Declaration Owner

Vitra AG

Klünenfeldstrasse 22, Birsfelden, BL CH-4127, Switzerland

info@vitra.com | +41.61.377.0000 | www.vitra.com

Product

Mikado

(UNSPSC Class Code 56101504)

Functional Unit

The functional unit is one seating product serving the function of typical office seating maintained for a 15-year period. The reference unit used in the study is one complete product.

EPD Number and Period of Validity

SCS-EPD-10276

EPD Valid September 30, 2024, through September 29, 2029

Version Date: October 22, 2024

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

Declaration Owner:	Vitra AG
Address:	Klünenfeldstrasse 22, Birsfelden, BL CH-4127, Switzerland
Declaration Number:	SCS-EPD-10276
Declaration Validity Period:	September 30, 2024 through September 29, 2029
Version:	October 22 2024
Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Gerard Mansell, Ph.D., SCS Global Services
LCA Software and LCI database:	OpenLCA v2.1 software and the Ecoinvent v3.10 database
Product RSL:	15 years
Markets of Applicability:	Global
EPD Type:	Product-Specific
EPD Scope:	Cradle-to-Grave
LCIA Method and Version:	EN 15804:2012+A2:2019 (EF3.1)
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 Furniture. Product Category Classification: NPCR 026. EPD Norge®. Version 2.0. September 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:	

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.*

The owner of the declaration shall be liable for the underlying information and evidence; SCS shall not be liable with respect to manufacturer information, life cycle assessment data, and evidence supplied or made available to SCS.

1. Vitra

Vitra is a Swiss family-owned company. It not only makes furniture and creates retail environments, but also has its own Campus with buildings by leading international architects. Creating innovative products and concepts with great designers is Vitra's essence. They are developed in Switzerland and installed worldwide by architects, companies and private users to build inspirational spaces for living, working and shopping as well as public areas. With its classics, Vitra represents groundbreaking 20th century design. Today, in combining technical and conceptual expertise with the creativity of contemporary designers, Vitra seeks to continue pushing the boundaries of the design discipline. A family business for eighty years, Vitra believes in lasting relationships with customers, employees and designers, durable products, sustainable growth and the power of good design. The Vitra Campus with buildings by some of the world's leading architects and the Vitra Design Museum with its exhibitions on design and architecture, design archives and a comprehensive furniture collection are all part of Vitra. They inspire visitors, inform the design process and create an atmosphere in which innovation flourishes.

2. Product

2.1 PRODUCT DESCRIPTION

Mikado

Mikado is a chair with a serene yet commanding aura that aims to impress not by its form but through its comfort. It achieves this thanks to upholstery on all sides and an ingeniously simple mechanism concealed beneath the seat that facilitates subtle movement of the backrest. Mikado was designed with sustainability in mind from the outset: the covers are not glued and can be removed for cleaning or replacement. The legs may be replaced individually or exchanged for a different material option – wood or recycled aluminium. The inner seat panel is made of recycled aluminium while the core of the backrest shell is produced from recycled post-consumer polypropylene, which can be easily separated from the foam padding during recycling. The concept of a simple exchange of components gives Mikado long-term versatility, thereby ensuring longevity. Mikado is available as an armchair with suggested armrests or as a side chair. The two backrests, different legs, a choice of fabric or leather covers and numerous colours enable a wide variety of possible combinations.

2.2 PRODUCT FLOW DIAGRAM

A flow diagram illustrating the production processes and life cycle phases included in the scope of the EPD is presented in Figure 1.

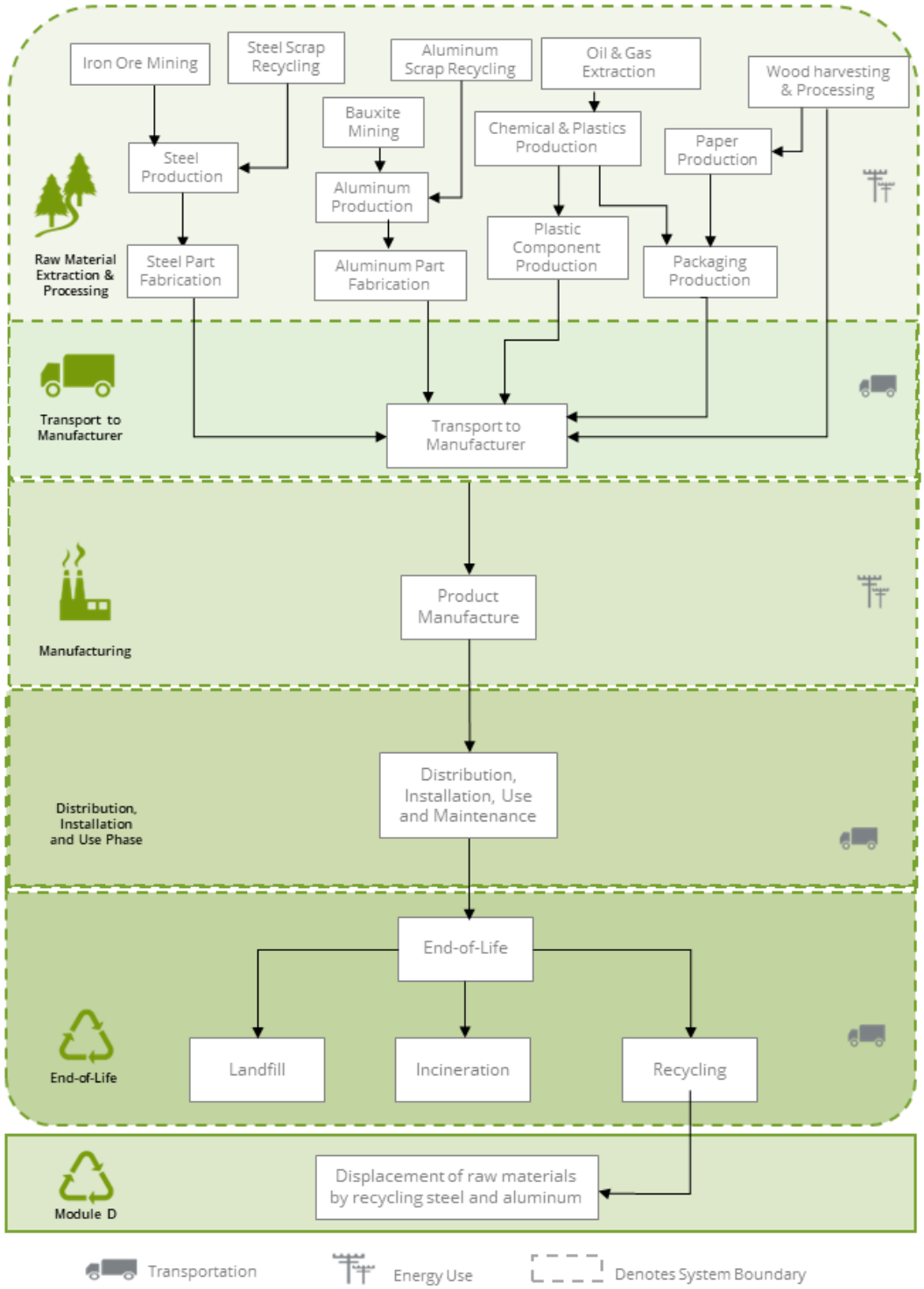

Figure 1. *Flow diagram for the life cycle of the Vitra Mikado seating products.*

2.3 APPLICATION

The Vitra products serve the function of typical office seating. The products used are in a variety of office settings.

2.4 DECLARATION OF METHODOLOGICAL FRAMEWORK

The scope of the EPD is cradle-to-grave, including raw material extraction and processing, transportation, product manufacture, product delivery, installation and use, and product disposal. The LCA is conducted using an attributional approach. The environmental loads and benefits resulting from recyclable materials leaving a product system (Module D) are also included. The life cycle phases included in the product system boundary are shown below.

Cut-off and allocation procedures are described below and conform to the PCR and ISO standards.

Table 1. *Life cycle phases included in the product system boundary.*

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	Reuse, recovery and/or recycling potential
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

X = included

2.5 TECHNICAL DATA

Technical specifications for the products can be found at the manufacturer's website https://www.vitra.com/en-us/product.

2.6 MARKET PLACEMENT/APPLICATION RULES

The products are distributed to consumer markets globally. Detailed product performance results can be found on the manufacturer's website https://www.vitra.com/en-us/product.

2.7 PROPERTIES OF DECLARED PRODUCT AS DELIVERED

The products are delivered assembled and wrapped in plastic and corrugate.

2.8 MATERIAL COMPOSITION

The products are manufactured from wood, fabricated steel and aluminum, plastics and various hardware.

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

Material	Mikado	
	kg	% mass
Wood	1.87	18%
Steel	0.452	4.4%
Aluminum	2.98	29%
Polypropylene	2.82	28%
Nylon	2.20×10^{-2}	0.21%
PUR	1.70	17%
Plastics	0.392	3.8%
Total Product	**10.2**	**100%**

Based on a review of the product components provided by the manufacturer, no regulated chemicals, i.e., substances of Very High Concern (SVHC) or substances on the REACH Candidate List, were identified in the product or product components.

2.9 MANUFACTURING

The products are manufactured at Vitra's production facility in Germany. The manufacturer provided primary data for their annual production, resource use and electricity consumption and waste generation at the facility.

Electricity consumption is modeled using modified Ecoinvent datasets for the regional electricity grid for Germany and is accounted for in the A3 stage of the life cycle. Additionally, GWP impact results modeled with hydroelectricity at the production facility are estimated and reported separately.

2.10 PACKAGING

The products are packaged for shipment using plastic, and corrugated cartons.

Table 3. *Material content for the product packaging in kg per unit.*

Material	Mikado	
	kg	% mass
Corrugate/Paper	0.590	80%
Plastic	0.147	20%
Total Packaging	**0.737**	**100%**

2.11 PRODUCT INSTALLATION

Installation of the product is accomplished using hand tools with negligible impacts. The impacts associated with packaging disposal are included with the installation phase as per PCR requirements.

2.12 USE CONDITIONS

No special conditions of use are noted.

2.13 REFERENCE SERVICE LIFE

The Reference Service Life (RSL) of the products is 15 years.

2.14 RE-USE PHASE

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

2.15 DISPOSAL

End-of-life assumptions are based on waste disposal statistics for the European Union.

2.16 FURTHER INFORMATION

Further information on the product can be found on the manufacturer's website https://www.vitra.com/en-us/product.

3. LCA: Calculation Rules

3.1 FUNCTIONAL UNIT

The Vitra products serve the function of a typical office seating. According to ISO 14044, the functional unit is "the quantified performance of a product system, for use as a reference unit." The functional unit used in the study, consistent with the PCR, is one complete product serving the specified function for a 15-year period. The reference flow for the product system is one complete product with mass as summarized in Table 4.

Table 4. *Reference flow and RSL for the table products.*

Product name	Reference flow (kg)	Reference Service Life – RSL (years)	Total # of Products Modeled
Mikado	10.2	15	1

3.2 SYSTEM BOUNDARY

The scope of the EPD is cradle-to-grave, including raw material extraction and processing, transportation, product manufacture, product delivery, installation and use, and product disposal. The life cycle phases included in the EPD scope are described in Table 5.

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

Module	Module Description	Unit Processes Included in Scope
A1	Extraction and processing of raw materials; any reuse of products or materials from previous product systems; processing of secondary materials; generation of electricity from primary energy resources; energy, or other, recovery processes from secondary fuels	Extraction and processing of raw materials for the product components.
A2	Transport (to the manufacturer)	Transport of component materials to the manufacturing facilities
A3	Manufacturing, including ancillary material production	Manufacturing of flooring products and packaging (including 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 with no installation wastage. Only impacts from packaging disposal are included in this stage
B1	Product use	Use of the product in a commercial building setting. There are no associated emissions or impacts from the use of the product
B2	Product maintenance	Impacts associated with product maintenance are negligible.
B3	Product repair	The products are not expected to require repair over their lifetime
B4	Product replacement	The products are not expected to require replacement over their lifetime
B5	Product refurbishment	The product is not expected to require refurbishment over its lifetime
B6	Operational energy use by technical building systems	There is no operational energy use associated with the use of the product
B7	Operational water uses by technical building systems	There is no operational water use associated with the use of the product
C1	Deconstruction, demolition	Demolition of the product is accomplished using hand tools with no associated emissions and negligible impacts
C2	Transport (to waste processing)	Transport of the product to waste treatment at end-of-life
C3	Waste processing for reuse, recovery and/or recycling	The products are disposed of by recycling, landfilling or incineration which require no waste processing
C4	Disposal	Disposal of the product
D	Reuse-recovery-recycling potential	Supplementary information regarding the potential net benefits from material recycling and energy recovery beyond the system boundary.

3.3 PRODUCT SPECIFIC CALCULATION FOR USE PHASE

There are no impacts associated with the use of the products. It is assumed any impacts associated with routine cleaning and maintenance are negligible over the product life cycle. Impacts related to indoor air quality during the product use phase are also negligible.

3.4 UNITS

All data and results are presented using SI units.

3.5 ESTIMATES AND ASSUMPTIONS

- Electricity and resource use at the Vitra facility were allocated to the product based on the product mass as a fraction of the total facility production volume.

- The Vitra products are manufactured at facilities in Germany. An Ecoinvent electricity dataset for the national grid was used to model electricity and resource use at the production facilities.
- According to the manufacturer, the facilities in Germany use only electricity provided by a certified hydroelectric producer. As per PCR requirements, climate change impacts are estimated and reported separately based on hydroelectricity use at the facilities in Germany. An inventory dataset for hydroelectricity was developed based on the Ecoinvent energy grid mix data and used to model electricity use at the facilities in Germany.
- Data for the manufacturing processes to produce many of the steel, aluminum and plastic components of the products were not specifically known. Therefore, average metal working and plastic injection moulding datasets for steel, aluminum and plastic component manufacturing are used.
- Modeling of recycled material follows the recycled content method (also known as 100-0 method or cut-off method) whereby only the burdens of reprocessing the waste material are allocated to the system from the use of the recycled material.
- Impacts from the use phase of the product life cycle are assumed negligible.
- An analysis of impacts to indoor air quality during use of the product was considered outside the scope and was not included.
- For the product end-of-life, including product packaging, recycling rates (Section 2.15) are modeled based on regional data for Europe. These data supply recycling rates for durable goods, as well as for packaging and containers.
- For final disposal of the packaging material and product at end-of-life, all materials are assumed to be transported 161 km by diesel truck to either a landfill, incineration facility, or material reclamation facility (for recycling). Datasets representing disposal in a landfill and waste incineration are from Ecoinvent.

The PCR requires the results for several inventory flows related to construction products to be reported including energy and resource use and waste and outflows. These are aggregated inventory flows, and do not characterize any potential impact; results should be interpreted taking into account this limitation.

3.6 CUT-OFF RULES

According to the PCR, processes contributing greater than 1% of the total environmental impact indicator for each impact are included in the inventory. No data gaps were allowed which were expected to significantly affect the outcome of the indicator results. No known flows are deliberately excluded from this EPD.

3.7 DATA SOURCES

Primary data were provided for the manufacturing facility. The sources of secondary LCI data are the Ecoinvent database.

Table 6. *Data sources for the Vitra products.*

Component	Dataset	Data Source	Publication Date
PRODUCT			
Aluminum			
Post-consumer recycled aluminum	market for aluminium, cast alloy | aluminium, cast alloy | Cutoff	EI v3.10	2023
Virgin Aluminum	aluminium production, primary, ingot | aluminium, primary, ingot | Cutoff, S/RoW	EI v3.10	2023
Steel			
Steel	steel production, converter, low-alloyed | steel, low-alloyed | Cutoff, S/RoW	EI v3.10	2023
Wood			
Softwood	sawnwood production, softwood, dried (u=10%), planed | sawnwood, softwood, dried (u=10%), planed | Cutoff, S/RoW	EI v3.10	2023
Nylon			

Component	Dataset	Data Source	Publication Date
Nylon; Glass reinforced nylon	nylon 6 production | nylon 6 | Cutoff, S/RoW	EI v3.10	2023
	glass fibre production | glass fibre | Cutoff, S/RoW	EI v3.10	2023
	nylon 6-6 production | nylon 6-6 | Cutoff, S/RoW	EI v3.10	2023
	extrusion, plastic pipes | extrusion, plastic pipes | Cutoff, S/RoW	EI v3.10	2023
Polyurethane			
PUR foam	market for polyurethane, flexible foam | polyurethane, flexible foam | Cutoff, S/RoW	EI v3.10	2023
Other Plastics/Rubber			
PET	polyethylene terephthalate, granulate, amorphous, recycled to generic market for amorphous PET granulate | polyethylene terephthalate, granulate, amorphous | Cutoff, S/RoW	EI v3.10	2023
	polyethylene production, low density, granulate | polyethylene, low density, granulate | Cutoff, S/RoW	EI v3.10	2023
PE	polyethylene production, low density, granulate | polyethylene, low density, granulate | Cutoff, S/RoW	EI v3.10	2023
PP	polypropylene production, granulate | polypropylene, granulate | Cutoff, S/RoW	EI v3.10	2023
Other			
	market for textile, woven cotton | textile, woven cotton | Cutoff, S/GLO	EI v3.10	2023
	kraft paper production | kraft paper | Cutoff, S/RoW	EI v3.10	2023
MATERIAL PROCESSING			
Injection molding - Plastic	injection moulding | injection moulding | Cutoff, S/RoW	EI v3.10	2023
Metal working - Aluminum	metal working, average for aluminium product manufacturing | metal working, average for aluminium product manufacturing | Cutoff, S/RoW	EI v3.10	2023
Metal working - Steel	metal working, average for steel product manufacturing | metal working, average for steel product manufacturing | Cutoff, S/RoW	EI v3.10	2023
PACKAGING			
Cardboard/Paper	corrugated board box production | corrugated board box | Cutoff, S/RoW	EI v3.10	2023
	kraft paper production | kraft paper | Cutoff, S/RoW	EI v3.10	2023
Wood	sawnwood production, softwood, dried (u=10%), planed | sawnwood, softwood, dried (u=10%), planed | Cutoff, S/RoW	EI v3.10	2023
Plastic	packaging film production, low density polyethylene | packaging film, low density polyethylene | Cutoff, S/RoW;	EI v3.10	2023
	polyethylene production, low density, granulate | polyethylene, low density, granulate | Cutoff, S/RoW	EI v3.10	2023
	polypropylene production, granulate | polypropylene, granulate | Cutoff, S/RoW	EI v3.10	2023
TRANSPORT			
Road transport	transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | Cutoff, S/RoW	EI v3.10	2023
Rail transport	transport, freight train, diesel | transport, freight train | Cutoff, S/RoW	EI v3.10	2023
Ship transport	transport, freight, sea, container ship | transport, freight, sea, container ship | Cutoff, S/GLO	EI v3.10	2023
RESOURCES			
Grid electricity – Germany[1]	market for electricity, medium voltage, hydro only | electricity, medium voltage | Cutoff, U - LCI/DE; market for electricity, medium voltage | electricity, medium voltage | Cutoff, S/DE	EI v3.10	2023
Heat – natural gas	heat production, natural gas, at industrial furnace >100kW | heat, district or industrial, natural gas | Cutoff, S/RoW	EI v3.10	2023
WASTE DISPOSAL			
Landfill	treatment of municipal solid waste, sanitary landfill | municipal solid waste | Cutoff, S/RoW	EI v3.10	2023
Incineration	treatment of municipal solid waste, incineration | municipal solid waste | Cutoff, S/RoW	EI v3.10	2023
Wastewater	treatment of wastewater, average, wastewater treatment | wastewater, average | Cutoff, S/RoW	EI v3.10	2023

[1)] The GWP impact of electricity from the German national grid is ~0.4724 kg CO_2e/kWh. The GWP impact of electricity from hydroelectricity in Germany is ~0.2032 kg CO_2e/kWh.

3.8 DATA QUALITY

The data quality assessment addressed the following parameters: time-related coverage, geographical coverage, technological coverage, precision, completeness, representativeness, consistency, reproducibility, sources of data, and uncertainty.

Table 7. *Data quality assessment for the product system.*

Data Quality Parameter	Data Quality Discussion
Time-Related Coverage: Age of data and the minimum length of time over which data is collected	The most recent available data are used, based on other considerations such as data quality and similarity to the actual operations. Typically, these data are less than 5 years old. All of the data used represented an average of at least one year's worth of data collection, and up to three years in some cases. Manufacturer-supplied data (primary data) are based on annual production for 2023.
Geographical Coverage: Geographical area from which data for unit processes is collected to satisfy the goal of the study	The data used in the analysis provide the best possible representation available with current data. Electricity use for product manufacture at the facilities in Germany is modeled using representative data for hydroelectricity and country-specific electricity datasets from Ecoinvent. Surrogate data used in the assessment are representative of global or European operations. Data representative of European operations is considered sufficiently similar to actual processes. Data representing product disposal are based on regional statistics.
Technology Coverage: Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations. Representative fabrication datasets, specific to the type of material, are used to represent the actual processes, as appropriate.
Precision: Measure of the variability of the data values for each data expressed	Precision of results are not quantified due to a lack of data. Data collected for operations were typically averaged for one or more years and over multiple operations, which is expected to reduce the variability of results.
Completeness: Percentage of flow that is measured or estimated	The LCA model included all known mass and energy flows for production of the furniture products. In some instances, surrogate data used to represent upstream and downstream operations may be missing some data which is propagated in the model. No known processes or activities contributing to more than 1% of the total environmental impact for each indicator are excluded.
Representativeness: Qualitative assessment of the degree to which the data set reflects the true population of interest	Data used in the assessment represent typical or average processes as currently reported from multiple data sources and are therefore generally representative of the range of actual processes and technologies for production of these materials. Considerable deviation may exist among actual processes on a site-specific basis; however, such a determination would require detailed data collection throughout the supply chain back to resource extraction.
Consistency: Qualitative assessment of whether the study methodology is applied uniformly to the various components of the analysis	The consistency of the assessment is considered to be high. Data sources of similar quality and age are used; with a bias towards Ecoinvent v3.10 data where available. Different portions of the product life cycle are equally considered.
Reproducibility: Qualitative assessment of the extent to which information about the methodology and data values would allow an independent practitioner to reproduce the results reported in the study	Based on the description of data and assumptions used, this assessment would be reproducible by other practitioners. All assumptions, models, and data sources are documented.
Sources of the Data: Description of all primary and secondary data sources	Data representing energy use at the manufacturing facilities represents an annual average and are considered of high quality due to the length of time over which these data are collected, as compared to a snapshot that may not accurately reflect fluctuations in production. For secondary LCI data, Ecoinvent v3.10 LCI data are used.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to materials in the products and packaging is low. Actual supplier data for upstream operations were not available and the study relied upon the use of existing representative datasets. These datasets contained relatively recent data (<10 years) but lacked geographical representativeness. Uncertainty related to the impact assessment methods used in the study are high. The impact assessment method required by the PCR includes impact potentials, which lack characterization of providing and receiving environments or tipping points.

3.9 PERIOD UNDER REVIEW

The period of review is calendar year 2023.

3.10 ALLOCATION

Manufacturing resource use was allocated to the products based on mass. Impacts from transportation were attributed to the products based on the mass of material and distance transported.

3.11 COMPARABILITY

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

4. LCA: Scenarios and Additional Technical Information

Delivery and Installation stage (A4 - A5)

Distribution of the products to the point of installation is included in the assessment based on information provided by the manufacturer. Transportation parameters for modeling transport to consumer markets are summarized in Table 8.

Table 8. *Product distribution parameters by transport mode and consumer market.*

Parameter	Unit	Value
Ground transport		
Fuel type	-	Diesel
Liters of fuel	L/100km	18.7
Vehicle type	-	Diesel truck
Transport distance	km	546
Capacity utilization	%	76
Weight of products transported	kg	10.97
Ocean transport		
Fuel type	-	Fuel oil
Liters of fuel	L/tkm	2.23
Vehicle type	-	Ocean freighter
Transport distance	km	1,534
Capacity utilization	%	70
Weight of products transported	kg	10.97

Installation of the product is accomplished using hand tools with no associated emissions and negligible impacts. The impacts associated with packaging disposal are included with the installation phase as per PCR requirements.

Table 9. *Installation parameters for the products.*

Parameter		Value
Ancillary materials		0.00
Net freshwater consumption (m3)		0.00
Electricity consumption (kWh)		0.00
Product loss per functional unit (kg)		0.00
Waste materials generated by product installation (kg)		0.737
Output materials resulting from on-site waste processing (kg)		n/a
Mass of packaging waste (kg)	Corrugate	0.590
	Plastic	0.147
Biogenic carbon contained in packaging (kg CO2)		1.08
Direct emissions (kg)		0.00

Use stage (B1)

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

Maintenance stage (B2)

No specific maintenance of the product is identified by the manufacturer. It is assumed any impacts associated with routine cleaning and maintenance are negligible in the LCA model for the product life cycle.

Repair/Refurbishment stage (B3; B5)

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

Replacement stage (B4)

No product replacements are required on the 15 year lifetime of the product.

Building operation stage (B6 – B7)

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

Disposal stage (C1 - C4)

No specific data are available regarding the recycling rate of materials of the Vitra products at end-of-life. Assumptions for end-of-life are based on statistics regarding municipal solid waste generation and disposal in the European Union[1,2]. The relevant recycling rates applied to the assessment are summarized in Table 10 while the disposal modeling parameters are presented in Table 11.

Table 10. *Recycling rates for packaging materials at end-of-life.*

Material	Product Recycling Rate (%)	Packaging Recycling Rate (%)
Recycling Rates		
Steel	50%	n/a
Plastics	50%	40%
Paper & Pulp	50%	84%
Wood	50%	n/a
Disposal of Non-recyclables		
Landfill	74%	55%
Incineration	26%	45%

Table 11. *End-of-life disposal scenario parameters for the Vitra products.*

Parameter	Value
Assumptions for scenario development	EU Waste Statistics
Collection processes	
Collected with mixed construction waste (kg)	10.2
Recovery	
Recycled (kg)	5.12
Landfill disposal (kg)	3.79
Incineration (kg)	1.33
Removals of biogenic carbon (kg CO_2 eq)[1]	-9.43

[1] European Commission. EU Construction & Demolition Waste Management Protocol. 2016. Available online: http://ec.europa.eu/growth/content/eu-construction-and-demolition-waste-protocol-0_en

[2] Eurostat, Recovery and recycling rates for packaging. 2015. http://ec.europa.eu/eurostat/web/environment/waste/main-tables

[1] Excluding packaging materials.

Transportation of the products at end of life assumes a 161 km average distance to disposal, consistent with PCR guidance.

Benefits and loads beyond the product system boundary (Module D)

Information Module D aims at transparency for the environmental loads and benefits resulting from reusable products, recyclable materials and/or useful energy carriers leaving a product system.

The product includes steel and aluminum components, containing some recycled content, which can be recycled at end-of-life. While the benefits of using recycled (secondary) materials in the product are accounted for in Module A1 for the product system, the benefits of recycling these materials can be assumed to offset some production of virgin steel and aluminum beyond the product system boundary.

Following the approach given by the World Steel Association[3], the net burden, or credit, for steel components of the products is estimated as

$$e_{\text{module D1}} = (RR - S)\, Y(Xpr - Xre)$$

where:

(RR – S) is the net amount of scrap produced from the system:

RR is the end-of-life recycling rate of the steel product
S is the scrap input to the steelmaking process

Y(Xpr - Xre) is the LCI value of steel scrap:

Y is the process yield of the EAF.
Xpr is the LCI for 100% primary metal production. This is a theoretical value for steel slab made in the BOF route, assuming 0% scrap input.
Xre is the LCI for 100% secondary metal production from scrap in the EAF (assuming 100% scrap input).

An analogous approach is applied for the aluminum material components as detailed by the Aluminum Association[4]
The recycling rates necessary for the Module D calculations are as described above based on EU waste statistics. The recycled content of the aluminum components in the product is ~95%, while steel components include ~45% recycled content based on primary data from the manufacturer. Resource use and emissions associated with the processing of the recycled materials are included and modeled using ecoinvent data. Energy recovery from incineration of waste steel and aluminum materials is assumed negligible.

The specific recycled content, EOL recycling rates, and the relevant Ecoinvent process datasets used for each material are summarized in Table 12.

[3] *Life cycle inventory methodology report for steel products.* World Steel Association. 2017.
[4] The Environmental Footprint of Semi-Fabricated Aluminum Products in North America. A Life Cycle Assessment Report. The Aluminum Association. 2022

Table 12. *Modeling parameters for Module D.*

Material	Recycled Content (S)	EOL Recycling Rate (RR)	Secondary Material (Xpr)	Primary Material (Xre)
Steel	45%	50%	steel production, electric, 100% scrap, low-alloyed | steel, low-alloyed | Cutoff, S/RoW	steel production, converter, low-alloyed, 0% scrap | steel, low-alloyed | Cutoff, S/RoW
Aluminum	95%	50%	market for aluminium, cast alloy | aluminium, cast alloy | Cutoff, S/GLO	aluminium production, primary, ingot | aluminium, primary, ingot | Cutoff, S/RoW

5. LCA: Results

Results of the Life Cycle Assessment are presented below. It is noted that LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks. These indicator results are based on characterisation methods that still need development and the use of the indicator result is therefore limited.

All LCA results are stated to three significant figures for this product and therefore the sum of the total values may not exactly equal 100%.

Modules B1, B2, B3, B4, B5, B6, B7, C1 and C3 are assumed null. In the interest of space and table readability, these modules are not included in the results presented below.

Table 13. *Core Life Cycle Impact Assessment results for the furniture products over a 15-yr product lifetime. Results reported in MJ are calculated using lower heating values.*

Impact Category	A1	A2	A3	A4	A5	C2	C4	D
Core Indicators								
Climate change – total (kg CO_2 eq)	63.1	0.692	3.30	1.37	0.356	0.473	2.56	-20.8
	88%	0.96%	4.6%	1.9%	0.5%	0.66%	3.6%	
Climate change – fossil (kg CO_2 eq)	67.1	0.692	2.29	1.37	0.165	0.473	1.97	-20.9
	91%	0.93%	3.1%	1.8%	0.22%	0.64%	2.7%	
Climate change - biogenic (kg CO_2 eq)	-4.84	$1.06x10^{-4}$	1.01	$6.21x10^{-5}$	0.192	$6.03x10^{-5}$	0.592	$7.91x10^{-2}$
	160%	-0.0035%	-33%	-0.002%	-6.3%	-0.002%	-19%	
Climate change - land use and land use change (kg CO_2 eq)	0.814	$2.87x10^{-4}$	$5.42x10^{-3}$	$5.57x10^{-4}$	$6.22x10^{-6}$	$4.55x10^{-5}$	$5.85x10^{-5}$	$1.56x10^{-2}$
	99%	0.035%	0.66%	0.068%	0.00076%	0.0056%	0.0071%	
Ozone Depletion (kg CFC11 eq)	$6.86x10^{-6}$	$9.78x10^{-9}$	$3.26x10^{-8}$	$1.98x10^{-8}$	$6.59x10^{-10}$	$7.08x10^{-9}$	$2.61x10^{-9}$	$-5.75x10^{-8}$
	99%	0.14%	0.47%	0.29%	0.0095%	0.1%	0.038%	
Acidification (mol H+ eq)	0.445	$3.31x10^{-3}$	$7.38x10^{-3}$	$9.92x10^{-3}$	$2.28x10^{-4}$	$2.43x10^{-3}$	$1.11x10^{-3}$	-0.224
	95%	0.71%	1.6%	2.1%	0.048%	0.52%	0.24%	
Eutrophication aquatic freshwater (kg PO_4 eq)	$7.66x10^{-2}$	$1.74x10^{-4}$	$6.48x10^{-3}$	$2.96x10^{-4}$	$4.26x10^{-6}$	$2.65x10^{-5}$	$1.39x10^{-4}$	$-3.76x10^{-2}$
	91%	0.21%	7.7%	0.35%	0.0051%	0.032%	0.17%	
Eutrophication aquatic marine (kg N eq)	0.235	$1.27x10^{-3}$	$4.60x10^{-3}$	$3.03x10^{-3}$	$1.82x10^{-4}$	$1.06x10^{-3}$	$1.48x10^{-2}$	$-2.74x10^{-2}$
	90%	0.49%	1.8%	1.2%	0.07%	0.41%	5.7%	
Eutrophication terrestrial (mol N eq)	1.07	$1.39x10^{-2}$	$1.87x10^{-2}$	$3.33x10^{-2}$	$1.04x10^{-3}$	$1.16x10^{-2}$	$5.39x10^{-3}$	-0.275
	93%	1.2%	1.6%	2.9%	0.091%	1%	0.47%	
Photochemical ozone formation (kg NMVOC eq)	0.152	$4.57x10^{-3}$	$7.54x10^{-3}$	$1.05x10^{-2}$	$4.16x10^{-4}$	$4.60x10^{-3}$	$1.55x10^{-3}$	$-8.29x10^{-2}$
	84%	2.5%	4.2%	5.8%	0.23%	2.5%	0.85%	
Depletion of abiotic resources - minerals and metals (kg Sb eq)[1]	$9.57x10^{-5}$	$9.02x10^{-7}$	$2.56x10^{-6}$	$1.71x10^{-6}$	$1.92x10^{-8}$	$1.41x10^{-7}$	$1.35x10^{-7}$	$6.77x10^{-5}$
	95%	0.89%	2.5%	1.7%	0.019%	0.14%	0.13%	
Depletion of abiotic resources - fossil fuels (MJ)[1]	537	9.30	36.9	18.4	0.503	5.94	1.52	-208
	88%	1.5%	6.1%	3%	0.083%	0.97%	0.25%	
Water use (m^3 depriv.)[1]	227	$5.55x10^{-2}$	0.205	$9.78x10^{-2}$	$-1.28x10^{-2}$	$1.32x10^{-2}$	-0.333	$3.92x10^{-2}$
	100%	0.024%	0.09%	0.043%	-0.0057%	0.0058%	-0.15%	

1) The results of this environmental impact indicator shall be used with case as uncertainties on these results are high or as there is limited experience with the indicator.

Table 14. *Additional Life Cycle Impact Assessment results for the furniture products over a 15-yr product lifetime. Results reported in MJ are calculated using lower heating values.*

Impact Category	A1	A2	A3	A4	A5	C2	C4	D
Additional Indicators								
Particulate Matter emissions (disease inc.)	$4.33x10^{-6}$	$4.81x10^{-8}$	$6.84x10^{-8}$	$8.27x10^{-8}$	$4.62x10^{-9}$	$5.76x10^{-8}$	$1.05x10^{-8}$	$-8.38x10^{-7}$
	94%	1%	1.5%	1.8%	0.1%	1.3%	0.23%	
Ionizing radiation, human health (kBq U-235 eq)[2]	2.95	$8.65x10^{-3}$	0.346	$1.44x10^{-2}$	$2.67x10^{-4}$	$1.86x10^{-3}$	$1.90x10^{-3}$	-1.31
	89%	0.26%	10%	0.43%	0.008%	0.056%	0.057%	
Eco-toxicity (freshwater) (CTUe)	3,100	10.1	125	18.2	3.74	3.03	31.7	-483
	94%	0.31%	3.8%	0.56%	0.11%	0.092%	0.96%	
Human toxicity, cancer (CTUh)[1]	$3.35x10^{-7}$	$4.10x10^{-9}$	$5.58x10^{-9}$	$6.82x10^{-9}$	$7.61x10^{-11}$	$6.93x10^{-10}$	$4.95x10^{-10}$	$-2.39x10^{-8}$
	95%	1.2%	1.6%	1.9%	0.022%	0.2%	0.14%	
Human toxicity, non-cancer effects (CTUh)[1]	$1.36x10^{-6}$	$7.38x10^{-9}$	$2.72x10^{-7}$	$1.35x10^{-8}$	$1.99x10^{-8}$	$2.18x10^{-9}$	$5.64x10^{-8}$	$-2.25x10^{-7}$
	79%	0.43%	16%	0.78%	1.1%	0.13%	3.3%	
Land use related impacts/ Soil quality (dimensionless)[1]	812	5.00	82.4	9.17	0.132	0.662	2.23	-32.1
	89%	0.55%	9%	1%	0.014%	0.073%	0.24%	

1) The results of this environmental impact indicator shall be used with case as uncertainties on these results are high or as there is limited experience with the indicator.

2) 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.

Table 15. *Resource use for the furniture products over a 15-yr product lifetime. Results reported in MJ are calculated using lower heating values.*

Parameter	A1	A2	A3	A4	A5	C2	C4	D
Resources								
Use of renewable primary energy (MJ)	146	0.142	19.7	0.231	$3.87x10^{-3}$	$2.58x10^{-2}$	$3.05x10^{-2}$	2.58
	88%	0.086%	12%	0.14%	0.0023%	0.016%	0.018%	
Use of renewable primary energy resources used as raw materials (MJ)	18.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100%	0%	0%	0%	0%	0%	0%	
Total renewable primary energy (MJ)	165	0.142	19.7	0.231	$3.87x10^{-3}$	$2.58x10^{-2}$	$3.05x10^{-2}$	0.00
	89%	0.077%	11%	0.12%	0.0021%	0.014%	0.016%	
Use of nonrenewable primary energy (MJ)	676	9.30	36.9	18.4	0.503	5.94	1.52	-208
	90%	1.2%	4.9%	2.5%	0.067%	0.79%	0.2%	
Use of nonrenewable primary energy resources used as raw materials (MJ)	105	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100%	0%	0%	0%	0%	0%	0%	
Total nonrenewable primary energy (MJ)	781	9.30	36.9	18.4	0.503	5.94	1.52	0.00
	91%	1.1%	4.3%	2.2%	0.059%	0.7%	0.18%	
Use of secondary materials (MJ)	5.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100%	0%	0%	0%	0%	0%	0%	
Use of renewable secondary fuels (MJ)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Use of nonrenewable secondary fuels (MJ)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Use of net fresh water (m^3)	13.3	$7.98x10^{-3}$	0.207	$1.40x10^{-2}$	$4.09x10^{-4}$	$2.22x10^{-3}$	$4.53x10^{-3}$	-0.829
	98%	0.059%	1.5%	0.1%	0.003%	0.016%	0.034%	

Table 16. *Waste and outflows for the furniture products over a 15-yr product lifetime. Results reported in MJ are calculated using lower heating values.*

Parameter	A1	A2	A3	A4	A5	C2	C4	D
Wastes								
Hazardous waste disposed (kg)	$1.55x10^{-2}$	$6.42x10^{-5}$	$2.76x10^{-4}$	$1.24x10^{-4}$	$3.56x10^{-6}$	$4.17x10^{-5}$	$1.02x10^{-5}$	$2.88x10^{-3}$
	97%	0.4%	1.7%	0.77%	0.022%	0.26%	0.064%	
Non-hazardous waste disposed (kg)	2.94	0.397	1.75	0.776	0.110	$2.82x10^{-2}$	3.83	-0.316
	30%	4%	18%	7.9%	1.1%	0.29%	39%	
Radioactive waste disposed (kg)	$7.30x10^{-4}$	$2.12x10^{-6}$	$9.97x10^{-5}$	$3.53x10^{-6}$	$6.52x10^{-8}$	$4.50x10^{-7}$	$4.67x10^{-7}$	$-3.13x10^{-4}$
	87%	0.25%	12%	0.42%	0.0078%	0.054%	0.056%	
Components for re-use (kg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Materials for recycling (kg)	0.00	0.00	0.00	0.00	0.548	0.00	5.12	0.00
	0%	0%	0%	0%	9.7%	0%	90%	
Materials for energy recovery (kg)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported energy, electrical (MJ)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported energy, thermal (MJ)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 17. *Climate change impact indicator results for the furniture products over a 15-yr product lifetime. Manufacturing electricity use modeled based on Guarantee of Origin certificates (Mikado)*

Impact Category	A1	A2	A3	A4	A5	C2	C4	D
Climate change – total (kg CO_2 eq)	63.1	0.692	2.55	1.37	0.356	0.473	2.56	-20.8
	89%	0.97%	3.6%	1.9%	0.5%	0.66%	3.6%	
Climate change – fossil (kg CO_2 eq)	67.1	0.692	1.57	1.37	0.165	0.473	1.97	-20.9
	91%	0.94%	2.1%	1.9%	0.22%	0.64%	2.7%	
Climate change - biogenic (kg CO_2 eq)	-4.84	$1.06x10^{-4}$	0.935	$6.21x10^{-5}$	0.192	$6.03x10^{-5}$	0.592	$7.91x10^{-2}$
	160%	-0.0034%	-30%	-0.002%	-6.1%	-0.0019%	-19%	
Climate change - land use and land use change (kg CO_2 eq)	0.814	$2.87x10^{-4}$	$4.26x10^{-2}$	$5.57x10^{-4}$	$6.22x10^{-6}$	$4.55x10^{-5}$	$5.85x10^{-5}$	$1.56x10^{-2}$
	95%	0.034%	5%	0.065%	0.00073%	0.0053%	0.0068%	

6. LCA: Interpretation

The contributions to total impact indicator results are dominated by the raw material extraction and processing stage (A1) of the life cycle, accounting for nearly 90% of the total impacts. Impacts are attributed primarily to raw material extraction while material processing of the steel and aluminum components account for ~20% to 45% of the stage A1 impacts. Impact contributions from transport and disposal are minimal.

7. References

(1) Life Cycle Assessment of Vitra Office Furniture. SCS Global Services Report. Prepared for client. September 2024.

(2) ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and Procedures.

(3) ISO 14040:2006/Amd 1:2020 Environmental Management – Life cycle assessment – Principles and Framework

(4) ISO 14044: 2006/Amd 1:2017/ Amd 2:2020 Environmental Management – Life cycle assessment – Requirements and Guidelines.

(5) NPCR Part A: Construction products and services. Version: 2.0. The Norwegian EPD Foundation. March 2021.

(6) NPCR 026. PCR - Part B for Furniture. Version 2.0. The Norwegian EPD Foundation. October 2024.

(7) SCS Type III Environmental Declaration Program: Program Operator Manual. V12.0 December 2023. SCS Global Services.

(8) EN 15804:2012+A2:2019. Sustainability of construction works – Environmental product declarations - Core rules for the product category of construction products. July 2020.

(9) Ecoinvent Centre (2023) ecoinvent data from v3.10. Swiss Center for Life Cycle Inventories, Dübendorf, 2023, http://www.ecoinvent.org

(10) European Joint Research Commission. International Reference Life Cycle Data System handbook. *General guide for Life Cycle Assessment – Detailed Guidance.* © European Union, 2010.

For more information, contact:

Vitra AG
Klünenfeldstrasse 22, Birsfelden, BL CH-4127, Switzerland
info@vitra.com | +41.61.377.0000 | www.vitra.com

SCS Global Services
2000 Powell Street, Ste. 600, Emeryville, CA 94608 USA
Main +1.510.452.8000 | fax +1.510.452.8001