LIFE CYCLE ASSESSMENT

ARKTURA

Products Included:

Metal Ceiling Panels

Study Completed:

May 2023

Critical Review Completed:

August 2023

WAP Sustainability Consulting, LLC.1701 Market Street Chattanooga TN 37408 www.wapsustainability.com

DOCUMENT SUMMARY

The following table identifies the relevant details of the life cycle assessment (LCA) for use in various certification programs.

MANUFACTURER	Arktura LLC 18225 South Figueroa Street, Los Angeles, CA 90248
PRODUCT(S)	Steel Ceiling and Interior Wall Panels Aluminum Ceiling and Interior Wall Panels
DECLARED UNIT	1 m^2 of panel (alternate unit of 1 ft^2)
REFERENCE SERVICE LIFE (RSL)	n/a
REFERENCE STANDARDS	☒ ISO 14040 ☒ ISO 14044 ☒ ISO 21930
REFERENCE PCR	ISO 21930:2017 UL Part A: Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010, V3.2. UL Part B: Metal Ceiling and Interior Wall Panel System EPD Requirements, UL 10010-12, v1.0
LCA SCOPE	Cradle-to-Gate
LCA STUDY DETAILS	Completed: May 2023 LCA Practitioner: Nicholas Hammond and Maggie Wildnauer, WAP Sustainability Consulting, LLC
LCA REVIEW DETAILS	Completed: August 2023 LCA Reviewer: Lindita Bushi, PhD Athena Sustainable Materials Institute ☐ INTERNAL ☒ EXTERNAL
PROGRAM OPERATOR	ASTM International
YEAR OF PRIMARY DATA	2021
LCA SOFTWARE	Sphera LCA for Experts (fka GaBi) 10.7
LCA DATABASE	Sphera Managed LCA Content (fka GaBi) 2022.2
LCIA METHODOLOGY	TRACI 2.1 and IPCC AR5
APPLICABLE REGION(S)	North America

Important Note: Results presented in this report are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins, or risks.

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1 EXECUTIVE SUMMARY

Current trends in corporate sustainability emphasize transparency and the evaluation of environmental and social impacts throughout a product's entire value chain. Thus, life cycle assessment (LCA) is considered to be an important delivery tool of transparent market communication and product optimization opportunities. By calculating the potential environmental impacts of their products, Arktura hopes to better understand areas of high environmental impacts, within and outside their direct production process, and participate in voluntary reporting of product environmental performance.

According to the international standards that dictate the LCA process, ISO 14040 and ISO 14044, the goal and scope of a study must be clearly defined (ISO, 2006; ISO, 2006). In the case of this assessment, the LCA was conducted for two central reasons. First, to understand key environmental parameters, such as greenhouse gas emissions and energy demand. Second, it will be used to develop publicly available environmental product declarations (EPDs). The latter reason will require a critical review by an independent third party. The critical review ensures that the LCA has met all relevant standards and that the results are plausible. The critical review does not ensure that the results can be compared to the results of other LCA studies. The resulting EPDs may be used to compare with EPDs produced under the same PCR.

Key inputs evaluated in the study include electrical and thermal energy consumption, transportation, sourcing of raw materials, packaging materials and generation of waste. Figure 1 presents relative global warming potential (GWP) results for all products. Upstream production of raw materials is the largest contributor, followed by packaging.

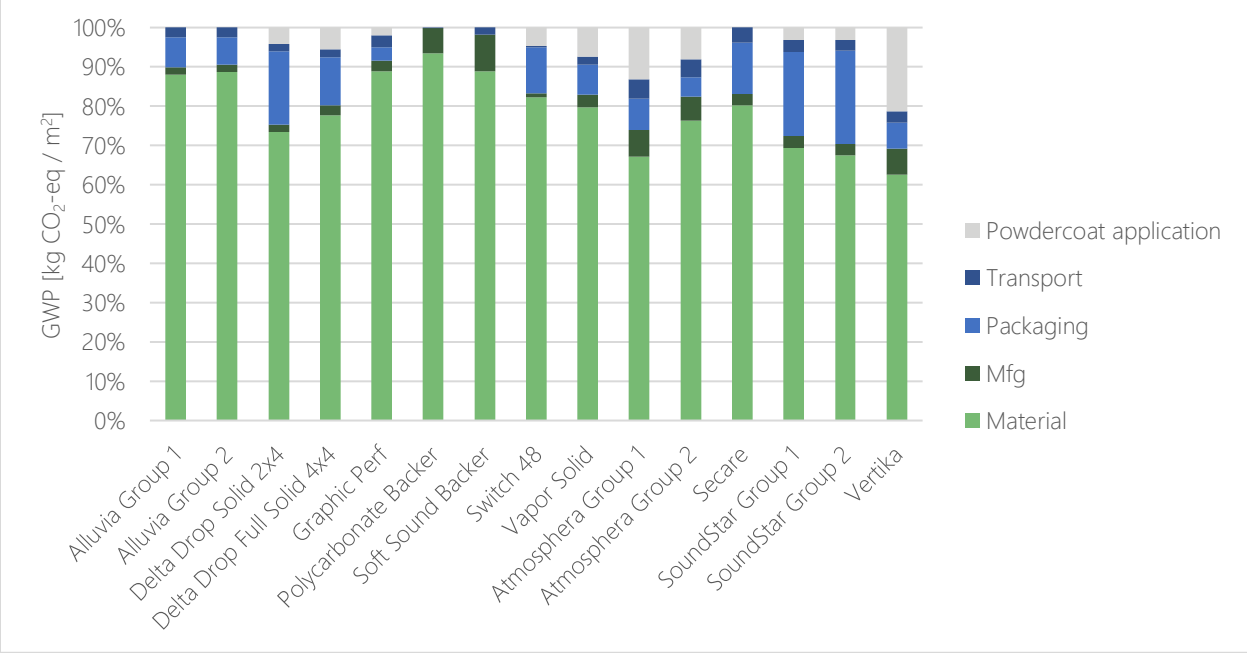


Figure 1: Overview of GWP Impacts, all products

2 GENERAL INFORMATION

This LCA project report represents the systematic and comprehensive summary of project documentation and showcases any data and information of importance to the results and as required by the product category rules (PCRs) listed below.

2.1 COMPANY PROFILE

At Arktura, we make design happen. For over a decade, Arktura has been at the forefront of architectural design and fabrication, delivering groundbreaking, award-winning products and custom projects, working in collaboration with architects and interior designers around the world.

Our architectural systems are devised with flexibility in mind, combining powerful design variables that allow each product to be tailored to a wide range of environments. Our growing line of offerings, including acoustic solutions, ceiling clouds and baffles, interior and exterior panel systems, and building façades set new standards across the A+D community in terms of design aesthetic, adaptability and product quality.

Each of our standardized products is an easy-to-use, highly flexible “tool set.” From overall configuration right down to attachment points, perforations, patterns, and finishes, the variables designed into each core product set can be adjusted to meet your requirements. Explore our products library to see the results—visual impact, simple refinement, and ease of installation.

2.2 LCA COMMISSIONERS AND PRACTITIONERS

Arktura commissioned this LCA study. Primary data were provided by Arktura associates from the facility in which the products are produced. WAP Sustainability Consulting was contracted to develop the LCA model and complete this background report. Maggie Wildnauer of WAP Sustainability served as the project manager. Nicholas Hammond of WAP Sustainability was the lead LCA practitioner. Primary data were collected, and quality assured through efforts of both WAP Sustainability and Arktura.

2.3 REPORTING DATE

This LCA study was commenced in March 2022 and a draft was submitted for critical review in May 2023.

2.4 INTENDED APPLICATION AND REASONS FOR THE STUDY

This LCA was conducted for the development and release of Environmental Product Declarations (EPDs) based on the following product category rules:

- UL PCR Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010, v3.2 (UL Environment, 2018)
- UL PCR Part B: Metal Ceiling and Interior Wall Panel System EPD Requirements, UL 10010-12, v1.0 (UL Environment, 2020; UL Environment, 2020)

These PCRs comply with ISO 21930 (ISO, 2017).

2.5 TARGET GROUP/AUDIENCE

The intended audience of this report includes external LCA critical reviewers and internal management, marketing, and/or research and development. The EPDs created from this report may be used for business-to-business communication.

2.6 COMPARATIVE ASSERTIONS AND PUBLIC DISCLOSURE

This study was not completed with the intent that comparative assertions with external objects or public disclosures (i.e., comparative marketing claims) would be made. However, the results from the report will be used as the basis of product optimization documentation and will be used to develop EPDs. The EPDs will be disclosed to the public.

2.7 STANDARDS AND PCR COMPLIANCE

This LCA has been critically reviewed for compliance with ISO 14025, 14040, 14044, 21930 and the PCRs mentioned in section 2.4 (ISO, 2006; ISO, 2006; ISO, 2006; ISO, 2017). The critical review confirmed that this LCA meets the requirements of these standards, and the verification statement and checklist are included in Appendix B.

2.8 PRODUCT DESCRIPTION

This life cycle assessment report covers the following product families:

- Steel Panels
    - Atmosphera®
    - Secare®
    - SoundStar®
    - TriSoft®
- Aluminum Panels
    - Alluvia®
    - Delta Drop®
    - Graphic Perf®
    - Vapor Graphic Perf®
    - Particle®
    - Trace®
    - Vapor®
    - VaporHue®
- Vertika® Wall Channel System

All products are intended for use in an interior (unless explicitly noted as exterior), commercial setting.

The relevant CSI divisions and UNSPSC codes are presented in Table 1.

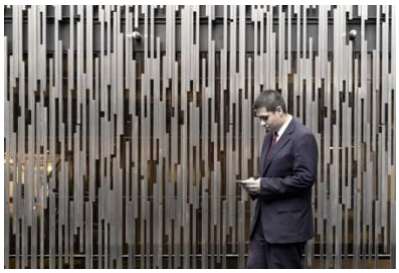
Table 1: Product CSI divisions and UNSPSC codes

	Atmosphera®	Secare®	SoundStar®	TriSoft®	Alluvia®	Delta Drop®	Graphic Perf®	Vapor Graphic Perf®	Particle®	Trace®	Vapor®	VaporHue®	Vertika® Wall Channel System
CSI													
05 70 00 Decorative Metal	x	x	x	x	x	x	x	x	x	x	x	x	
07 42 13 Metal Wall Panels		x				x		x	x	x	x	x	
07 42 63 Fabricated Wall Panel Assemblies													x
09 50 00 Ceilings	x		x	x	x	x	x	x	x	x	x	x	
09 51 00 Acoustical Ceilings								x	x	x	x	x	
09 54 05 Specialty Ceilings	x		x	x	x	x	x	x	x	x	x	x	
09 78 13 Metal Interior Wall Paneling		x											
UNSPSC													
30161601 Acoustic ceiling tiles										x	x		
30161602 Ceiling panels	x	x	x	x	x	x	x	x	x	x	x	x	
25172000 Suspension system components													x

Product descriptions, images, and technical requirements are presented in the following sections.

2.8.1 Steel Panels

Atmosphera® systems showcase the pinnacle of Arktura's innovative design and manufacturing capabilities. With a versatile family of modular ceiling systems, Atmosphera® presents options that are dynamic, scalable, and affordable. Choose from a spectrum of designs that cater to your aesthetic preferences, be it linear, organic, or faceted, and enjoy the wide range of colors available. Immerse your spaces in a unique visual experience that breathes life into any environment.



Assembled from precision-cut tubes, **Secare**® panels add a textural and dimensional impact to any project. The choice of round or square tubing, the luxurious aesthetic of the brushed stainless steel, and the variety of the powder coated options combine to create a versatile product range. Each preassembled module is designed to respond dynamically to the needs of your space.

The **SoundStar**® ceiling system's hexagonally shaped cellular clouds offer a scalable way to add geometric dimensionality and disrupt sound's ability to travel across a space. Its design incorporates angled surfaces made from our Soft Sound® acoustical material to dampen noise in every direction. Thanks to its flexible, modular configuration, SoundStar® can quickly be installed and adapt to a range of spaces and design visions.

TriSoft® ceiling system makes it easy to add faceted dimensionality and quiet elegance to interiors. Its triangular faceted pyramid faces are composed of our Soft Sound® acoustical material with a metal substructure. Mix and match TriSoft's® available modules and nodes as building blocks to build faceted straight field layouts scalable to any size space. With a variety of color options, and specially engineered attachment brackets, TriSoft® is designed for maximum impact, flexibility, convenience, and acoustic performance.

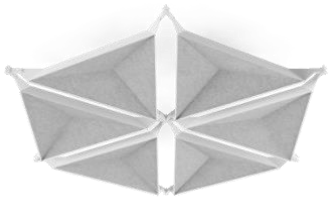


Table 2: Technical properties, steel panels

Name and Standard	Unit	Atmosphera® Group 1	Atmosphera® Group 2	Secare®	SoundStar® Group 1	SoundStar® Group 2
Sound absorption coefficient (ASTM C423)	%	Not Relevant	0.35-1.5	Not Relevant	0.75-0.85	0.75-0.95
Standard test methods for surface burning characteristics of building materials (ASTM E84)	Flame spread/ smoke developed	Class A	Class A	Class A	Class A	Class A

2.8.2 Aluminum Panels

The **Alluvia**® family of products is a preconfigured ceiling system that combines vertical elements to generate unique topographies in space. Each variation makes reference to nature and landscape, offering a refined, textural aesthetic that is full of depth. With changing vantage points, Alluvia® produces shifting views that add energy and movement to the room.

Delta Drop® uses faceted geometry to transform the visual possibilities for tiled ceiling and wall systems. These preconfigured modules can achieve a variety of looks through variations in pattern, faceting, and panel size.

Give your walls personality and function through Arktura's **Graphic Perf**® Family of products. With Arktura's Graphic Perf® your design will be broken down into modular segments that come together seamlessly and install with flexible attachments tailored to the specific needs of your space.

Particle® micro-perforated ceiling and wall panel system offers the same ease of install, scalability, you've grown to expect from Arktura's torsion spring panel systems, with finer detail than ever before. Its intricate yet subtle complexity lends visual interest to spaces big and small and will have people looking twice.

Trace® introduces subtle visual interest inspired by the ephemeral beauty of mist or cirrus clouds—continuous strands weave through a grid to yield a truly elegant visual pattern. The quiet simplicity of the design makes it an ideal background for large spans and multiple rooms.

Vapor® and **Vapor**® **Graphic Perf**® wall and ceiling panel systems achieve modern expression through abstract patterns. Its subtle complexity lends visual interest across large spans and multiple spaces.

VaporHue® is an innovative line of torsion spring wall and ceiling panels that blends printed and perforated patterning to bring a new layer of depth and emotion to projects. It blends the beauty of wallpapers and the performance of perforated metal panels, to enhance aesthetics and functionality like never before.

For Trace® and Vapor® products, add depth and performance with our sound attenuating non-woven acoustic fabric (Soft Sound®) or light-transmitting frosted polycarbonate backers.

Table 3: Technical properties, aluminum panels

Name and Standard	Unit	Alluvia Group 1	Alluvia Group 2	Delta Drop Solid 2x4	Delta Drop Full Solid 4x4	Graphic Perf	Switch 48	Vapor Solid
Sound absorption coefficient (ASTM C423)	%	Not Relevant	Not Relevant	0.20-0.85	0.20-0.85	Not Relevant	Not Relevant	0.30-0.90
Standard test methods for surface burning characteristics of building materials (ASTM E84)	Flame spread/ smoke developed	Class A	Class A	Class A	Class A	Class A	Class A	Class A

Table 4: Technical properties, aluminum panel backers

Name and Standard	Unit	Polycarbonate Backer	Soft Sound Backer
Standard test methods for surface burning characteristics of building materials (ASTM E84)	Flame spread/smoke developed	Class B	Class A

2.8.3 Vertika Wall Panel System

Vertika® wall channel system enables Arktura's growing lineup of torsion panel products to effortlessly span walls or achieving seamless wall-to-ceiling transitions. It is designed to make installation simple while keeping in mind ease of access for ongoing maintenance. Add available options and accessories, including Arktura's integrated InLine or Backlight lighting, acoustic and translucent backers, and there is no limit to the effects you can achieve. Pair it with Vapor®, VaporHue™, VaporSoft®, Delta Drop®, Trace®, Particle®, or Vapor® Graphic Perf®.

Table 5: Technical properties, aluminum panel backing options

Name and Standard	Unit	Vertika
Standard test methods for surface burning characteristics of building materials (ASTM E84)	Flame spread/smoke developed	Class A

2.9 ADDITIONAL ENVIRONMENTAL INFORMATION

2.9.1 Environment and Health During Manufacturing

Arktura prioritizes environmental sustainability, health, and safety throughout its manufacturing processes. From product design to waste reduction initiatives, Arktura integrates responsible practices to minimize environmental impact. The company is committed to ensuring a safe working environment for its employees and strives to optimize energy and water usage while promoting recycling and responsible disposal practices.

2.9.2 Environment and Health During Installation

All recommendations shall be utilized as indicated by SDS and installation guidelines. Specific product SDS and installation instructions can be requested directly from Arktura.

2.9.3 Environmental Activities and Certifications

Additional environmental certifications for Arktura's products such as Declare Labels, HPD, SDS, VOC Testing, acoustical performance and light reflectance can be requested directly from Arktura.

3 SCOPE OF THE STUDY

3.1 LCA METHODOLOGICAL FRAMEWORK

The LCA follows an attributional approach.

3.2 AVERAGE PRODUCT METHODOLOGY

Product averages were developed to encompass all products that fall within +/-10% for all environmental impact indicators, excluding ODP. This was done by first grouping based on the mass of raw material and packaging, evaluated for each material. Products, such as Vapor, where the differences in the perforation patterns require the same amount of raw material input and therefore can be grouped as one average product. The only difference in results would fall in the output of material for recycling, which is not required to be within +/-10%. The results for this indicator represent the lowest amount of material to recycling, i.e., most conservative.

Further refinement was done by running LCA results for each first round grouping and combining results that were similar to reduce the number of groupings.

Results are also reported for Soft Sound® and Polycarbonate backers for the aluminum panels that can be added to certain products. These are single products that would be shipped with the panels and are therefore not averages.

Table 6: Product groupings, steel panels

Results Group	Product
Atmosphera® Group 1	Atmosphera® Fiora
	Atmosphera® Lotus
	Atmosphera® Pulse
	Atmosphera® Ripple
Atmosphera® Group 2	Atmosphera® Analog
	Atmosphera® Analog 3D
	Atmosphera® Contour
	Atmosphera® Contour 3D
	Atmosphera® Flow
	Atmosphera® Linea
	Atmosphera® Rinse
	Atmosphera® Strata
	Atmosphera® Surf
	Atmosphera® Swell
	Atmosphera® Versa
	Atmosphera® Versa 3D
Secare®	Secare®
SoundStar® Group 1	SoundStar® 12
	Trisoft® Half Module

Results Group	Product
SoundStar® Group 2	SoundStar® 24
	Trisoft® Full Module

Table 7: Product groupings, aluminum panels

Results Group	Product	
Alluvia® Group 1	Alluvia® Direct 12	
Alluvia® Group 2	Alluvia® Direct 24	
Delta Drop® 2x4	Delta Drop® Full Solid 2x4	
	Delta Drop® Half Pattern Circle 2x4	
	Delta Drop® Full Pattern Circle 2x4	
Delta Drop® 4x4	Delta Drop® Full Solid 4x4	
	Delta Drop® Half Pattern Circle 4x4	
	Delta Drop® Full Pattern Circle 4x4	
Graphic Perf®	Graphic Perf® Standard Pattern	
	Graphic Perf® Custom Pattern	
Switch 48®	Switch 48®	
Vapor®	Particle® Code	Particle® Ion
	Particle® Fuse	Particle® Phase
	Trace® Curved	Trace® Slide
	Trace® Skew	Trace® Straight
	Trace® Slant	
	Vapor® Bloom	Vapor® Shift X
	Vapor® Bond	Vapor® Shift X Drop In
	Vapor® Breeze	Vapor® Shift XB
	Vapor® Byte	Vapor® Shift XB Drop In
	Vapor® Cluster Dense	Vapor® Sky
	Vapor® Cluster Dense Drop In	VaporSoft® Cluster Dense
	Vapor® Cluster Sparse	VaporSoft® Cluster Sparse
	Vapor® Cora	VaporSoft® Cora
	Vapor® Cora Drop In	VaporSoft® Trail
	Vapor® Cumula	Vapor® Solid
	Vapor® Element	Vapor® Syntax
	Vapor® Exterior 2x4 Cluster Dense 0.09	Vapor® Trail
	Vapor Exterior 2x4 Cluster Dense 0.125	Vapor® Transit
	Vapor® Frequency	Vapor® Verve
	Vapor® Gradients	VaporHue™ Astra

Results Group	Product	
	Vapor® Liana	VaporHue™ Flora
	Vapor® Pixel	VaporHue™ Link
	Vapor® Shift SB Drop In	VaporHue™ Pop
	Vapor® Shift SS Drop In	VaporHue™ Stitch

Table 8: Product groupings, Vertika

Results Group	Product
Vertika®	Vertika® Interior
	Vertika® Exterior

3.3 DECLARED UNIT

The declared unit for panels, according to the PCR, is 1 kg. However, 1 m^2 better represents the intended function of the product and aligns with the declared unit for non-metal ceiling panels, for which Arktura is also creating EPDs. Therefore, a conversion to 1 kg has been provided. Table 9 shows additional details related to the declared unit.

Table 9: Declared Unit Details

	Weight [kg/m^2]	Weight [lbs/ft^2]	Conversion to 1 kg	Thickness [cm] Average [Range]	Thickness [in] Average [Range]
Atmosphera® Group 1	7.17	1.47	0.140	19.7 [12.7-40.6]	7.75 [5.0-16.0]
Atmosphera® Group 2	12.4	2.54	0.0807	26.2 [12.7-40.6]	10.3 [5.0-16.0]
Secare®	36.9	7.56	0.0271	10.6 [8.89-12.4]	4.19 [3.5-4.875]
SoundStar® Group 1	17.3	3.55	0.0577	30.8	12.1
SoundStar® Group 2	16.5	3.38	0.0605	59.7	23.5
Alluvia® Group 1	32.0	6.56	0.0312	120 [80.6-159]	47.25 [31.75-62.75]
Alluvia® Group 2	35.6	7.30	0.0281	120 [80.6-159]	47.25 [31.75-62.75]
Delta Drop® 2x4	5.96	1.22	0.168	19.7	7.75
Delta Drop® 4x4	5.44	1.11	0.184	19.7	7.75
Graphic Perf®	25.8	5.29	0.0387	10.8	4.25
Switch 48®	5.27	1.08	0.190	12.7	5.0
Vapor®	5.51	1.13	0.181	10.8	4.25
Soft Sound® Backer	3.05	0.625	0.328	1.20	0.472
Polycarbonate Backer	2.44	0.500	0.410	0.15	0.06
Vertika®	2.48	0.509	0.403	10.8	4.25

3.4 SYSTEM BOUNDARY

This LCA is a Cradle-to-Gate study. An overview of the system boundary is shown in Figure 2 and a summary of the life cycle stages included in this LCA is presented in Table 10. Inclusions and exclusions are summarized in Table 11.

Note that no carbon dioxide credits are assumed in the framework of this project.

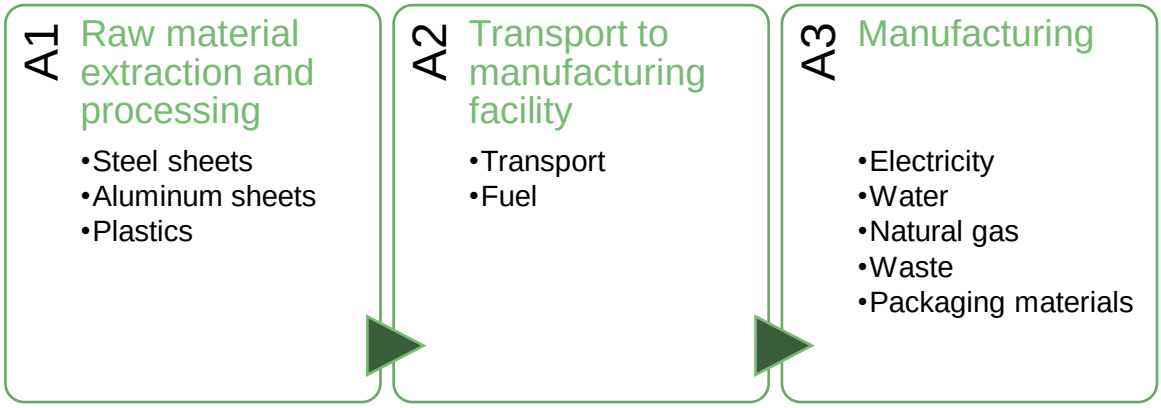


Figure 2: System Boundary Diagram

Table 10: Life Cycle Stages Included in the Study

Production			Construction		Use							End of Life				Benefits & Loads Beyond System Boundary
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw Material Supply	Transport	Manufacturing	Transport to Site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction	Transport	Waste Processing	Disposal	Reuse, Recovery, Recycling Potential
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

X = Module Included in LCA Report, MND = Module not Declared

Table 11: System inclusions and exclusions

Included	**Excluded**
Extraction and processing of raw materials and packaging	Construction of facility
Processing of recycled raw materials from previous product system	Manufacturing of operational equipment
Transportation of materials and packaging to the manufacturing location	Production of co-products leaving the system
Manufacturing of products, including energy, water, and material usage and water disposal	Hanger wires and other components required fro attachment to the structure (i.e., molding and hold down clips)
On-site transportation and overhead energy	
Waste generation from manufacturing and disposal	

3.4.1 Product Composition

This stage includes an aggregation of raw material extraction and supplier processing, delivery of the materials to the manufacturing site, and impacts from manufacturing.

The products were modeled in LCA FE to calculate the potential environmental impacts over their lifecycle. For any materials unavailable in Sphera's Managed Lifecycle Content (MLC) database, appropriate proxies were used. Details on these proxies are mentioned in Appendix A. Specific descriptions of secondary unit processes can be viewed through the MLC dataset documentation online at https://gabi.sphera.com/america/databases/gabi-data-search/

The raw materials for the product were obtained from the US, Australia, and China. The general compositions of the products are represented in Table 12.

For all materials, recycled content minimums are not specified, but rather are dependent on the vendor's current supply. Recycled content will likely vary over time and should be confirmed at the time of manufacture. Given this potential variation, and the need to create average products, average recycled content values were calculated for all materials, weighted based on spend between suppliers, and applied consistently across all products.

Table 12: Material Composition, Steel Panels

Mass %	Average Recycled Content %	Atmosphera Group 1	Atmosphera Group 2	Secare	SoundStar Group 1	SoundStar Group 2
Summary						
Steel	22%	99.1%	75.9%	44.6%	76.4%	74.5%
PET	60%	-	19.5%	-	17.0%	17.5%
Stainless Steel	23%	-	-	55.4%	-	-
Aluminum	25%	-	-	-	4.4%	5.7%
Other	Varies	0.9%	4.6%	-	2.2%	2.2%
Detail						
Steel Sheets	22%	99.1%	75.9%	44.6%	76.4%	74.5%
Soft Sound (PET)	60%	-	19.5%	-	17.0%	17.5%
Stainless Steel Sheets	23%	-	-	55.4%	-	-
Misc. Steel Parts	25%	-	3.2%	-	-	-
Steel Screws, Washers, etc.	-	0.3%	0.9%	-	1.2%	1.4%
Aluminum Sheets	25%	-	-	-	4.4%	5.7%
Powder coat	-	0.3%	0.4%	-	0.3%	0.3%
Torsion Wire	-	0.1%	-	-	0.4%	0.3%
Plated Brass	-	0.2%	-	-	0.3%	0.3%
Polyurethane Tube	-	0.0%	-	-	0.0%	0.0%

Table 13: Material Composition, Aluminum Panels

	Average Recycled Content %	Alluvia Group 1	Alluvia Group 2	Delta Drop 2x4	Delta Drop 4x4	Graphic Perf	Switch 48	Vapor Products	Soft Sound Backer	PC Backer
Summary										
Aluminum	25%	94.1%	94.8%	98.4%	97.7%	72.8%	97.7%	92.0%	-	-
Steel	22%	5.3%	4.7%	-	-	20.5%	-	-	-	-
PET	60%	-	-	-	-	-	-	5.7%	100%	-
Polycarbonate	25%	-	-	-	-	-	-	-	-	100%
Other	Varies	0.6%	0.5%	1.6%	2.3%	6.7%	2.3%	2.2%	-	-
Detail										
Aluminum Sheets	25%	94.1%	94.8%	98.4%	97.7%	72.8%	-	92.0%	-	-
Steel Sheets	22%	5.3%	4.7%	-	-	20.5%	-	-	-	-
Misc. Alum Parts	-	-	-	-	-	-	97.7%	-	-	-
Soft Sound (PET)	60%	-	-	-	-	-	-	5.7%	100%	-
Steel Screws, Washers, etc.	-	0.4%	0.4%	-	-	3.4%	-	-	-	-
Powder coat	-	-	-	0.4%	0.4%	1.6%	1.0%	0.7%	-	-
Polycarbonate Backer Sheets	25%	0.1%	-	-	-	1.7%	-	-	-	100%
Torsion Wire	-	-	-	1.2%	1.9%	-	0.4%	1.5%	-	-
Plated Brass	-	-	-	-	-	-	0.9%	-	-	-
Stainless Steel Sheets	23%	0.1%	0.1%	-	-	-	-	-	-	-
Polyurethane Tube	-	-	-	-	-	-	0.1%	-	-	-

Table 14: Material Composition, Vertika

	Recycled Content %	Vertika
Summary		
Steel	22%	70.9%
Aluminum	25%	26.7%
Other	-	2.4%
Detail		
Steel Sheets	22%	70.9%
Aluminum Sheets	25%	26.7%
Powder coat	-	2.2%
Steel Screws, Washers, etc.	-	0.2%

3.4.2 Inbound Transport

The materials are delivered to the manufacturing facility via truck and are accounted for in the model. The distances were modeled by material and were calculated using the supplier location and the location of manufacturing. Transportation data are shown in Table 15, though they are

presented as a weighted average to protect the identity of the suppliers. Transportation impacts account for the additional material required due to production losses.

Table 15: A2 Transportation Data

	Ship	Truck (US)	Truck (CN)
Vehicle Type	Bulk commodity carrier, 5,000 to 200,000 dwt payload capacity, ocean going	Truck - Heavy Heavy-duty Diesel Truck / 53,333 lb payload - 8b	Truck-trailer, Euro 1, 34 - 40t gross weight / 27t payload capacity
Fuel Efficiency [L/100km]	5,470	42	56.2
Capacity Utilization [%]	53%	67%	61%
Distance [mi]			
Atmosphera® Group 1	3105	1154	0
Atmosphera® Group 2	3660	904	20
Secare®	1398	1543	0
SoundStar® Group 1	3113	1196	13
SoundStar® Group 2	3226	1210	16
Alluvia® Group 1	165	1623	0
Alluvia® Group 2	149	1619	0
Delta Drop® 2x4	0	1823	0
Delta Drop® 4x4	0	1688	0
Graphic Perf®	943	1374	0
Switch 48®	0	385	0
Vapor®	2180	1146	33
Soft Sound® Backer	0	50	0
Polycarbonate Backer	6568	100	100
Vertika®	2221	1289	0

3.4.3 Manufacturing

Arktura's Atmosphera®, Secare®, SoundStar®, and Trisoft® ceilings are manufactured primarily from a combination of sheet metal, and up to 60% recycled PET (Polyethylene) acoustical boards. Metal sheets are cut, labeled, and bent into shape for the structural or framing components. These metal components are powder coated and assembled together with the PET acoustical boards which are labeled and cut to shape. The products are packaged and then shipped and installed. In the case of Atmosphera® systems, the components are shipped flat-packed and assembled onsite.

Arktura's Vertika is manufactured from sheet metal which are cut, labeled and bent into shape. These components are powder coated and partially assembled. The products are then packaged and then shipped and installed.

Powder coating is done offsite and a secondary data source, from MLC, was used to model this impact. Transportation to and from powder coating is included.

Energy resources used in the manufacturing process are accounted for in the model. The electricity is sourced from the power grid. Electricity production datasets from GaBi and eGRID

are used to assess the generation, distribution, and transmission of electricity. Secondary datasets for other fuels, packaging, and waste were utilized from the GaBi database, as shown in Appendix A. Manufacturing inputs and outputs per area were calculated by using annual figures and dividing them by annual production. Waste to recycling is calculated based on the reported steel and aluminum scrap and accounted for in the amount of raw material input. Waste to landfill was not able to be separated out by product and includes overhead waste associated with the on-site office facilities, therefore it does not scale up any raw material inputs. These details are summarized in

Table 16. Total input and output weights are presented in Table 17.

Table 16: Manufacturing Inputs and Outputs, per m^2

Manufacturing Data	Steel Panels, Vertika	Aluminum Panels
Utilities		
Electricity [kWh]	2.15	
Natural Gas [MJ]	0.509	
Water [Gal]	1.96	
Waste		
Waste to Landfill [kg]	0.290	
Waste to Recycling [kg]	0.0316	0.0462

Table 17: Manufacturing Input and Output Material Weights, by product, per m^2

	Input Weight [kg/m^2]	Output Weight [kg/m^2]
Atmosphera® Group 1	7.39	7.17
Atmosphera® Group 2	12.8	12.4
Secare®	38.1	36.9
SoundStar® Group 1	17.9	17.3
SoundStar® Group 2	17.0	16.5
Alluvia® Group 1	33.5	32.0
Alluvia® Group 2	37.3	35.6
Delta Drop® 2x4	6.23	5.96
Delta Drop® 4x4	5.69	5.44
Graphic Perf®	27.0	25.8
Switch 48®	5.52	5.27
Vapor®	5.77	5.51
Soft Sound® Backer	3.21	3.05
Polycarbonate Backer	4.02	2.44
Vertika®	2.56	2.48

A number of components come in as semi-finished products, which require some additional processing before reaching Arktura. Details on the

Semi-finished Products	Material Dataset	Semi-Finished Process	Loss %
Aluminum Sheets	• Primary aluminum ingot • Recycled aluminum ingot (100% recycled content) • Aluminium sheet mix	None, purchased as sheet	n/a

Semi-finished Products	Material Dataset	Semi-Finished Process	Loss %
Steel Screws, Washers, etc.	Fixing material screws stainless steel	Included in material dataset	Unknown
Stainless Steel Sheets	Stainless steel cold rolled coil (430)	None, purchased as coil	n/a
Steel Sheets	Steel cold rolled coil	None, purchased as coil	n/a
Polycarbonate Backer Sheets	Polycarbonate Granulate (PC)	Injection moulding + compounding	3%
Soft Sound	Polyethylene terephthalate bottle grade granulate (PET) via PTA	Needle-punched, non-woven	4%
Misc Steel Parts	Steel hot dip galvanised	Stamping and bending	5%
Plated Brass	Brass component (EN15804 A1-A3)	Included in material dataset	Unknown
Torsion Wire	Steel wire rod	None	
Polyurethane Tube	Thermoplastic polyurethane (TPU, TPE-U) adhesive	Injection moulding + compounding	3%
Misc. Alum Parts	Aluminum extrusion, anodized	Included in material dataset	Unknown

Packaging was reported per product and calculated alongside the product averages.

Table 18: Packaging requirements per declared unit, steel panels

kg/m^2	Atmosphera Group 1	Atmosphera Group 2	Secare	SoundStar Group 1	SoundStar Group 2
Packaging Lumber	0.63	0.63	11.26	8.64	9.98
Packaging Plywood	0.44	0.44	19.29	5.50	7.27
Packaging Aluminum				0.54	0.54
Packaging Polystyrene	0.20	0.20	0.61	0.11	0.11
Packaging LDPE Foam				0.06	0.06
Packaging LDPE Film	0.04	0.04			
Packaging Cardboard	0.005	0.005			

Table 19: Packaging requirements per declared unit, aluminum panels

kg/m^2	Alluvia Group 1	Alluvia Group 2	Delta Drop 2x4	Delta Drop 4x4	Graphic Perf	Switch 48	Vapor Products
Packaging Lumber	8.61	8.61	7.90	3.95	2.78	2.62	1.32
Packaging Cardboard	4.05	4.05	0.02	0.01	0.16	0.58	0.63
Packaging Plywood					2.33	0.91	0.49
Packaging Polystyrene			0.20	0.10		0.58	
Packaging LDPE Foam			0.02	0.01		0.05	
Packaging LDPE Film						0.18	0.02

Table 20: Packaging requirements per declared unit, Vertika

kg/m^2	Vertika
Packaging Lumber	0.45
Packaging Plywood	0.31
Packaging Paper	0.04
Packaging Polystyrene	0.01
Packaging Cardboard	0.01
Packaging LDPE Foam	0.01

3.5 CUT-OFF CRITERIA

Material inputs greater than 1% (based on total mass of the final product) were included within the scope of analysis. Material inputs less than 1% were included if sufficient data was available to warrant inclusion and/or the material input was thought to have significant environmental impact. Cumulative excluded material inputs and environmental impacts are less than 5% based on total weight of the functional unit. No flows were knowingly omitted.

The list of excluded materials and energy inputs include:

- Some material inputs may have been excluded within the GaBi datasets used for this project. All GaBi datasets have been critically reviewed and conform to the exclusion requirement of the PCR, Part A: “Calculation Rules for the Life Cycle Assessment and Requirements on the Background Report”.

3.6 ALLOCATION PROCEDURES

General principles of allocation were based on ISO 14040/44. To derive a per-unit value for manufacturing inputs such as electricity, thermal energy and water, allocation based on total production by area was adopted. This was deemed the most accurate way to allocate given that products are sold and processed on an area basis, regardless of product weight. As a default, secondary GaBi datasets use a physical basis for allocation.

Of relevance to the defined system boundary is the method in which recycled materials were handled. Throughout the study recycled materials were accounted for via the cut-off method. Under this method, impacts and benefits associated with the previous life of a raw material from recycled stock are excluded from the system boundary. Additionally, impacts and benefits associated with secondary functions of materials at end of life are also excluded (i.e., production into a third life or energy generation from the incineration plant). The study does include the impacts associated with reprocessing and preparation of recycled materials that are part of the bill of materials of the products under study.

3.7 DATA QUALITY REQUIREMENTS

Secondary datasets utilized in the model are disclosed in Appendix A along with data quality indicators related to the geographic, temporal, and technological coverage of the dataset. Additionally, details on proxies are provided, if applicable.

3.7.1 Geographic Coverage

The geographical scope of the manufacturing portion of the life cycle is the United States, specifically Los Angeles, CA. All primary data were collected from the manufacturer. The geographic coverage of primary data is considered excellent.

The geographical scope of the raw material acquisition is international.

In selecting secondary data (i.e., MLC Datasets), priority was given to the accuracy and representativeness of the data. When available and deemed of significant quality, country-specific data was used. However, priority was given to technological relevance and accuracy in selecting secondary data. This often led to the substitution of regional and/or global data for country-specific

data. The geographical coverage of secondary datasets can be referenced in the dataset references table in Appendix A. Overall geographic data quality is considered good.

3.7.2 Time Coverage

Primary data were provided by the manufacturer and represent all information for calendar year 2021. Using this data meets the PCR requirements. Time coverage of this primary data is considered excellent.

Data necessary to model cradle-to-gate unit processes were sourced from Sphera's MLC LCI datasets. Time coverage of the datasets varies from approximately 2014 to present. One exception is a dataset from 2005, but the overall contribution of that dataset to results is negligible. All datasets rely on at least one 1-year average data. Overall time coverage of the datasets is considered good and meets the requirement of the PCR that all data be updated within a 10- year period. The specific time coverage of secondary datasets can be found in Appendix A.

3.7.3 Technological Coverage

Primary data provided by the manufacturer is specific to the technology the company uses in manufacturing their product. It is site-specific and considered of good quality. It is worth noting that the energy and water used in manufacturing the product includes overhead energy such as lighting, heating, and sanitary use of water. Sub-metering was not available to extract process-only energy and water use from the total energy use. Sub-metering would improve the technological coverage of data quality.

Data necessary to model cradle-to-gate unit processes were sourced from GaBi LCI datasets. Technological coverage of the datasets is considered good relative to the actual supply chain of the manufacturer. While improved life cycle data from suppliers would improve technological coverage, the use of lower-quality generic datasets does meet the goal of this LCA.

3.7.4 Treatment of Missing Data

Primary data were used for all manufacturing processes. Whenever available, supplier data was used for raw materials used in the production process. When primary data did not exist, secondary data for raw material production were obtained from the GaBi database, as shown in Appendix A. Any proxies used for raw materials have also been detailed in Appendix A.

3.7.5 Data Quality Assessment

Appendix A shows an assessment for the data quality of all secondary processes included in the model. The following sections provide details on the data quality of the model itself.

3.7.5.1 Precision

The precision of the data is considered high. Product engineers provided detailed bills of materials, and facility managers provided utility information for the manufacturing facilities. The raw material transportation distances were calculated based on the raw material manufacturers' addresses, extracted from the relevant SDS's. Proxy datasets were utilized in the LCA model when secondary data were not available, as shown in Appendix A. Precision can be increased via sub-metering individual manufacturing processes to better account for manufacturing processes rather than including overhead utility information.

3.7.5.2 Completeness

The data included is consider complete. The LCA model included all known material and energy flows, with the exception of what is listed in Section 3.5. As pointed out in that section, no known flows above 1% were excluded and the sum of all excluded flows totals less than 5%, whether evaluated by mass, energy, or potential environmental impact.

3.7.5.3 Consistency

The consistency of the model is considered high. The bills of materials provided by the product engineers were developed for multiple internal departments use and are maintained regularly. The LCA practitioner also cross-referenced the installation documents and other relevant information to ensure consistency. Furthermore, modeling assumptions were consistent across the model, with preference given towards GaBi data, where available.

3.7.5.4 Reproducibility

This study is considered reproducible. Descriptions of the data and assumptions through this report would allow a practitioner to utilize the LCA tool to generate results for the products.

3.7.5.5 Uncertainty

Uncertainty for the secondary datasets is discussed in the documentation published by Sphera for the GaBi LCI database. Uncertainty of the primary data comes from the utility data allocated to each product. The yearly total energy use changes over time due to more efficient operations, warmer or cooler seasons and other factors. Because energy data comes directly from utility bills, the uncertainty is mainly based on the accuracy of the utility meters. The allowable error for a water meter remaining in service is 4% by Pennsylvania law. For watthour meters and gas meters, the allowable error is 2%.

4 LIFE CYCLE INVENTORY ANALYSIS

Primary data were collected from Arktura associates. All calculation procedures adhere to ISO14044. Collection and processing of major data points is described below.

- Electrical Energy, Thermal Energy and Water Consumption.
    - Data were collected for 2021 through yearly utility bills and consumption was divided by production area during this period to derive an energy use-per-production unit for use in the LCA.
- Raw Materials and Purchasing
    - Bills of materials were obtained from Arktura associates. The technical team provided supplier locations and additional information as needed.
- Waste Value
    - Facility waste records from 2021 were assessed.
    - Waste amounts were divided by production area during this period to derive a waste generation amount-per-production unit for use in the LCA.

Data were reviewed for accuracy as collected by first calculating the per-unit values and comparing them against published studies. Any inconsistencies in data were resolved through email and telephone communication with technical associates at the manufacturer.

5 LIFE CYCLE IMPACT ASSESSMENT

5.1 SELECTION OF IMPACT PARAMETERS

Environmental Impacts were calculated using the GaBi software platform. Impact results have been calculated using IPCC AR5, and TRACI 2.1 characterization factors (IPCC, 2013; US EPA, 2012). Results presented in this report are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins, or risks.

Table 21: LCIA Indicators

Abbreviation	Parameter	Unit
IPCC AR5		
GWP	Global warming potential (100 years, excludes biogenic CO_2)	kg CO_2 eq
TRACI 2.1		
AP	Acidification potential of soil and water	kg SO_2 eq
EP	Eutrophication potential	kg N eq
ODP	Depletion of stratospheric ozone layer	kg CFC 11 eq
Resources	Depletion of non-renewable fossil fuels	MJ, surplus energy
SFP	Smog formation potential	kg O_3 eq

These six 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.

Indicators on the uptake and emissions of CO_2 are not reported as they are not included in the global warming potential results.

The following resource use and waste categories are also disclosed.

Table 22: Resource Use, Waste, and Output Flow Indicators

Abbreviation	Parameter	Unit
Resource Use Parameters		
RPR_E	Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value (LHV)
RPR_M	Use of renewable primary energy resources used as raw materials	MJ, net calorific value
RPR_T	Total use of renewable primary energy resources	MJ, net calorific value
$NRPR_E$	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value
$NRPR_M$	Use of non-renewable primary energy resources used as raw materials	MJ, net calorific value
$NRPR_T$	Total use of non-renewable primary energy resources	MJ, net calorific value
SM	Use of secondary materials	kg
RSF	Use of renewable secondary fuels	MJ, net calorific value
NRSF	Use of non-renewable secondary fuels	MJ, net calorific value
RE	Recovered energy	MJ, net calorific value
FW	Net use of fresh water	m^3
Waste Parameters and Output Flows		

Abbreviation	Parameter	Unit
HWD	Disposed-of-hazardous waste	kg
NHWD	Disposed-of non-hazardous waste	kg
HLRW	High-level radioactive waste, conditioned, to final repository	kg
ILLRW	Intermediate- and low-level radioactive waste, conditioned, to final repository	kg
CRU	Components for reuse	kg
MR	Materials for recycling	kg
MER	Materials for energy recovery	kg
EEE	Exported electrical energy	MJ
EET	Exported thermal energy	MJ

5.2 LCA RESULTS

All results are given per functional unit, as shown in Section 3.2, which is 1 m^2. Each product under study is reported for aggregated A1-A3 (production) impacts.

5.2.1 Steel Panels

The LCIA results presented below are for 1 m^2 of steel panels.

Table 23: LCIA A1-A3 results for Steel Panels, per 1 m^2

Impact Categories	Atmosphera Group 1	Atmosphera Group 2	Secare	SoundStar Group 1	SoundStar Group 2
GWP [kg CO_2 eq]	23.0	38.3	183	81.6	81.3
ODP [kg CFC 11 eq]	3.22E-10	3.22E-10	2.14E-12	2.23E-11	1.98E-11
AP [kg SO_2 eq]	7.46E-02	1.17E-01	9.21E-01	2.96E-01	2.98E-01
EP [kg N eq]	8.04E-03	1.25E-02	5.41E-02	2.59E-02	2.71E-02
SFP [kg O_3 eq]	9.37E-01	1.58E+00	1.19E+01	3.86E+00	3.97E+00
Resources [MJ]	2.32E+01	4.16E+01	1.65E+02	8.68E+01	8.91E+01
Resource Use Indicators					
RPRE [MJ]	5.33E+01	7.01E+01	5.61E+02	4.29E+02	4.61E+02
RPRM [MJ]	1.84E+01	1.84E+01	5.44E+02	2.41E+02	2.95E+02
RPRT [MJ]	7.17E+01	8.84E+01	1.10E+03	6.70E+02	7.57E+02
NRPRE [MJ]	2.82E+02	4.40E+02	2.34E+03	9.87E+02	9.99E+02
NRPRM [MJ]	9.93E+00	6.68E+01	2.48E+01	6.09E+01	6.78E+01
NRPRT [MJ]	2.92E+02	5.07E+02	2.37E+03	1.05E+03	1.07E+03
SM [kg]	2.61E+00	5.31E+00	9.34E+00	6.88E+00	6.72E+00
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW [m^3]	1.20E-01	2.16E-01	1.57E+00	7.23E-01	7.00E-01

Impact Categories	Atmosphera Group 1	Atmosphera Group 2	Secare	SoundStar Group 1	SoundStar Group 2
Output Flows and Waste Categories					
HWD [kg]	7.86E-06	1.29E-02	1.35E-02	1.22E-02	1.38E-02
NHWD [kg]	2.73E+00	4.74E+00	1.01E+01	1.35E+01	1.26E+01
HLRW [kg]	9.99E-06	1.50E-05	9.75E-05	4.34E-05	4.67E-05
ILLRW [kg]	8.55E-03	1.27E-02	7.55E-02	3.83E-02	4.11E-02
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR [kg]	2.26E-01	4.04E-01	1.17E+00	5.47E-01	5.21E-01
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE [MJ]	2.51E-01	4.48E-01	1.29E+00	6.07E-01	5.78E-01
EET [MJ]	1.18E-01	2.11E-01	6.08E-01	2.85E-01	2.72E-01

5.2.2 Aluminum Panels

The LCIA results presented below are for 1 m^2 of aluminum panels.

Table 24: LCIA A1-A3 results for Aluminum Panels, per 1 m^2

Impact Categories	Alluvia Group 1	Alluvia Group 2	Delta Drop Solid 2x4	Delta Drop Full Solid 4x4	Graphic Perf	Switch 48	Vapor Solid
GWP [kg CO_2 eq]	261	289	64.8	53.1	162	62.4	41.8
ODP [kg CFC 11 eq]	2.77E-07	2.77E-07	1.38E-09	7.13E-10	1.12E-08	4.63E-08	4.33E-08
AP [kg SO_2 eq]	1.14E+00	1.26E+00	2.82E-01	2.32E-01	7.09E-01	3.53E-01	1.78E-01
EP [kg N eq]	4.87E-02	5.30E-02	1.70E-02	1.28E-02	3.23E-02	1.49E-02	1.11E-02
SFP [kg O_3 eq]	1.10E+01	1.21E+01	2.90E+00	2.24E+00	6.56E+00	3.46E+00	1.74E+00
Resources [MJ]	2.30E+02	2.54E+02	6.51E+01	5.16E+01	1.49E+02	7.19E+01	4.50E+01
Resource Use Indicators							
RPRE [MJ]	1.57E+03	1.73E+03	4.84E+02	3.60E+02	8.52E+02	2.88E+02	2.32E+02
RPRM [MJ]	1.36E+02	1.36E+02	1.24E+02	6.22E+01	8.81E+01	5.85E+01	3.00E+01
RPRT [MJ]	1.70E+03	1.86E+03	6.09E+02	4.23E+02	9.40E+02	3.47E+02	2.62E+02
NRPRE [MJ]	2.73E+03	3.02E+03	7.49E+02	5.95E+02	1.75E+03	7.57E+02	4.56E+02
NRPRM [MJ]	5.96E-01	0.00E+00	9.04E+00	4.52E+00	1.54E+01	3.36E+01	4.44E+01
NRPRT [MJ]	2.70E+03	2.98E+03	7.58E+02	5.99E+02	1.76E+03	7.85E+02	4.95E+02
SM [kg]	8.59E+00	9.54E+00	1.55E+00	1.40E+00	7.31E+00	0.00E+00	2.36E+00
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW [m^3]	4.45E+00	4.97E+00	9.52E-01	8.27E-01	2.49E+00	8.69E-01	5.99E-01
Output Flows and Waste Categories							
HWD [kg]	5.61E-04	5.61E-04	2.86E-06	1.54E-06	3.00E-05	4.49E-03	9.99E-03
NHWD [kg]	8.62E+01	9.65E+01	1.72E+01	1.55E+01	4.96E+01	1.18E+01	1.12E+01
HLRW [kg]	6.46E-05	6.97E-05	2.87E-05	1.91E-05	4.26E-05	2.54E-05	1.34E-05
ILLRW [kg]	5.04E-02	5.43E-02	2.35E-02	1.55E-02	3.42E-02	2.13E-02	1.10E-02
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR [kg]	1.48E+00	1.64E+00	2.75E-01	2.51E-01	1.19E+00	5.63E-03	2.54E-01
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE [MJ]	1.12E+00	1.25E+00	2.08E-01	1.90E-01	9.04E-01	4.26E-03	1.93E-01
EET [MJ]	5.27E-01	5.87E-01	9.81E-02	8.95E-02	4.25E-01	2.01E-03	9.07E-02

Table 25: LCIA A1-A3 results for Aluminum Panel Backers, per 1 m^2

Impact Categories	Polycarbonate Backer	Soft Sound Backer
GWP [kg CO_2 eq]	17.4	10.9
ODP [kg CFC 11 eq]	2.91E-12	1.04E-12
AP [kg SO_2 eq]	3.27E-02	2.81E-02
EP [kg N eq]	3.70E-03	3.26E-03
SFP [kg O_3 eq]	6.05E-01	4.82E-01
Resources [MJ]	4.14E+01	1.80E+01
Resource Use Indicators		
RPRE [MJ]	6.54E+01	2.80E+01
RPRM [MJ]	0.00E+00	0.00E+00
RPRT [MJ]	6.54E+01	2.80E+01
NRPRE [MJ]	2.28E+02	1.08E+02
NRPRM [MJ]	1.25E+02	7.31E+01
NRPRT [MJ]	3.52E+02	1.81E+02
SM [kg]	1.22E+00	2.37E+00
RSF [MJ]	0.00E+00	0.00E+00
NRSF [MJ]	0.00E+00	0.00E+00
RE [MJ]	0.00E+00	0.00E+00
FW [m^3]	1.08E-01	8.39E-02
Output Flows and Waste Categories		
HWD [kg]	1.77E-08	1.66E-02
NHWD [kg]	1.10E+00	1.03E+00
HLRW [kg]	1.17E-05	4.83E-06
ILLRW [kg]	9.75E-03	4.03E-03
CRU [kg]	0.00E+00	0.00E+00
MR [kg]	9.65E-01	7.72E-01
MER [kg]	0.00E+00	0.00E+00
EEE [MJ]	1.07E-01	8.54E-02
EET [MJ]	5.02E-02	4.02E-02

5.2.3 Vertika

The LCIA results presented below are for 1 m^2 of Vertika Wall Channel System.

Table 26: LCIA A1-A3 results for Vertika, per 1 m^2

Impact Categories	Vertika
GWP [kg CO_2 eq]	14.5
ODP [kg CFC 11 eq]	7.73E-10
AP [kg SO_2 eq]	6.12E-02
EP [kg N eq]	5.31E-03
SFP [kg O_3 eq]	5.56E-01
Resources [MJ]	1.58E+01
Resource Use Indicators	
RPRE [MJ]	7.15E+01
RPRM [MJ]	1.35E+01
RPRT [MJ]	8.49E+01
NRPRE [MJ]	1.80E+02
NRPRM [MJ]	1.01E+00
NRPRT [MJ]	1.81E+02
SM [kg]	8.19E-01
RSF [MJ]	0.00E+00
NRSF [MJ]	0.00E+00
RE [MJ]	0.00E+00
FW [m^3]	1.44E-01
Output Flows and Waste Categories	
HWD [kg]	3.31E-06
NHWD [kg]	2.76E+00
HLRW [kg]	6.27E-06
ILLRW [kg]	5.37E-03
CRU [kg]	0.00E+00
MR [kg]	7.84E-02
MER [kg]	0.00E+00
EEE [MJ]	8.69E-02
EET [MJ]	4.09E-02

6 INTERPRETATION

Within this section, the results of the life cycle assessment are interpreted according to the goal and scope of the study. This interpretation includes a dominance analysis, a sensitivity check, and a data quality check, before providing conclusions based on the LCA.

6.1 DOMINANCE ANALYSIS

A dominance analysis was performed for all of the products in the LCA to show which of the life cycle modules contributes to the majority of the impacts. Due to the relevance to the product type and the manufacturer's interests, this dominance analysis will be provided for global warming potential (GWP) results. Other environmental impacts, such as acidification potential, smog formation potential, resource depletion, and freshwater consumption were all found to follow similar trends as GWP. In contrast, eutrophication potential demonstrated a different trend and is therefore also presented.

6.1.1 Global Warming Potential (GWP)

Global warming potential (GWP) is a measure of how much heat a greenhouse gas traps in the atmosphere up to a specified time horizon and measured relative to carbon dioxide. Figure 3 presents the relative GWP results for each product.

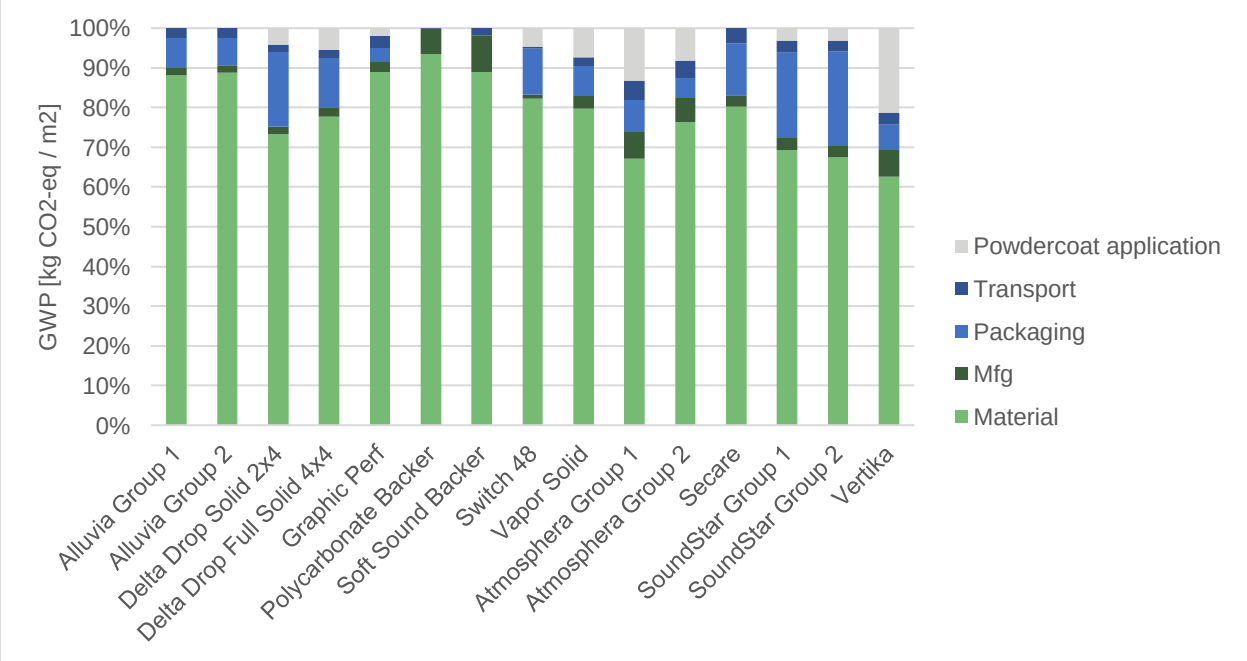


Figure 3: Relative GWP results, all products

It can be seen that the upstream production of the raw materials dominates the results, contributing anywhere from 60% to over 90%. Packaging is often the next most relevant contributor, especially for the SoundStar® groups where a large amount of packaging is required to preserve the product shape during shipping. Powdercoating and manufacturing impacts are scaled per area and therefore larger contributions from these processes are due to lower overall weight products, i.e., less raw material inputs.

Considering the global relevance of GWP, absolute results are also presented alongside each other in Figure 4 to provide context.

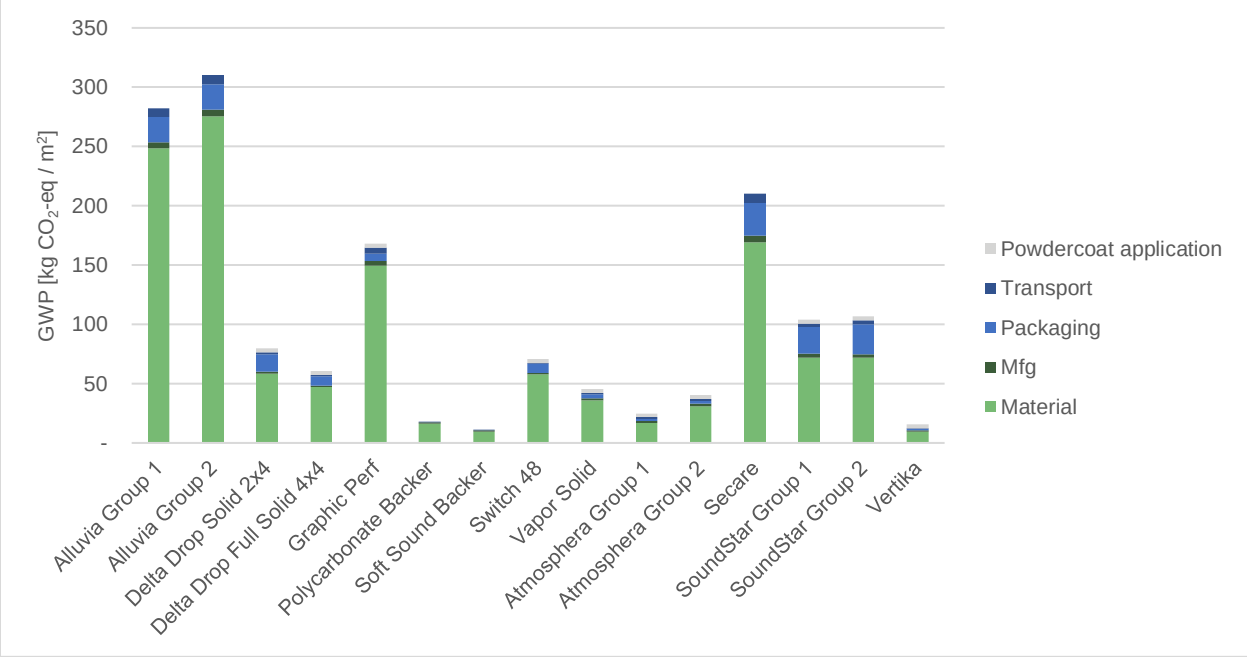


Figure 4: Absolute GWP results, all products

6.1.2 Eutrophication Potential (EP)

Eutrophication potential (GWP) is a measure of over-nutrification in aquatic and terrestrial ecosystems, driven primarily by nitrogen and phosphorous compounds. It is measured relative to nitrogen. Figure 3 presents the relative EP results for each product.

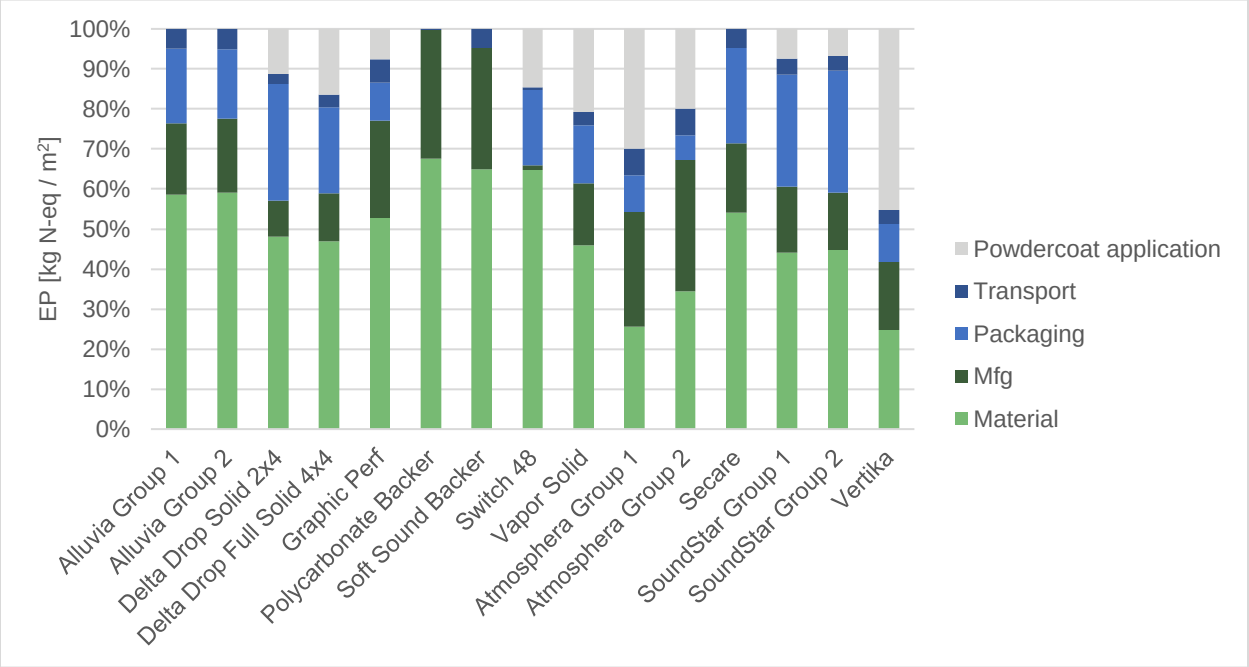


Figure 5: Relative EP results, all products

It can be seen that the upstream production of the raw materials is less dominant than with GWP, contributing anywhere from 25% to almost 70%. Packaging is of more relevance for EP than GWP, contributing up to 30% of impacts. This is due to the emissions to water from paper mills. Manufacturing impacts are driven primarily by waste treatment, specifically the treatment of leachate from landfills. This is likely an overestimate given the conservative approach for accounting for waste from manufacturing.

6.2 SENSITIVITY ANALYSIS

A sensitivity analysis is performed within life cycle assessment to determine how the results of an LCA are affected by the assumptions the LCA practitioner made during the course of the study.

6.2.1 Transportation (A2)

For unknown distances, an assumption of 200 miles was used. While this only affected less significant materials, i.e., smaller weight components, a sensitivity analysis was done on all transport impacts to test the overall sensitivity of the results to transportation distances. Impacts were halved and double and the maximum range values across all products are shown in

Table 27.

Table 27: LCIA results of sensitivity analysis on transportation (A2)

Phase	Estimate is Halved	Estimate is Doubled
GWP [kg CO_2 eq]	-2%	5%
AP [kg SO_2 eq]	-6%	13%
EP [kg N eq]	-3%	7%
SFP [kg O_3 eq]	-9%	18%

The results of this analysis indicate the GWP and EP results are not very sensitive to transportation distance, but AP and SFP are somewhat sensitive.

6.2.2 Manufacturing Energy

Inputs of electricity and natural gas were allocated across products by area, however they could have also been allocated by mass of each panel. To test the overall sensitivity of the results to the manufacturing energy inputs, impacts attributed to electricity and natural gas were halved and doubled and the maximum range values across all products are shown in Table 28.

Table 28: LCIA results of sensitivity analysis on manufacturing energy

Phase	Estimate is Halved	Estimate is Doubled
GWP [kg CO_2 eq]	-2%	5%
AP [kg SO_2 eq]	-3%	5%
EP [kg N eq]	-2%	3%
SFP [kg O_3 eq]	-2%	3%

The results of this analysis indicate the results are not sensitive to manufacturing energy consumption.

6.3 DATA QUALITY ASSESSMENT

The assessed data quality for each data point utilized within the study can be viewed in the Data Quality Section of the report, found in Section 3.7. Overall data quality is considered good. Improvements can be made through the modification of datasets to incorporate more regional specificity, both in terms of energy and technology. However, the data was considered appropriate in relation to the goal, scope and budget of the project.

Primary data in the form of energy consumption and water consumption were normalized based on total area of production during the same time frame. The resulting energy and water per unit were used for product manufactured at the facilities under study. Overall, primary energy and water data quality are considered good.

Primary data also includes the bills of materials used to formulate the products that are included in the study. Overall this data is considered excellent. Upstream data quality can be increased through the use of supplier-specific secondary datasets.

6.4 TRANSPARENCY DECISIONS THAT MAY HAVE AFFECTED THE LCA

Throughout this report, value choices and judgements that may have affected the LCA have been described. Additional decisions are summarized below:

- The inclusion of overhead energy data was determined appropriate due to the inability to sub-meter and isolate manufacturing energy from overhead energy.
- The inclusion of overhead waste was determined appropriate due to the inability to distinguish general waste between manufacturing and office uses.
- Where distances were unknown, a value of 200 miles are assumed. As this did not affect the high weight materials (steel, aluminum, soft sound, polycarbonate) this was deemed acceptable in the absence of more specific data.
- Average recycled contents were used for all materials based on Arktura's purchase records.
- The use and selection of secondary datasets from MLC – The selection of which generic dataset to use to represent an aspect of a supply chain is a significant value choice. Collaboration between the LCA practitioner, the manufacturer, and MLC data experts was invaluable in determining best-case scenarios in the selection of data. However, no generic data can be a perfect fit. Improved supply chain specific data would improve the accuracy of results, however budgetary and time constraints also must be considered.

Some limitations to the study have been identified as follows:

- The assessment looks at average products with a +/-10% impact range. While custom products may fall within the established groupings, they were not included in the assessment given the wide variety.
- Availability of geographically more accurate and/or supplier-specific datasets would have improved the accuracy of the study.
- Since this LCA uses the cut-off approach to model recycled material in the product, no credit is given to the product system. Instead, the manufacturer realizes reduced environmental impacts through the absence of the burden of extracting virgin material.
- Only known and quantifiable environmental impacts are considered.
- Due to the assumptions and value choices listed above, these do not reflect real-life scenarios and hence they cannot assess actual and exact impacts, but only potential environmental impacts.

6.5 CONCLUSION

This study presents the results for the production of metal panels by Arktura. The largest sources of environmental impacts are the upstream raw material production and packaging. More precise results could be obtained by working directly with raw material suppliers to obtain life cycle inventory data.

Reductions in overall production impacts could be made by:

- specifying minimum recycled contents within products and packaging,

- working to reduce packaging requirements,
- implementing a take back program for larger packaging set ups to ensure materials get re-used.

While Arktura's direct manufacturing impacts are not a large overall contributor, efforts to reduce energy consumption or obtain energy from renewable resources should not be overlooked. Additionally, Arktura should work to understand and quantify the sources of waste during manufacturing. This greater understanding of the process could highlight potential inefficiencies in overall raw material use.

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APPENDIX A SECONDARY DATASETS

Input/ Output	Dataset	Geo.	Year of Ref.	Source	Process type	Representativeness
Energy	Electricity grid mix – CAMX	US	2019	Sphera	Aggregated	Very good
	Thermal energy from natural gas	US	2018	Sphera	Aggregated	Very good
	Thermal energy from natural gas	CN	2017	Sphera	Aggregated	Very good
Fuel	Diesel mix at filling station	US	2018	Sphera	Aggregated	Very good
	Diesel mix at filling station	CN	2018	Sphera	Aggregated	Very good
	Heavy fuel oil at refinery (2.5wt.% S)	US	2018	Sphera	Aggregated	Very good
Packaging	Average Corrugated Product (Cradle-to-Gate, 2014)	US	2017	CPA	Aggregated	Very good
	Kraft paper (EN15804 A1-A3)	EU-28	2021	Sphera	Aggregated	Good, geographic proxy
	Thermoplastic polyurethane (TPU, TPE-U) adhesive	US	2021	Sphera	Aggregated	Very good
	Polyethylene film (PE-LD)	RER	2005	PlasticsEurope	Aggregated	Fair, temporal proxy
	Plywood board (EN15804 A1-A3)	EU-28	2021	Sphera	Aggregated	Good, geographic proxy
	Polyethylene foam (EN15804 A1-A3)	EU-28	2021	Sphera	Aggregated	Good, geographic proxy
	Polyurethane foam (PUR)	DE	2021	Sphera	Aggregated	Good, geographic proxy
	White Oak lumber, 4 inch (769 kg/m3), kiln-dried (7% moisture content, 6.5% H2O content)	US	2021	Sphera/AHEC	Aggregated	Good, technologic proxy
Powder coating	Coating powder (industry; outside; white) (EN15804 A1-A3)	DE	2021	Sphera	Aggregated	Good, geographic proxy
	Top coat powder (aluminium) (EN15804 A1-A3) - open input alu profile	DE	2021	Sphera	Partially aggregated	Fair, geographic and technological proxy
Raw Material	Primary aluminum ingot	RNA	2016	AA	Aggregated	Very good
	Recycled aluminum ingot (100% recycled content)	RNA	2016	AA	Aggregated	Very good
	Steel cold rolled coil	RNA	2017	AISI	Aggregated	Good, partial geographic proxy (some steel imported)
	Aluminum extrusion, anodized - AEC (A1-A3)	RNA	2015	Sphera-EPD	Aggregated	Very good
	Stainless steel cold rolled coil (430)	EU-28	2014	Eurofer	Aggregated	Good, geographic proxy

Input/ Output	Dataset	Geo.	Year of Ref.	Source	Process type	Representativeness
	Extruded polystyrene (XPS)	CN	2021	Sphera	Aggregated	Very good
	Fixing material screws stainless steel (EN15804 A1-A3)	EU-28	2021	Sphera	Aggregated	Good, geographic proxy
	Brass component (EN15804 A1-A3)	EU-28	2021	Sphera	Aggregated	Good, geographic proxy
	Aluminium sheet mix	EU-28	2021	Sphera	Aggregated	Good, geographic proxy
	Polyethylene terephthalate bottle grade granulate (PET) via PTA	US	2021	Sphera	Aggregated	Good, geographic proxy (CN)
	Polycarbonate Granulate (PC)	US	2021	Sphera	Aggregated	Very good
	Steel hot dip galvanised	Asia	2021	worldsteel	Aggregated	Very good
	Steel wire rod	Asia	2021	worldsteel	Aggregated	Very good
Raw Material Processing	Lubricants at refinery	IN	2018	Sphera	Aggregated	Good, geographic proxy (CN)
	Lubricants at refinery	US	2018	Sphera	Aggregated	Very good
	Needle-punched nonwoven	GLO	2014	ecoinvent	Unit	Very good
	Electricity grid mix – SPSO	US	2019	Sphera	Aggregated	Very good
	Electricity grid mix	CN	2018	Sphera	Aggregated	Very good
	Aluminium sheet (2015)	EU28+ EFTA+ Turkey	2015	European Aluminium	Partially aggregated	Good, geographic proxy
	Plastic recycling (clean scrap)	US	2021	Sphera	Aggregated	Very good
	Polyethylene terephthalate (PET) granulate secondary	US	2021	Sphera	Aggregated	Very good
	Compressed air 7 bar (medium power consumption)	GLO	2018	Sphera	Unit	Very good
	Plastic injection moulding (parameterized)	GLO	2021	Sphera	Unit	Very good
	Compounding (plastics)	GLO	2021	Sphera	Unit	Very good
	Steel sheet stamping and bending (5% loss)	GLO	2021	Sphera	Unit	Very good
	Process water from surface water	US	2021	Sphera	Aggregated	Very good
Transport	Bulk commodity carrier, 5,000 to 200,000 dwt payload capacity, ocean going	GLO	2021	Sphera	Unit	Very good
	Truck - Heavy Heavy-duty Diesel Truck / 53,333 lb payload - 8b	US	2021	Sphera	Unit	Very good

Input/ Output	Dataset	Geo.	Year of Ref.	Source	Process type	Representativeness
	Truck-trailer, Euro 1, 34 - 40t gross weight / 27t payload capacity	GLO	2021	Sphera	Unit	Very good
Waste	Municipal Solid Waste Incineration Plant	US	2021	Sphera	Aggregated	Very good
	Plastic waste on landfill, post-consumer	US	2021	Sphera	Aggregated	Very good
	Municipal Solid Waste on landfill	US	2021	Sphera	Aggregated	Very good
	Municipal waste water treatment (mix)	US	2021	Sphera	Aggregated	Very good
	Municipal waste water treatment (sludge incineration, for regionalization)	GLO	2021	Sphera	Aggregated	Very good

APPENDIX B LCA RESULTS, PER FT^2

Table 29: LCIA A1-A3 results for Steel Panels, per 1 ft^2

Impact Categories	Atmosphera Group 1	Atmosphera Group 2	Secare	SoundStar Group 1	SoundStar Group 2
GWP [kg CO_2 eq]	2.14	3.56	16.98	7.58	7.55
ODP [kg CFC 11 eq]	2.99E-11	2.99E-11	1.98E-13	2.07E-12	1.84E-12
AP [kg SO_2 eq]	6.93E-03	1.09E-02	8.55E-02	2.75E-02	2.77E-02
EP [kg N eq]	7.47E-04	1.16E-03	5.02E-03	2.40E-03	2.52E-03
SFP [kg O_3 eq]	8.71E-02	1.47E-01	1.10E+00	3.58E-01	3.69E-01
Resources [MJ]	2.15E+00	3.86E+00	1.53E+01	8.06E+00	8.28E+00
Resource Use Indicators					
RPRE [MJ]	4.95E+00	6.51E+00	5.21E+01	3.99E+01	4.29E+01
RPRM [MJ]	1.71E+00	1.71E+00	5.05E+01	2.23E+01	2.74E+01
RPRT [MJ]	6.66E+00	8.21E+00	1.03E+02	6.22E+01	7.03E+01
NRPRE [MJ]	2.62E+01	4.09E+01	2.18E+02	9.17E+01	9.28E+01
NRPRM [MJ]	9.23E-01	6.21E+00	2.30E+00	5.66E+00	6.30E+00
NRPRT [MJ]	2.72E+01	4.71E+01	2.20E+02	9.74E+01	9.91E+01
SM [kg]	2.42E-01	4.94E-01	8.68E-01	6.39E-01	6.24E-01
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW [m^3]	1.11E-02	2.01E-02	1.46E-01	6.72E-02	6.50E-02
Output Flows and Waste Categories					
HWD [kg]	7.30E-07	1.20E-03	1.25E-03	1.13E-03	1.28E-03
NHWD [kg]	2.54E-01	4.40E-01	9.42E-01	1.25E+00	1.17E+00
HLRW [kg]	9.28E-07	1.39E-06	9.06E-06	4.03E-06	4.34E-06
ILLRW [kg]	7.95E-04	1.18E-03	7.02E-03	3.56E-03	3.82E-03
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR [kg]	2.10E-02	3.75E-02	1.08E-01	5.09E-02	4.84E-02
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE [MJ]	2.33E-02	4.16E-02	1.20E-01	5.64E-02	5.37E-02
EET [MJ]	1.10E-02	1.96E-02	5.65E-02	2.65E-02	2.53E-02

Table 30: LCIA A1-A3 results for Aluminum Panels, per 1 ft^2

Impact Categories	Alluvia Group 1	Alluvia Group 2	Delta Drop Solid 2x4	Delta Drop Full Solid 4x4	Graphic Perf	Switch 48	Vapor Solid
GWP [kg CO_2 eq]	24.2	26.9	6.02	4.93	15.05	5.80	3.88
ODP [kg CFC 11 eq]	2.58E-08	2.58E-08	1.28E-10	6.62E-11	1.04E-09	4.31E-09	4.02E-09
AP [kg SO_2 eq]	1.06E-01	1.17E-01	2.62E-02	2.16E-02	6.59E-02	3.28E-02	1.65E-02
EP [kg N eq]	4.52E-03	4.92E-03	1.58E-03	1.19E-03	3.00E-03	1.39E-03	1.03E-03
SFP [kg O_3 eq]	1.02E+00	1.12E+00	2.70E-01	2.08E-01	6.10E-01	3.21E-01	1.62E-01
Resources [MJ]	2.14E+01	2.36E+01	6.05E+00	4.80E+00	1.38E+01	6.68E+00	4.18E+00
Resource Use Indicators							
RPRE [MJ]	1.45E+02	1.60E+02	4.50E+01	3.35E+01	7.91E+01	2.68E+01	2.15E+01
RPRM [MJ]	1.26E+01	1.26E+01	1.16E+01	5.78E+00	8.19E+00	5.44E+00	2.78E+00
RPRT [MJ]	1.58E+02	1.73E+02	5.66E+01	3.93E+01	8.73E+01	3.22E+01	2.43E+01
NRPRE [MJ]	2.54E+02	2.80E+02	6.96E+01	5.53E+01	1.62E+02	7.03E+01	4.24E+01
NRPRM [MJ]	5.53E-02	0.00E+00	8.40E-01	4.20E-01	1.43E+00	3.12E+00	4.12E+00
NRPRT [MJ]	2.51E+02	2.77E+02	7.04E+01	5.57E+01	1.64E+02	7.30E+01	4.60E+01
SM [kg]	7.98E-01	8.86E-01	1.44E-01	1.30E-01	6.79E-01	0.00E+00	2.19E-01
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW [m^3]	4.14E-01	4.62E-01	8.84E-02	7.68E-02	2.32E-01	8.07E-02	5.57E-02
Output Flows and Waste Categories							
HWD [kg]	5.21E-05	5.21E-05	2.65E-07	1.43E-07	2.79E-06	4.18E-04	9.28E-04
NHWD [kg]	8.01E+00	8.96E+00	1.60E+00	1.44E+00	4.61E+00	1.10E+00	1.04E+00
HLRW [kg]	6.00E-06	6.48E-06	2.67E-06	1.78E-06	3.95E-06	2.36E-06	1.24E-06
ILLRW [kg]	4.68E-03	5.04E-03	2.19E-03	1.44E-03	3.18E-03	1.98E-03	1.02E-03
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR [kg]	1.37E-01	1.53E-01	2.56E-02	2.33E-02	1.11E-01	5.23E-04	2.36E-02
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE [MJ]	1.04E-01	1.16E-01	1.94E-02	1.77E-02	8.40E-02	3.96E-04	1.79E-02
EET [MJ]	4.90E-02	5.45E-02	9.11E-03	8.32E-03	3.95E-02	1.86E-04	8.43E-03

Table 31: LCIA A1-A3 results for Aluminum Panel Backers, per 1 ft^2

Impact Categories	Polycarbonate Backer	Soft Sound Backer
GWP [kg CO_2 eq]	1.61	1.02
ODP [kg CFC 11 eq]	2.70E-13	9.66E-14
AP [kg SO_2 eq]	3.04E-03	2.61E-03
EP [kg N eq]	3.44E-04	3.03E-04
SFP [kg O_3 eq]	5.62E-02	4.47E-02
Resources [MJ]	3.85E+00	1.67E+00
Resource Use Indicators		
RPRE [MJ]	6.07E+00	2.60E+00
RPRM [MJ]	0.00E+00	0.00E+00
RPRT [MJ]	6.07E+00	2.60E+00
NRPRE [MJ]	2.12E+01	1.00E+01
NRPRM [MJ]	1.16E+01	6.80E+00
NRPRT [MJ]	3.27E+01	1.68E+01
SM [kg]	1.13E-01	2.20E-01
RSF [MJ]	0.00E+00	0.00E+00
NRSF [MJ]	0.00E+00	0.00E+00
RE [MJ]	0.00E+00	0.00E+00
FW [m^3]	1.01E-02	7.79E-03
Output Flows and Waste Categories		
HWD [kg]	1.64E-09	1.54E-03
NHWD [kg]	1.02E-01	9.60E-02
HLRW [kg]	1.08E-06	4.48E-07
ILLRW [kg]	9.06E-04	3.74E-04
CRU [kg]	0.00E+00	0.00E+00
MR [kg]	8.96E-02	7.17E-02
MER [kg]	0.00E+00	0.00E+00
EEE [MJ]	9.92E-03	7.93E-03
EET [MJ]	4.67E-03	3.73E-03

Table 32: LCIA A1-A3 results for Vertika, per 1 ft^2

Impact Categories	Vertika
GWP [kg CO_2 eq]	1.35
ODP [kg CFC 11 eq]	7.18E-11
AP [kg SO_2 eq]	5.69E-03
EP [kg N eq]	4.93E-04
SFP [kg O_3 eq]	5.16E-02
Resources [MJ]	1.47E+00
Resource Use Indicators	
RPRE [MJ]	6.64E+00
RPRM [MJ]	1.25E+00
RPRT [MJ]	7.89E+00
NRPRE [MJ]	1.67E+01
NRPRM [MJ]	9.39E-02
NRPRT [MJ]	1.68E+01
SM [kg]	7.61E-02
RSF [MJ]	0.00E+00
NRSF [MJ]	0.00E+00
RE [MJ]	0.00E+00
FW [m^3]	1.34E-02
Output Flows and Waste Categories	
HWD [kg]	3.07E-07
NHWD [kg]	2.56E-01
HLRW [kg]	5.82E-07
ILLRW [kg]	4.99E-04
CRU [kg]	0.00E+00
MR [kg]	7.28E-03
MER [kg]	0.00E+00
EEE [MJ]	8.07E-03
EET [MJ]	3.80E-03