Declaration Owner
Landscape Forms, Inc.
7800 East Michigan Ave., Kalamazoo, MI 49048
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Product
Chipman Chair

Functional Unit
The functional unit is one chair, serving the function of a typical unit of outdoor furniture for a 15-year period. The reference unit used in the study is one complete chair.

EPD Number and Period of Validity
SCS-EPD-10192
EPD Valid June 28, 2024 through June 27, 2029

Product Category Rule
Product Category Rule for Furniture. Product Category Classification: NPCR 026. EPD Norge®. Version 2.0. September 2022.

Program Operator
SCS Global Services
2000 Powell Street, Ste. 600, Emeryville, CA 94608
+1.510.452.8000 | www.SCSglobalServices.com

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Address:	7800 East Michigan Ave., Kalamazoo, MI 49048
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Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
Product:	Chipman Chair
LCA Practitioner:	Connor Mikre, SCS Global Services
LCA Software:	OpenLCA v2.01 & Ecoinvent v3.9 (EN15804 Add-On)
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☐ internal ☒ external
LCA Reviewer:	Lindita Bushi, Ph.D.,Athena Sustainable Materials Institute
Product Category Rule:	Product Category Rule for Seats. Product Category Classification: UN CPC 3811. International EPD® System. 2009:02. Version 3.0.2. April 2022.
PCR approved by:	Christofer Skaar, Leader of the Technical Committee, Norwegian EPD Foundation
Independent verification of the declaration and data, according to ISO 14025 and the PCR	☐ internal ☒ external
EPD Verifier:	Lindita Bushi, Ph.D.,Athena Sustainable Materials Institute
Declaration Contents:	ABOUT LANDSCAPE FORMS....2 PRODUCT DESCRIPTION....2 PRODUCT SPECIFICATIONS....2 MATERIAL COMPOSITION....2 PRODUCT LIFE CYCLE FLOW DIAGRAM....3 LIFE CYCLE ASSESSMENT STAGES....4 LIFE CYCLE IMPACT ASSESSMENT....4 SUPPORTING TECHNICAL INFORMATION....9 REFERENCES....15

Disclaimers: *This EPD conforms to ISO 14025, 14040, 14044, and EN 15804+A2.*

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

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

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

ABOUT LANDSCAPE FORMS

Landscape Forms is a prominent provider of outdoor furniture and amenities focused on enhancing public spaces and outdoor environments. Since its founding in 1969, the company has been recognized for its innovative design and craftsmanship. Committed to creating inviting and functional outdoor experiences, Landscape Forms collaborates with designers and architects to offer a diverse range of products for various settings including parks, transit centers, and corporate, college, and health care campuses. Their products inspire interaction, foster community, and address emerging issues in the landscape.

PRODUCT DESCRIPTION

The Chipman Collection is part of Terrace Life: lifestyle furniture for terraces, rooftop gardens and other private and protected spaces. Designed by landscape architect Robert Chipman and inspired by the curves and hollows of the mountains he loves, the new collection features a table and chair of stunning sculptural form conceived for more intimate social settings. The lightweight cast-aluminum chair is offered with or without arms; the 45" round table comes in dining and lounge heights; both are flawless in detail and finish.

PRODUCT SPECIFICATIONS

Table 1. *Product weights for the Landscape Forms Chipman Chair.*

Product name	Product mass (kg)
Chipman Chair	9.33

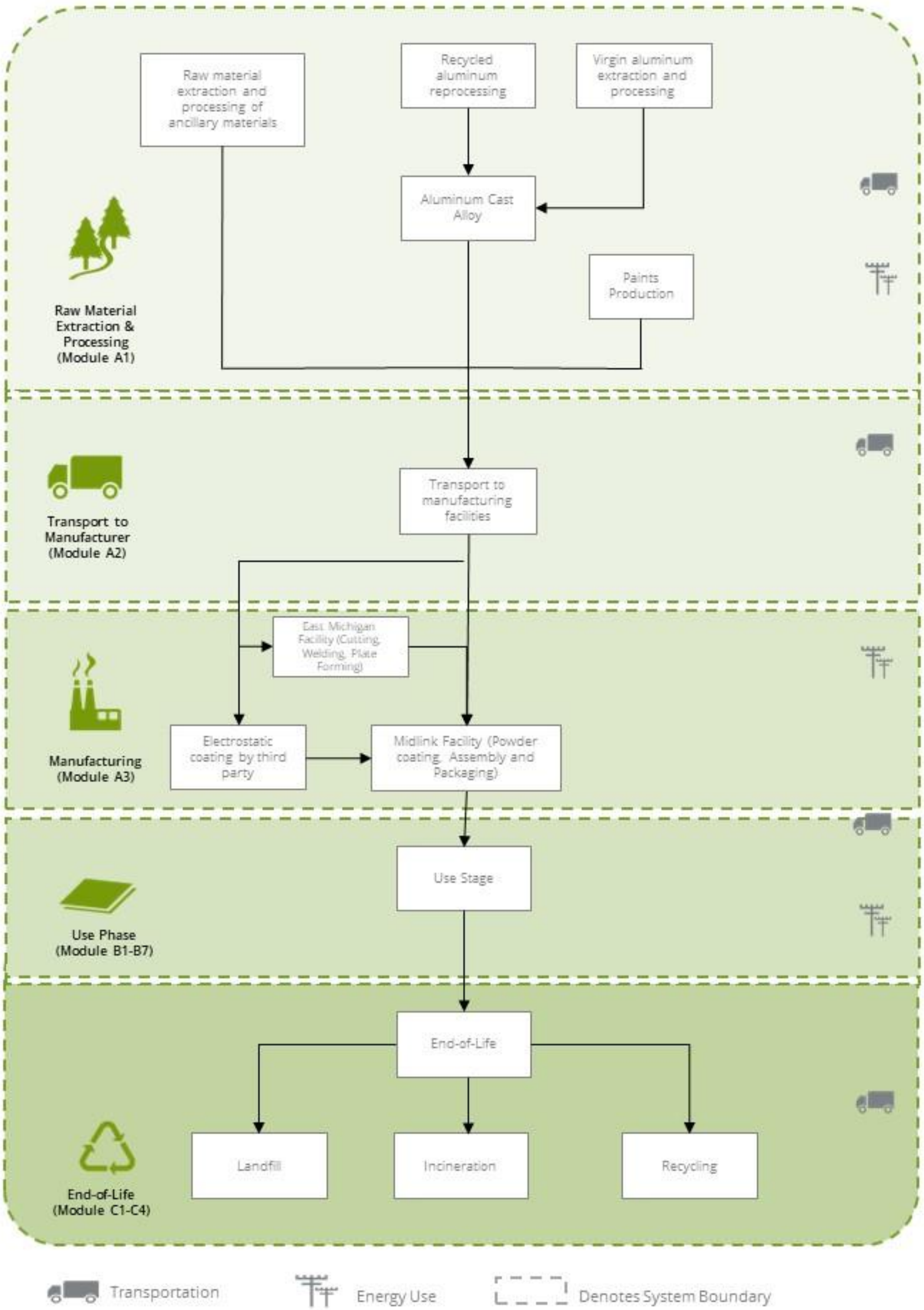
MATERIAL COMPOSITION

Table 2. *Material composition of the Landscape Forms **Chipman Chair** and packaging. Results are shown on a mass basis (kg/unit) and as a percent of total.*

Product	Product Material			Packaging Materials			
	Aluminum	Coating	Total Product	Wood	Cardboard	Plastic	Total Packaging
Chipman Chair	8.76	0.545	**9.31**	2.18	3.84	0.0312	**6.05**
	94%	6%	**100%**	36%	63%	1%	**100%**

PRODUCT LIFE CYCLE FLOW DIAGRAM

The diagram below is a representation of the most significant contributions to the life cycle of Landscape Forms Chipman Chair seating product.



LIFE CYCLE ASSESSMENT STAGES

The system boundary is cradle-to-grave and includes resource extraction and processing, product manufacture and assembly, distribution/transport, use and maintenance, and end-of-life. The diagram below illustrates the life cycle stages included in this EPD. Modules B1, B2, B3, B4, B5, B6, B7, C1 and C3 are assumed null. For module A4, distance for distribution is assumed to be 1,000 km by lorry. Transportation for end-of-life scenarios was modeled using the US EPA WARM model assumption of 20 miles (~32 km), from the point of product use to a landfill, material recovery center, or waste incinerator. For module C4, where the disposal was done by a third party, 80% of non-hazardous wastes are assumed to be disposed in landfill and 20% incinerated. Module D calculated by modelling the mass of scrap wood pallets fed into the product system per declared unit, as represented by the percent of pallets recycled by Landscape Forms.

Product			Construction Process		Use							End-of-life				Benefits and loads beyond the system boundary
A1	A2	A3	A4	A5	B1	B2	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	Benefits and loads beyond the system boundary
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

LIFE CYCLE IMPACT ASSESSMENT

. The impact indicators specified under this EPD include:

- Potential for Global Warming,
- Acidification Potential,
- Eutrophication Potential,
- Ozone Depletion Potential,
- Photochemical Ozone (smog) Creation Potential,
- Ecotoxicity,
- Human Toxicity, and
- Land Use/Land Occupation.

Impact category indicators for acidification, eutrophication, ozone depletion potential and photochemical ozone creation are estimated using the characterization factors as prescribed by the PCR, including from the CML-IA , ReCiPe and USEtox methodologies as well as those defined by EN 15804.

The PCR requires that several parameters be reported in the EPD, including resource use, waste categories and output flows, and other environmental information. The results for these parameters per declared unit are also included below.

All results are reported in SI units using English-style formatting for the thousand separator and decimal mark (i.e., 1 234.56). In addition to the requirements of the PCR, EN15804+A2, which this EPD conforms to, requires disclaimers from environmental indicators, which are shown in **Table 3** below.

Table 3. *Disclaimers for environmental indicators as required by the PCR*

Classification	Indicator	Disclaimer
ILCD Type 1	Global warming potential (GWP)	none
	Depletion potential of the stratospheric ozone layer (ODP)	none
	Potential incidence of disease due to PM emissions (PM)	none
ILCD Type 2	Acidification potential, Accumulated Exceedance (AP)	none
	Eutrophication potential, Fraction of nutrients reaching freshwater end compartment (EP-freshwater)	none
	Eutrophication potential, Fraction of nutrients reaching marine end compartment (EP-marine)	none
	Eutrophication potential, Accumulated Exceedance (EP-terrestrial)	none
	Formation potential of tropospheric ozone (POCP)	none
	Potential Human exposure efficiency relative to U235 (IRP)	1
ILCD Type 3	Abiotic depletion potential for non-fossil resources (ADP-minerals&metals)	2
	Abiotic depletion potential for fossil resources (ADP-fossil)	2
	Water (user) deprivation potential, deprivation-weighted water consumption (WDP)	2
	Potential Comparative Toxic Unit for ecosystems (ETP-fw)	2
	Potential Comparative Toxic Unit for humans (HTP-c)	2
	Potential Comparative Toxic Unit for humans (HTP-nc)	2
	Potential Soil quality index (SQP)	2

Disclaimer 1: *This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.* ***Disclaimer 2:*** *The results of this environmental impact indicator shall be used with care as uncertainties on these results are high or as there is limited experience with the indicator.*

Table 4. *Core Life Cycle Impact Assessment Results by life cycle phase for the Landscape Forms* ***Chipman Chair.*** *Results are shown for one chair maintained for 15 years.*

Impact Category	Unit	A1	A2	A3	A4	A5	C2	C4	D
Core Indicators									
Acidification	molc H+ eq	1.46	4.34×10^{-2}	0.207	1.28×10^{-2}	4.61×10^{-4}	2.50×10^{-4}	9.11×10^{-4}	-3.45×10^{-5}
	%	84.7%	2.5%	12.0%	0.7%	0.0%	0.0%	0.1%	0.0%
Climate change - Biogenic	kg CO2 eq	-1.10	6.18×10^{-3}	-0.647	4.47×10^{-3}	1.97	8.74×10^{-5}	3.78×10^{-2}	-4.25×10^{-5}
	%	-399.7%	2.3%	-235.8%	1.6%	717.8%	0.0%	13.8%	0.0%
Climate change - Fossil	kg CO2 eq	161	3.00	63.5	2.52	7.17×10^{-2}	4.94×10^{-2}	0.117	-7.87×10^{-3}
	%	70.0%	1.3%	27.5%	1.1%	0.0%	0.0%	0.1%	0.0%
Climate change - Land use and LU change	kg CO2 eq	9.80×10^{-2}	2.12×10^{-3}	3.12×10^{-2}	1.00×10^{-3}	1.92×10^{-5}	1.96×10^{-5}	3.80×10^{-5}	-6.51×10^{-6}
	%	74.0%	1.6%	23.6%	0.8%	0.0%	0.0%	0.0%	0.0%
Climate Change - Total	kg CO2 eq	160	3.01	62.9	2.53	2.04	4.95×10^{-2}	0.155	-7.92×10^{-3}
	%	69.4%	1.3%	27.2%	1.1%	0.9%	0.0%	0.1%	0.0%
Eutrophication, freshwater	kg PO_4 eq	8.65×10^{-2}	2.73×10^{-4}	2.11×10^{-2}	1.65×10^{-4}	6.57×10^{-6}	3.23×10^{-6}	3.13×10^{-5}	-3.62×10^{-6}
	%	80.1%	0.3%	19.5%	0.2%	0.0%	0.0%	0.0%	0.0%
Eutrophication, marine	kg N eq	0.196	1.42×10^{-2}	4.03×10^{-2}	4.41×10^{-3}	1.72×10^{-3}	8.62×10^{-5}	3.58×10^{-4}	-8.18×10^{-6}
	%	76.2%	5.5%	15.7%	1.7%	0.7%	0.0%	0.1%	0.0%
Eutrophication, terrestrial	molc N eq	1.99	0.157	0.347	4.81×10^{-2}	1.68×10^{-3}	9.42×10^{-4}	3.81×10^{-3}	-7.77×10^{-5}
	%	78.1%	6.1%	13.6%	1.9%	0.1%	0.0%	0.1%	0.0%
Ozone depletion	kg CFC11 eq	4.83×10^{-6}	5.79×10^{-7}	4.79×10^{-6}	5.89×10^{-7}	1.41×10^{-8}	1.15×10^{-8}	3.14×10^{-8}	-3.93×10^{-10}
	%	44.5%	5.3%	44.2%	5.4%	0.1%	0.1%	0.3%	0.0%
Photochemical ozone formation	kg MVOC eq	0.552	4.13×10^{-2}	0.103	1.35×10^{-2}	8.07×10^{-4}	2.64×10^{-4}	1.07×10^{-3}	-3.12×10^{-5}
	%	77.5%	5.8%	14.5%	1.9%	0.1%	0.0%	0.1%	0.0%
Abiotic Depletion Potential, minerals and metals	kg Sb-Eq	3.31×10^{-4}	9.05×10^{-6}	1.00×10^{-4}	8.50×10^{-6}	2.07×10^{-7}	1.66×10^{-7}	5.84×10^{-7}	-7.87×10^{-8}
	%	73.6%	2.0%	22.3%	1.9%	0.0%	0.0%	0.1%	0.0%
Abiotic Depletion Potential, fossils	MJ LHV	1,800	5.86	375	2.89	8.12×10^{-2}	5.66×10^{-2}	0.219	-8.17×10^{-2}
	%	82.5%	0.3%	17.1%	0.1%	0.0%	0.0%	0.0%	0.0%
Water use	m3	21.7	0.246	13.1	0.184	3.96×10^{-2}	3.60×10^{-3}	0.153	-3.82×10^{-3}
	%	61.2%	0.7%	37.0%	0.5%	0.1%	0.0%	0.4%	0.0%

Table 5. *Additional Life Cycle Impact Assessment Results by life cycle phase for the Landscape Forms* ***Chipman Chair****. Results are shown for one chair maintained for 15 years.*

Impact Category	Unit	A1	A2	A3	A4	A5	C2	C4	D
Additional Indicators									
Freshwater ecotoxicity	PAF.m3.day	23.8	0.615	11.7	1.27	2.54×10^{-2}	2.48×10^{-2}	0.184	-1.84×10^{-3}
	%	63.2%	1.6%	31.2%	3.4%	0.1%	0.1%	0.5%	0.0%
Human toxicity, cancer	CTUh	1.21×10^{-7}	1.72×10^{-9}	2.03×10^{-8}	8.22×10^{-10}	4.38×10^{-11}	1.61×10^{-11}	2.61×10^{-10}	-4.50×10^{-11}
	%	84.0%	1.2%	14.1%	0.6%	0.0%	0.0%	0.2%	0.0%
Human toxicity, non-cancer	CTUh	1.61×10^{-5}	4.82×10^{-8}	1.29×10^{-6}	4.72×10^{-8}	6.10×10^{-9}	9.23×10^{-10}	7.35×10^{-9}	-4.20×10^{-10}
	%	92.0%	0.3%	7.4%	0.3%	0.0%	0.0%	0.0%	0.0%
Land use	Pt	238	18.4	65.1	32.1	2.07	0.628	7.34	-1.93×10^{-2}
	%	65.5%	5.1%	17.9%	8.8%	0.6%	0.2%	2.0%	0.0%
Particulate Matter emissions	Disease inc.	8.55×10^{-6}	2.39×10^{-7}	1.15×10^{-6}	1.82×10^{-7}	6.17×10^{-9}	3.56×10^{-9}	1.96×10^{-8}	-6.03×10^{-10}
	%	84.2%	2.4%	11.3%	1.8%	0.1%	0.0%	0.2%	0.0%
Ionizing Radiation, human health	kBq U-235 eq	9.20	0.198	8.83	0.198	6.77×10^{-3}	3.87×10^{-3}	2.86×10^{-2}	-3.74×10^{-4}
	%	49.8%	1.1%	47.8%	1.1%	0.0%	0.0%	0.2%	0.0%

Table 6. *Resource use and waste flows by life cycle phase for the Landscape Forms **Chipman Chair.** Results are shown for one chair maintained for 15 years.*

Impact Category	Unit	A1	A2	A3	A4	A5	C2	C4	D
Resources									
Use of nonrenewable primary energy	MJ LHV	1,940	6.67	509	3.70	0.132	7.23×10^{-2}	0.533	-8.67×10^{-2}
	%	78.9%	0.3%	20.7%	0.2%	0.0%	0.0%	0.0%	0.0%
Use of nonrenewable primary energy resources used as raw materials	MJ LHV	309	34.7	555	35.0	0.881	0.685	2.11	-2.70×10^{-2}
	%	33.0%	3.7%	59.2%	3.7%	0.1%	0.1%	0.2%	0.0%
Use of renewable primary energy	MJ LHV	27.6	0.522	23.9	0.408	4.44×10^{-2}	7.98×10^{-3}	0.311	-5.92×10^{-3}
	%	52.3%	1.0%	45.3%	0.8%	0.1%	0.0%	0.6%	0.0%
Use of renewable primary energy resources used as raw materials	MJ LHV	21.9	0.257	41.3	0.134	6.62×10^{-3}	2.62×10^{-3}	0.120	-1.47×10^{-3}
	%	34.3%	0.4%	64.8%	0.2%	0.0%	0.0%	0.2%	0.0%
Use of net fresh water	m3	0.545	5.90×10^{-3}	0.391	4.39×10^{-3}	9.28×10^{-4}	8.58×10^{-5}	3.59×10^{-3}	-9.05×10^{-5}
	%	57.3%	0.6%	41.1%	0.5%	0.1%	0.0%	0.4%	0.0%
Use of secondary materials	kg	3.21	6.30×10^{-2}	9.26	3.87×10^{-2}	3.95×10^{-3}	7.58×10^{-4}	4.92×10^{-2}	-1.62×10^{-3}
	%	25.5%	0.5%	73.3%	0.3%	0.0%	0.0%	0.4%	0.0%
Use of Nonrenewable secondary fuels	MJ LHV	1.20	4.70×10^{-2}	8.08	4.70×10^{-2}	2.17×10^{-3}	9.19×10^{-4}	0.539	-2.04×10^{-4}
	%	12.1%	0.5%	81.4%	0.5%	0.0%	0.0%	5.4%	0.0%
Use of Renewable secondary fuels	MJ LHV	0.126	8.52×10^{-3}	2.73	1.16×10^{-2}	1.20×10^{-3}	2.26×10^{-4}	8.68×10^{-3}	-4.53×10^{-5}
	%	4.4%	0.3%	94.6%	0.4%	0.0%	0.0%	0.3%	0.0%
Use of renewable primary energy excluding renewable primary energy resources used as raw materials (RPRE)	MJ LHV	49.4	0.779	31.6	0.542	5.11×10^{-2}	1.06×10^{-2}	0.431	-7.39×10^{-3}
	%	59.7%	0.9%	38.1%	0.7%	0.1%	0.0%	0.5%	0.0%
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials (NRPRE)	MJ LHV	2,250	41.4	1,060	38.7	1.01	0.757	2.64	-0.114
	%	66.2%	1.2%	31.3%	1.1%	0.0%	0.0%	0.1%	0.0%
Wastes									
Components for re-use	kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Exported energy	MJ LHV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Materials for energy recovery	kg	0.118	3.03×10^{-2}	6.36×10^{-2}	8.89×10^{-3}	3.65×10^{-4}	1.74×10^{-4}	1.09×10^{-3}	-1.34×10^{-3}
	%	53.4%	13.7%	28.8%	4.0%	0.2%	0.1%	0.5%	-0.6%
Materials for recycling	kg	0.374	4.41×10^{-2}	4.56	3.23×10^{-2}	2.92×10^{-3}	6.32×10^{-4}	0.652	-9.90×10^{-4}
	%	6.6%	0.8%	80.5%	0.6%	0.1%	0.0%	11.5%	0.0%
Hazardous waste	kg	425	1.38	102	0.851	2.44×10^{-2}	1.66×10^{-2}	0.113	-1.72×10^{-2}
	%	80.2%	0.3%	19.3%	0.2%	0.0%	0.0%	0.0%	0.0%
Nonhazardous waste	kg	12.2	0.708	2.15	1.96	2.38	3.84×10^{-2}	8.77	-1.18×10^{-3}
	%	43.2%	2.5%	7.6%	7.0%	8.4%	0.1%	31.1%	0.0%
Radioactive waste	kg	8.54×10^{-2}	7.69×10^{-4}	8.37×10^{-2}	7.66×10^{-4}	3.75×10^{-5}	1.50×10^{-5}	2.07×10^{-4}	-3.21×10^{-6}
	%	50.0%	0.5%	49.0%	0.4%	0.0%	0.0%	0.1%	0.0%

INA = Indicator Not Assessed

SUPPORTING TECHNICAL INFORMATION

Unit processes were developed with OpenLCA v2.0.1 software, drawing upon data from multiple sources. Primary data were provided by Landscape Forms for their manufacturing processes. The primary sources of secondary LCI data are from the Ecoinvent Database.

Table 7. *Data sources used for the LCA study.*

Component	Material Dataset	Data Source	Publication Date
PRODUCTS			
Aluminum			
China/ aluminium, cast alloy	aluminium production, primary, cast alloy slab from continuous casting | aluminium, primary, cast alloy slab from continuous casting | Cutoff, U± - RoW treatment of aluminium scrap, new, at refiner | aluminium, cast alloy | Cutoff, U – RoW treatment of aluminium scrap, post-consumer, prepared for recycling, at refiner | aluminium, cast alloy | Cutoff, U – RoW treatment of aluminium scrap, new, at refiner | aluminium, cast alloy | Cutoff, U – RoW	Ecoinvent	2021
US/ aluminium, cast alloy	aluminium production, primary, cast alloy slab from continuous casting | aluminium, primary, cast alloy slab from continuous casting | Cutoff, U* - RoW treatment of aluminium scrap, new, at refiner | aluminium, cast alloy | Cutoff, U – RoW treatment of aluminium scrap, post-consumer, prepared for recycling, at refiner | aluminium, cast alloy | Cutoff, U – RoW treatment of aluminium scrap, new, at refiner | aluminium, cast alloy | Cutoff, U – RoW	Ecoinvent	2021
Hardware manufacturing	metal working, average for aluminium product manufacturing | metal working, average for aluminium product manufacturing | Cutoff, U – RoW	Ecoinvent	2021
Extrusion	section bar extrusion, aluminium | section bar extrusion, aluminium | Cutoff, U * - RoW section bar extrusion, aluminium | section bar extrusion, aluminium | Cutoff, U ± - RoW	Ecoinvent	2021
Sheet rolling	sheet rolling, aluminium | sheet rolling, aluminium | Cutoff, U* - RoW sheet rolling, aluminium | sheet rolling, aluminium | Cutoff, U± - RoW	Ecoinvent	2021
PACKAGING			
Pallets/wood	EUR-flat pallet production | EUR-flat pallet | Cutoff, U – RoW	Ecoinvent	2021
Corrugated cardboard	corrugated board box production | corrugated board box | Cutoff, U - RoW	Ecoinvent	2021
Packaging film	packaging film production, low density polyethylene | packaging film, low density polyethylene | Cutoff, U – RoW	Ecoinvent	2021
FACILITY			
US-RFC -Grid electricity	market for electricity, medium voltage | electricity, medium voltage | Cutoff, U – Custom RFCM – US-RFC	EI v3.8; EPA eGRID	2021; 2022
Natural gas	heat and power co-generation, natural gas, conventional power plant, 100MW electrical | heat, district or industrial, natural gas | Cutoff, U – US-RFC	Ecoinvent	2021
Welding	welding, arc, aluminium | welding, arc, aluminium | Cutoff, U – RER	Ecoinvent	2021
E-coating	market for electrostatic paint | electrostatic paint | Cutoff, U – GLO	Ecoinvent	2021
WASTES			
Incineration	treatment of municipal solid waste, incineration | municipal solid waste | Cutoff, U – RoW	Ecoinvent	2021
Landfill	treatment of inert waste, sanitary landfill | inert waste | Cutoff, U – RoW	Ecoinvent	2021

Component	Material Dataset	Data Source	Publication Date
TRANSPORTATION			
Road transport	transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | Cutoff, U – RER	Ecoinvent	2021
Ocean shipping	transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, U – GLO	Ecoinvent	2021
Train transport	market for transport, freight train | transport, freight train | Cutoff, U – US	Ecoinvent	2021
END-OF-LIFE			
Corrugated landfill	treatment of waste paperboard, sanitary landfill | waste paperboard | Cutoff, U – CH	Ecoinvent	2021
Corrugated incineration	treatment of waste paperboard, municipal incineration with fly ash extraction | waste paperboard | Cutoff, U – CH	Ecoinvent	2021
Plastic landfilling	treatment of waste plastic, mixture, sanitary landfill | waste plastic, mixture | Cutoff, U – CH	Ecoinvent	2021
Plastic incineration	treatment of waste plastic, mixture, municipal incineration with fly ash extraction | waste plastic, mixture | Cutoff, U – CH	Ecoinvent	2021
Wood landfill and incineration	treatment of waste wood, untreated, sanitary landfill | waste wood, untreated | Cutoff, U – CH	Ecoinvent	2021
Wood incineration	treatment of waste wood, untreated, municipal incineration with fly ash extraction | waste wood, untreated | Cutoff, U – CH	Ecoinvent	2021
Aluminum	treatment of waste aluminium, sanitary landfill | waste aluminium | Cutoff, U – CH	Ecoinvent	2021

* modified for US electricity grid
± modified for State Grid Corp of China electricity grid

Data Quality

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage Age of data and the minimum length of time over which data should be collected	The most recent available data are used, based on other considerations such as data quality and similarity to the actual operations. Typically, these data have been updated within the last 5 years (2021 for Ecoinvent). All of the secondary data used represents an average of at least one year's worth of data collection.
Geographical Coverage Geographical area from which data for unit processes should be collected to satisfy the goal of the study	The data used in the analysis provide the best possible representation available with current data. Actual processes for upstream operations are primarily North American or Chinese. Surrogate data used in the assessment for North American operations are representative of North American or European operations. Data representative of European operations are considered sufficiently similar to actual processes. Data for upstream processes in China are modeled with secondary data based on China, where available, of Rest-of-World operations. Electricity grids for secondary datasets are based on the country or sub-national grids, as available in Ecoinvent.
Technology Coverage Specific technology or technology mix	Data are generally representative of the actual technologies used for energy generation, processing, transportation, and manufacturing operations.
Precision Measure of the variability of the data values for each data expressed (e.g. variance)	Precision of results are not quantified due to a lack of data on data variance. Precision on the allocating manufacturing resources is moderate, as subdividing electricity and fuel use by each manufacturing process was not possible. Data collected for most operations were typically averaged for one or more years and over multiple operations, which is expected to reduce the variability of results. Precision of the individual component materials could be improved with more primary data.
Completeness Percentage of flow that is measured or estimated	The LCA model includes all known mass and energy flows for production of the five outdoor furniture products. In some instances, surrogate data are used to represent unit processes. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded.
Representativeness Qualitative assessment of the degree to which the data set reflects the true population of interest (i.e. geographical coverage, time period, and technology coverage)	Data used in the assessment represent typical or average processes as currently reported from multiple data sources and are therefore generally representative of the range of actual processes and technologies for production of the outdoor furniture products.
Consistency Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	The consistency of the assessment is considered to be high. Data sources of similar quality and age are used; with a bias towards Ecoinvent data for secondary data.
Reproducibility Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Based on the description of data and assumptions used, the major contributing components and life cycle stages of the assessment would be reproducible by other practitioners with access to the primary data used in the study and the assumptions built into Ecoinvent datasets. These major assumptions, models, and data sources are documented.
Sources of the Data Description of all primary and secondary data sources	Data sources used are documented and described in this report. For secondary LCI datasets, Ecoinvent databaseare used. Ecoinvent datasets are also used to underlie some assumptions on welding and coating processes. Other sources of data include the AISI report on steelmaking.
Uncertainty of the Information Uncertainty related to data, models, and assumptions	Uncertainty related to the manufacturing processes are low. Primary data for key unit operations are included. Uncertainty related to the IPCC 2021 metrics are high, given that these metrics assume impacts from climate change will not occur for 100 years and do not include short-lived climate forcers.

LCIA Methodology

Category Indicator	Method & Version	Units	Impact Category and Environmental Mechanism
Global Warming Potential (GWP)	GWP100, EN 15804. August 2021.	kg CO_2 eq.	Anthropogenic emissions of greenhouse gases and short-lived climate forcers have led to increased radiative forcing, which has in turn increased the global mean temperature by above 0.99°C since pre-industrial times. All IPCC scenarios project an increase to 1.5°C in the near term, occurring between 2021 to 2040. The projection for the SSP2-4.5 scenario estimates an increase of 2.0°C occurring between 2043-2062, with 3°C occurring between 2061-2080. As global mean temperatures continue to climb, global climate change will result. Some of the predicted impacts include reductions in food and food supplies, water supplies, and sea level rise. Note: WMO Statement of the Global Climate 2021 (18 May 2022) is reporting as an update to the IPCC AR6 WGI, that the average global temperature in 2021 was ~1.11 (±0.13) °C above pre-industrial levels.
Ozone Layer Depletion (ODP)	ODP, EN 15804. August 2021.	kg CFC-11 eq.	Emissions of ozone depleting substances such as chlorofluorocarbons contribute to a thinning of the stratospheric ozone layer. This can lead to increased cases of skin cancer, and effects on crops, other plants, marine life, and human-built materials. All chlorinated and brominated compounds stable enough to reach the stratosphere can have an effect. CFCs, halons and HCFCs are the major causes of ozone depletion. Damage to the ozone layer reduces its ability to prevent ultraviolet (UV) light entering the earth's atmosphere, increasing the amount of carcinogenic UVB light reaching the earth's surface. Due to the international ban on ozone depleting chemicals, the stratospheric ozone layer has begun to recover; U.S. EPA projects that the ozone layer will recover within about 50 years.
Photochemical Oxidant Creation Potential (POCP)	POCP, LOTOS-EUROS as applied in ReCiPe, EN 15804. August 2021.	kg NMVOC eq	Photochemical ozone, also called "ground level ozone", is formed by the reaction of volatile organic compounds and nitrogen oxides in the presence of heat and sunlight. If ozone concentrations reach above certain critical thresholds, health effects in humans can result, including bronchitis, asthma, and emphysema. The impact category depends largely on the amounts of carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxide (NO), ammonium and NMVOC (non-methane volatile organic compounds).
Acidification (AP)	AP, accumulated exceedance, EN 15804. August 2021	kg SO_2 eq.	Acidification is the increasing concentration of hydrogen ion (H^+) within the local environmental and occurs as a result of adding acids such as nitric acid and sulfuric acids into the environment. Acid precursor emissions transport in the atmosphere and deposit as acids. These acids may deposit in soils which are sensitive, or insensitive, to the increased acid burden; sensitivity can depend on a number of factors. In acid-sensitive soils, the deposition can decrease the soil pH (acidification) and increase the mobility of heavy metals in the environment, such as aluminum. This acidification can affect the pH of local soils and freshwater bodies, by increasing local hydrogen ion concentrations, causing endpoints such as tree die-offs and dead lakes. Emissions of sulfur dioxide and nitrogen oxides from the combustion of fossil fuels have been the greatest contributor to acid rain.
Eutrophication (EP)	EP, aquatic freshwater, EUTREND model; EP, aquatic marine, EUTREND model; EP, terrestrial, accumulated exceedance EN 15804. August 2021.	kg PO_4 eq. kg N eq.	Eutrophication is the build-up of a concentration of chemical nutrients in an ecosystem which leads to abnormal productivity. In some regions, emissions of excess nutrients (including phosphorus and nitrogen) into water can lead to increased algal blooms. These blooms can reach such a severity that waterways become choked, with no other plant life able to establish itself. If algal blooms are intense enough, the decaying algae consumes dissolved oxygen in the water column starving other organisms of needed oxygen. Whereas phosphorous is mainly responsible for eutrophication in freshwater systems, nitrogen is mainly responsible for eutrophication in ocean water bodies. Emissions of ammonia, nitrates, nitrogen oxides and phosphorous to air or water all have an impact on eutrophication.

Category Indicator	Method & Version	Units	Impact Category and Environmental Mechanism
Abiotic Depletion, elements (ADPE)	ADP minerals & metals, EN 15804. August 2021.	kg Sb eq.	This impact category refers to the consumption of non-biological resources such as minerals and metals. The value of the abiotic resource consumption of a substance is a measure of the scarcity of a substance and depends on the amount of resources and the extraction rate. The indicator is calculated as the amount of resources that are depleted and measured in antimony equivalents for mineral depletion.
Abiotic Depletion, fossil fuels (ADPF)	ADP fossil resources, EN 15804. August 2021.	MJ	This impact category refers to the consumption of fossil fuels. The value of the abiotic resource consumption of a substance (e.g., lignite or coal) is a measure of the scarcity of a substance and depends on the amount of resources and the extraction rate. It is calculated as the amount of resources that are depleted and measured in equivalent MJ of fossil fuels.
Ecotoxicity	USEtox 2.02, 2008	CTUe	This category concerns effects of toxic substances on the fresh water aquatic environment. The characterization factor of ecotoxicity accounts for the environmental persistence (fate) and toxicity (effect) of a chemical. The damage (endpoint) level ecotoxicity potential [PDF m^3 d] or comparative damage units [CDUe] per kg chemical emitted represents an increase in the fraction of species potentially disappearing as a consequence of an emission in a compartment
Human Toxicity	USEtox 2.02, 2008	CTUh	This category concerns effects of toxic substances on the human environment. The USEtox model calculates characterization factors for carcinogenic impacts, non-carcinogenic impacts, and total impacts (Carc + non-carc) for chemical emissions to urban air, rural air, freshwater, sea water, agricultural soil and/or natural soil. The characterization factors for human toxicity are expressed in cases/kg.
Land Use	ADP fossil resources, EN 15804. August 2021.	Pt	This impact category quantifies the amount of agricultural, urban or natural land occupied for a certain time.
Water Deprivation Potential (AWARE)	AWARE. EN 15804. August 2021	m^3 depriv	The AWARE method is based on the inverse of the difference between water availability per area and demand per area. It quantifies the potential of water deprivation, to either humans or ecosystems, and serves in calculating the impact score of water consumption at midpoint in LCA or to calculate a water scarcity footprint as per ISO 14046. It is based on the available water remaining (AWARE) per unit of surface in a given watershed relative to the world average, after human and aquatic ecosystem demands have been met. The resulting CF ranges between 0.1 and 100 and is meant to be multiplied with the local water consumption inventory.

Allocation

The furniture products are manufactured at the Landscape Forms facilities. All electricity and resources used at the manufacturing facilities are attributed to the products on a per unit basis, except for welding operations which are modeled on the basis of length of weld. Mass allocation was not possible due to data constraints. Electrostatic coating processes at the third party facility are modeled based on the surface area of the coated portion of the product.

Impacts from transportation were allocated based on the mass of material and distance transported.

Per the PCR, the polluter pays principle is applied to the product systems in which the generator of the waste carries the environmental impact until the point in the product's life cycle at which the waste is transported to a scrapyard or gate of waste processing. Benefits from recovery operations at the end of life of these materials are not attributed to the product system.

System Boundaries

The system boundaries of the life cycle assessment was cradle-to-grave. A description of the system boundaries for this EPD are as follows:

Module	Module description from the PCR	Unit Processes Included in Scope
A1	Extraction and processing of raw materials; any reuse of products or materials from previous product systems; processing of secondary materials; generation of electricity from primary energy resources; energy, or other, recovery processes from secondary fuels	Extraction and processing of raw materials for the material components.
A2	Transport (to the manufacturer)	Transport of component materials to the manufacturing facility
A3	Manufacturing, including ancillary material production	Manufacturing of outdoor furniture products and packaging (incl. upstream unit processes)
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 negligible. Impacts from the production, transport and disposal of waste material associated with installation are included in this phase in addition to impacts from packaging disposal.
B1	Product use	Use of the outdoor furniture 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 15-year ESL, including periodic cleaning.
B3	Product repair	The furniture is not expected to require repair over its lifetime.
B4	Product replacement	The furniture is not expected to require replacement over its lifetime.
B5	Product refurbishment	The outdoor furniture 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 use by technical building systems	There is no operational water use associated with the use of the product
C1	Deconstruction, demolition	Demolition of the product is accomplished using hand tools with no associated emissions and negligible impacts
C2	Transport (to waste processing)	Transport of product to waste treatment at end-of-life
C3	Waste processing for reuse, recovery and/or recycling	The product is disposed of by landfilling which require no waste processing
C4	Disposal	Disposal of outdoor furniture product in municipal landfill
D	Benefits and loads beyond the system boundary	Reused, recovery, and recycling of materials.

Electricity use in both upstream and downstream processes is modeled using ecoinvent datasets representing the electricity mix for regional and global markets.

Cut-off criteria

According to the PCR, cumulative omitted mass or energy flows within the product boundary shall not exceed 5%. In the present study, except as noted, all known materials and processes were included in the life cycle inventory.

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