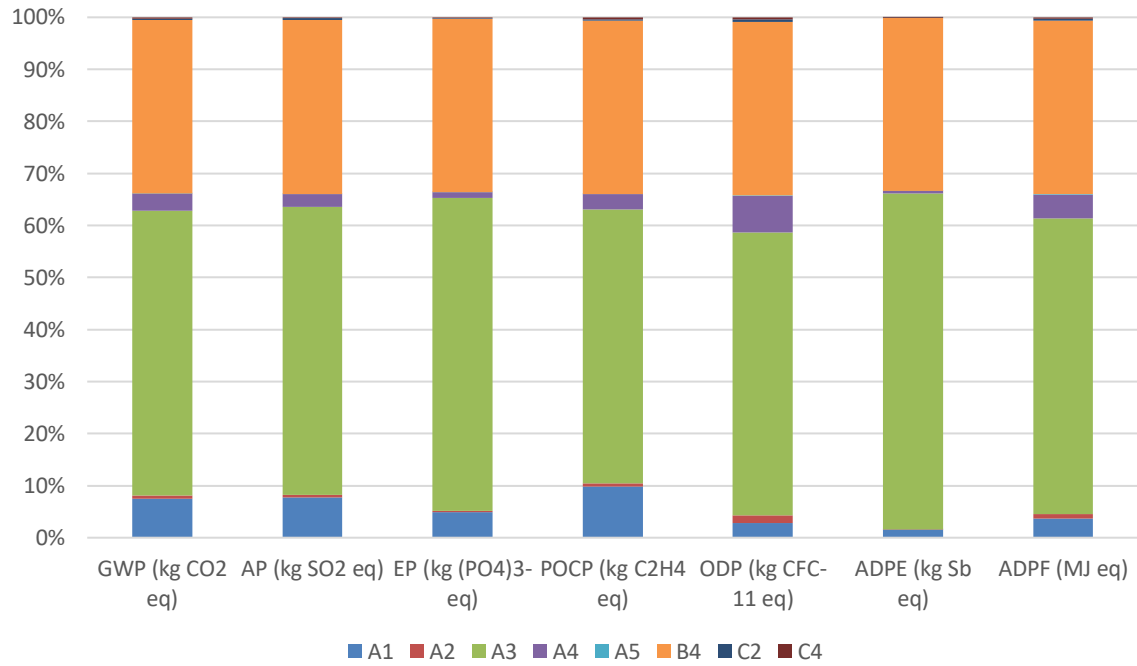


Figure 5. Contribution analysis for the 1.5 inch (3.81 cm) thick acoustic panel.

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