MODERNFOLD dormakaba Group

VERIFIED by SCS GLOBAL SERVICES ENVIRONMENTAL PRODUCT DECLARATION BASED ON LCA

Declaration Owner

Modernfold
215 West New Road
Greenfield, IN 46140
United States
www.modernfold.com

Product

Glass Wall System:

- Compactline/Glass/Anodized; Compactline/Glass/RAL
- PureView/Glass/Anodized; PureView Plus/Glass/Anodized
- DRS/Glass/Anodized; DRS/Glass/RAL
- GP/Glass/Stainless Steel

Declared Unit

The declared unit is one square meter of wall system product

EPD Number and Period of Validity

SCS-EPD-06014
EPD Valid March 2, 2020 through March 1, 2025

Product Category Rule

ISO 21930:2017. Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services.

Program Operator

SCS Global Services
2000 Powell Street, Ste. 600, Emeryville, CA 94608
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SCSglobal SERVICES

Declaration Owner:	Modernfold
Address:	215 West New Road, Greenfield, IN 46140
Declaration Number:	SCS-EPD-06014
Declaration Validity Period:	EPD Valid March 2, 2020 through March 1, 2025
Program Operator:	SCS Global Services
Declaration URL Link:	https://www.scsglobalservices.com/certified-green-products-guide
LCA Practitioner:	Gerard Mansell, PhD.
LCA Software:	SimaPro 8.3
Independent critical review of the LCA and data, according to ISO 14044 and ISO 14071	☐ internal ☒ external
LCA Reviewer:	Tom Gloria, Ph.D., Industrial Ecology Consultants
Product Category Rule:	
PCR Review conducted by:	
Independent verification of the declaration and data, according to ISO 14025 and the PCR	☐ internal ☒ external
EPD Verifier:	Tom Gloria, Ph.D., Industrial Ecology Consultants
Declaration Contents:	

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

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

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

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

In accordance with ISO 21930:2017, EPDs are comparable only if they comply with the core PCR, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

1. About Modernfold

For more than 94 years, Modernfold, Inc. has been the premier provider of products that enable optimal space utilization. Whether the primary requirement is acoustical control, versatile space management, energy savings, or daylighting, Modernfold's innovative product solutions assist and facilitate building management. Beginning in 1925, the company helped invent the movable wall industry. Its current product line continues that leadership.

In a wide range of installations, outstanding, highly flexible results are provided by Modernfold Operable Partitions, Movable Glass Walls, acoustically rated Acousti-Clear® Glass Wall systems, Acousti-Seal® Encore®, Acousti-Seal® Encore® Automated, Accordion Doors and now ComfortDrive®.

2. Product

2.1 Product Description

Modernfold Glass Wall Systems (GWS) add new openness to your space, making natural light a welcomed addition to any design. Elegance takes physical shape with these walls, becoming a tool with architects and interior designers who can craft unique and welcoming environments in a variety of spaces.

Modernfold's products are manufactured at the company's production facility in Dyersville, Iowa. The products are constructed from a variety of materials including steel, aluminum, glass, plastics and coatings sourced from various suppliers.

2.2 Application

Modernfold Movable Glass Wall Systems are intended for interior applications including commercial office environments, education, healthcare, hospitality, and multi-purpose spaces and provide the primary function of partitioning interior spaces.

2.3 Technical Data

Technical specifications of the products included in the LCA scope, as well as product performance testing results are available on the manufacturer's website (https://www.modernfold.com/en-US/downloads/product-documents).

2.4 Base Materials

The primary materials including steel, aluminum, glass, plastics, wood, textiles and coatings sourced from various suppliers. Packaging materials consist of plastic wrap and corrugated and particleboard and wood pallets.

Table 1. *Material content for the Modernfold Glass Wall System products in kg per square meter and percent of total mass.*

Component Material	Compactline/Glass/Anodized	Compactline/Glass/RAL
	kg/m² (%)	kg/m² (%)
Aluminum	2.50	2.50
	14%	14%
Steel	2.44	2.44
	14%	14%
Glass	12.0	12.0
	69%	68%
Plastics	0.170	0.170
	0.97%	0.96%
Other	0.359	0.640
	2.1%	3.6%
Total	**17.5**	**17.7**
	100%	**100%**

Table 2. *Material content for the Modernfold Glass Wall System products in kg per square meter and percent of total mass.*

Component Material	PureView/Glass/Anodized	PureView Plus/Glass/Anodized
	kg/m² (%)	kg/m² (%)
Aluminum	3.01	3.62
	17%	20%
Steel	1.93	1.93
	11%	11%
Glass	12.0	12.0
	68%	66%
Plastics	0.610	0.610
	3.5%	3.4%
Rubber	$6.10x10^{-3}$	$6.10x10^{-3}$
	0.03%	0.03%
Total	**17.6**	**18.2**
	100%	**100%**

Table 3. *Material content for the Modernfold Glass Wall System products in kg per square meter and percent of total mass.*

Component Material	DRS/Glass/Anodized	DRS/Glass/RAL
	kg/m² (%)	kg/m² (%)
Aluminum	3.58	3.58
	22%	22%
Steel	0.312	0.312
	2.0%	1.9%
Glass	12.0	12.0
	75%	74%
Other	$9.23x10^{-2}$	0.374
	0.58%	2.3%
Total	**16.0**	**16.3**
	100%	**100%**

Table 4. *Material content for the Modernfold Glass Wall System products in kg per square meter and percent of total mass.*

Component Material	*GP/Glass/ Stainless Steel*
	kg/m^2 (%)
Aluminum	4.30
	22%
Steel	2.98
	15%
Glass	12.0
	62%
Total	**19.3**
	100%

Table 5. *Material content for the Modernfold product packaging, per square meter.*

Material	(kg/m^2)	(%)
Plastic	8.12x10^{-3}	0.40%
Corrugated	1.10x10^{-2}	0.54%
Particle board	0.762	37.6%
Wood Pallet	1.23	60.4%
Adhesive tape	2.15x10^{-2}	1.06%
Total Packaging	**2.03**	**100%**

2.5 Manufacture

Modernfold's wall system products are manufactured at company's production facility in Dyersville, Iowa. Resource use at the production facility is allocated to the product based on mass.

2.6 Environment and Health during Manufacture

No environmental or health impacts are expected during the manufacture of the glass wall system product.

2.7 Product Processing/Installation

Typical installation is accomplished using hand tools.

2.8 Packaging

The Modernfold products are packaged for shipment using plastic wrap, cardboard and wood pallets

2.9 Condition of Use

No special conditions of use are noted.

2.10 Environment and Health during use

No environmental or health impacts are expected due to normal use of the glass wall system product.

2.11 Reference Service Life

The scope of the assessment is cradle-to-gate. The Reference Service Life (RSL) is not applicable.

2.12 Extraordinary Effects

No environmental or health impacts are expected due to extraordinary effects including fire and/or water damage.

2.13 Further Information

Further information on the product can be found on the manufacturers' website at https://www.modernfold.com/.

3. LCA: Calculation Rules

3.1 Declared Unit

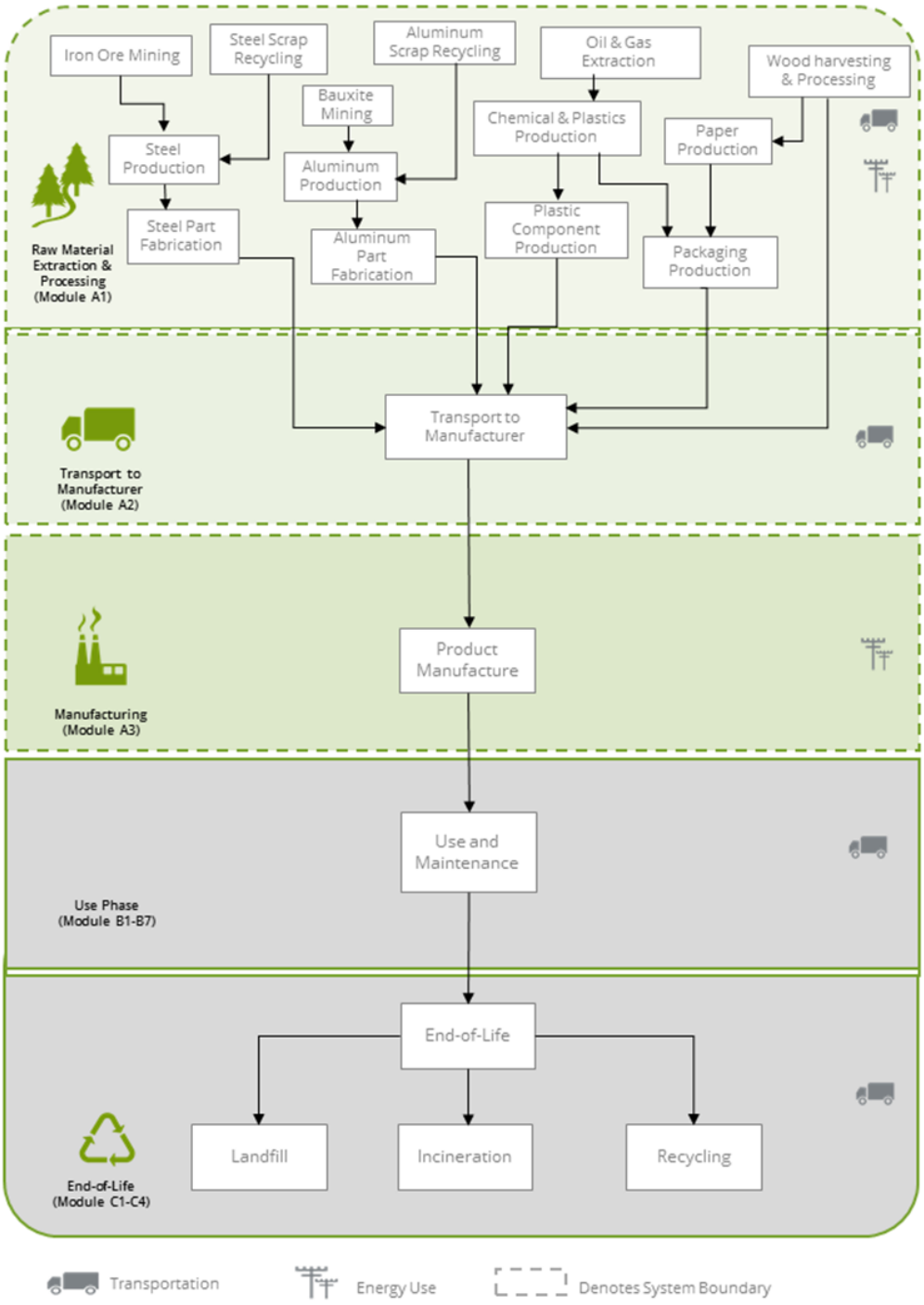
The declared unit used in the study is defined as 1 m^2 of operable wall or partition system product. The reference flows for each product are summarized in Table 6.

Table 6. *Reference flows for the Modernfold Glass Wall System products, per square meter.*

Product	Reference flow (kg/m^2)
Compactline/Glass/Anodized	17.5
Compactline/Glass/RAL	17.7
PureView/Glass/Anodized	17.6
PureView Plus/Glass/Anodized	18.2
DRS/Glass/Anodized	16.0
DRS/Glass/RAL	16.3
GP/Glass/Stainless Steel	19.3

3.2 System Boundary

The scope of the EPD is cradle-to-gate, including raw material extraction and processing, transportation and product manufacture, including packaging. The life cycle phases included in the product system boundary are shown below.



3.3 Estimates and Assumptions

- Modernfold's Dyersville, Iowa facility is located in the MROW eGRID EPA NERC subregion. An Ecoinvent inventory dataset was modified to reflect the eGRID energy mix for the MROW subregion to estimate resource use and emissions from electricity use at the manufacturing facility.
- Electricity use at the production facilities were allocated to the wall system products based on product mass utilizing production data for calendar year 2018 provided by the manufacturer.
- Primary data for upstream component fabrication were not available. Representative LCI datasets from the ecoinvent database were used to model processing for aluminum and steel material components.

It should also be noted that LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

The PCR allows for the results for several inventory flows related to construction products to be reported as "other parameters". These are aggregated inventory flows, and do not characterize any potential impact; results should be interpreted taking into account this limitation.

3.4 Cut-off criteria

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.

3.5 Background Data

Primary data were provided by Modernfold for the Dyersville, Iowa manufacturing facility. The sources of secondary LCI data are the Ecoinvent database.

Table 7. *Data sources for the Modernfold Glass Wall System product system.*

Component	Material Dataset	Data Source	Publication Date
PRODUCT			
Aluminum	Aluminium, primary, ingot {IAI Area, North America, without Quebec}| aluminium production, primary, ingot | Alloc Rec	EI v3.3	2016
	Aluminium recycled, 20% pre-consumer {GLO}| Recycled Content cut-off | Alloc Rec	EI v3.3	2016
Glass	Flat glass, uncoated {GLO}| market for | Alloc Rec	EI v3.3	2016
Other	Acrylic binder, without water, in 34% solution state {RER}| acrylic binder production, product in 34% solution state | Alloc Rec	EI v3.3	2016
	Bitumen adhesive compound, hot {GLO}| market for | Alloc Rec	EI v3.3	2016
	Glass fibre {GLO}| market for | Alloc Rec	EI v3.3	2016
	Electronics, for control units {GLO}| market for | Alloc Rec	EI v3.3	2016
	Kraft paper, unbleached {GLO}| market for | Alloc Rec	EI v3.3	2016
	Graphite {GLO}| market for | Alloc Rec	EI v3.3	2016
	Silicone product {GLO}| market for | Alloc Rec	EI v3.3	2016
	Chemical, organic {GLO}| market for | Alloc Rec	EI v3.3	2016
	Alkyd paint, white, without water, in 60% solution state {RER}| alkyd paint production, white, water-based, product in 60% solution state | Alloc Rec	EI v3.3	2016
Plastics	Acrylonitrile-butadiene-styrene copolymer {GLO}| market for | Alloc Rec	EI v3.3	2016
	Polyethylene terephthalate, granulate, amorphous {GLO}| market for | Alloc Rec	EI v3.3	2016
	Ethylene vinyl acetate copolymer {GLO}| market for | Alloc Rec	EI v3.3	2016
	Polyurethane, flexible foam {GLO}| market for | Alloc Rec	EI v3.3	2016
	Nylon 6 {GLO}| market for | Alloc Rec	EI v3.3	2016
	Polyethylene, low density, granulate {GLO}| market for | Alloc Rec	EI v3.3	2016
	Glass fibre reinforced plastic, polyester resin, hand lay-up {GLO}| market for | Alloc Rec	EI v3.3	2016
	Polyoxymethylene (POM)/EU-27	EI v3.3	2016
	Polystyrene foam slab {GLO}| market for | Alloc Rec	EI v3.3	2016
	Polyurethane, 10% recycled {GLO} | market for | Alloc Rec	EI v3.3	2016
	Polyvinylchloride, bulk polymerised {GLO}| market for | Alloc Rec	EI v3.3	2016
	Polystyrene, expandable {GLO}| market for | Alloc Rec	EI v3.3	2016
Rubber	Synthetic rubber {GLO}| market for | Alloc Rec	EI v3.3	2016
Steel	Steel, low-alloyed {RoW}| steel production, converter, low-alloyed | Alloc Rec	EI v3.3	2016
	Steel, low-alloyed {RoW}| steel production, electric, low-alloyed | Alloc Rec	EI v3.3	2016
PACKAGING			
Plastic	Packaging film, low density polyethylene {RoW}| production | Alloc Rec; Polystyrene foam slab {GLO}| market for | Alloc Rec	EI v3.3	2016
Corrugated	Corrugated board box {GLO}| market for corrugated board box | Alloc Rec	EI v3.3	2016
Particle board	Particle board, for indoor use 750 kg/m3 {GLO}| market for | Alloc Rec	EI v3.3	2016
Pallet	Wood pallet (22kg)/ RER	EI v2.2	2012
Adhesive tape	Acrylic binder, without water, in 34% solution state {RER}| acrylic binder production, product in 34% solution state | Alloc Rec	EI v3.3	2016
RESOURCES			
Electricity	Electricity, medium voltage, at grid/MROW 2016	EI v3.3	2016
Heat	Heat, district or industrial, natural gas {GLO}| market group for | Alloc Rec	EI v3.3	2016
Heat	Heat, district or industrial, other than natural gas {RoW}| heat production, propane, at industrial furnace >100kW | Alloc Rec	EI v3.3	2016
TRANSPORTATION			
Road transport	Transport, freight, lorry 16-32 metric ton, EURO4 {GLO}| market for | Alloc Rec	EI v3.3	2016

3.6 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 8. *Data quality assessment for the Modernfold Glass Wall System 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 (typically 2016). All of the data used represented an average of at least one year's worth of data collection, and up to three years in some cases. Manufacturer-supplied data (primary data) are based on annualized production for 2018.
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 is modeled using representative data for the MROW eGRID subregion. Surrogate data used in the assessment are representative of global or European operations. Data representative of European operations are considered sufficiently similar to actual processes.
Technology Coverage: Specific technology or technology mix	For the most part, data are representative of the actual technologies used for processing, transportation, and manufacturing operations. 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 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 v3.3 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 Modernfold's facility in Indiana represent an annual average and are considered of high quality due to the length of time over which these data are collected, as compared to a snapshot that may not accurately reflect fluctuations in production. For secondary LCI datasets, Ecoinvent v2.2 and v3.3 LCI data are used, with a bias towards Ecoinvent v3.3 data.
Uncertainty of the Information: Uncertainty related to data, models, and assumptions	Uncertainty related to materials in the product and packaging is low. Actual supplier data for upstream operations was not available for all suppliers and the study relied upon the use of existing representative datasets. These datasets contained relatively recent data (<10 years) but lacked geographical representativeness. Uncertainty related to the impact assessment methods used in the study are high. The impact assessment method required by the PCR includes impact potentials, which lack characterization of providing and receiving environments or tipping points.

3.7 Period under review

The period of review is calendar year 2018.

3.8 Allocation

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

The product system includes some recycled materials, which were allocated using the recycled content allocation method (also known as the 100-0 cut-off method). Using the recycled content allocation approach, system inputs with recycled content do not receive any burden from the previous life cycle other than reprocessing of the waste material. At end-of-life, materials which are recycled leave the system boundaries with no additional burden.

3.9 Comparability

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

4. LCA: Results

Results of the Life Cycle Assessment are presented below. It is noted that LCA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

Table 9. *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	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

X = Included in system boundary

MND = Module not declared

The following environmental impact category indicator are reported using characterization factors based on the U.S. EPA's Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts – TRACI:

Impact Category	Unit
Global Warming Potential (GWP 100)	kg CO_2 eq
Ozone Depletion Potential (ODP)	kg CFC 11 eq
Acidification Potential (AP)	kg SO_2 eq
Eutrophication Potential (EP)	kg N eq
Smog Formation Potential (POCP)	kg O_3 eq
Fossil Fuel Depletion Potential (FFD)	MJ Surplus, LHV

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.

The following optional environmental impact category indicators are also reported based on the CML-IA characterization factors:

Impact Category	Unit
Global Warming Potential (GWP 100)	kg CO_2 eq
Depletion potential of the stratospheric ozone layer (ODP)	kg CFC 11 eq
Acidification Potential of soil and water (AP)	kg SO_2 eq
Eutrophication Potential (EP)	kg PO_4^{3-} eq
Photochemical Oxidant Creation Potential (POCP)	kg C_2H_4 eq
Abiotic depletion potential (ADP-elements) for non-fossil resources	kg Sb eq
Abiotic depletion potential (ADP-fossil fuels) for fossil resources	MJ, LHV

Table 10. *Life Cycle Impact Assessment (LCIA) results for the Modernfold Glass Wall System products per 1 m^2. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.* ***Compactline/Glass/Anodized; Compactline/Glass/RAL***

Impact Category	Unit	A1 – Raw material extraction & processing	A2 – Transport to manufacturer	A3 - Manufacturing	Total
CML-IA					
Global warming (GWP100a)	kg CO_2 eq	40.4	4.69	1.61	46.7
	%	86%	10%	3.5%	100%
Ozone layer depletion (ODP)	kg CFC-11 eq	$2.38x10^{-6}$	$8.65x10^{-7}$	$1.03x10^{-7}$	$3.35x10^{-6}$
	%	71%	26%	3.1%	100%
Acidification potential	kg SO_2 eq	0.272	$1.87x10^{-2}$	$5.80x10^{-3}$	0.296
	%	92%	6.3%	2.0%	100%
Eutrophication potential	kg $(PO_4)^{3-}$ eq	$7.38x10^{-2}$	$4.21x10^{-3}$	$3.94x10^{-3}$	$8.20x10^{-2}$
	%	90%	5.1%	4.8%	100%
Photochemical oxidation	kg C_2H_4 eq	$1.53x10^{-2}$	$7.95x10^{-4}$	$6.52x10^{-4}$	$1.68x10^{-2}$
	%	91%	4.7%	3.9%	100%
Abiotic depletion	kg Sb eq	$2.32x10^{-4}$	$1.39x10^{-5}$	$2.60x10^{-6}$	$2.48x10^{-4}$
	%	93%	5.6%	1.0%	100%
Abiotic depletion (fossil fuels)	MJ	426	74.9	18.4	519
	%	82%	14%	3.5%	100%
TRACI 2.1					
Global warming	kg CO_2 eq	39.8	4.67	1.49	46.0
	%	87%	10%	3.2%	100%
Ozone depletion	kg CFC-11 eq	$2.37x10^{-6}$	$8.65x10^{-7}$	$1.02x10^{-7}$	$3.34x10^{-6}$
	%	71%	26%	3.1%	100%
Acidification	kg SO_2 eq	0.269	$2.15x10^{-2}$	$5.88x10^{-3}$	0.296
	%	91%	7.3%	2.0%	100%
Eutrophication	kg N eq	0.146	$5.21x10^{-3}$	$9.23x10^{-3}$	0.161
	%	91%	3.2%	5.7%	100%
Smog	kg O_3 eq	2.72	0.506	$7.68x10^{-2}$	3.30
	%	82%	15%	2.3%	100%
Fossil fuel depletion	MJ eq.	36.2	10.2	2.23	48.7
	%	74%	21%	4.6%	100%

Table 11. *Resource use, waste and outflows for the Modernfold Glass Wall System products per 1 m². Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.* ***Compactline/Glass/Anodized; Compactline/Glass/RAL***

Impact Category	Unit	A1 – Raw material extraction & processing	A2 – Transport to manufacturer	A3 - Manufacturing	Total
Resource Use					
Use of renewable primary energy excluding the renewable primary energy resources used as raw materials	MJ	41.0	0.913	46.5	88.4
	%	46%	1.0%	53%	100%
Use of renewable primary energy resources used as raw materials	MJ	-	-	-	-
	%	-	-	-	-
Use of non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA
Use of non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA
Use of secondary materials	kg	2.43	-	-	2.43
	%	100%	0.00%	0.00%	100%
Use of renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.
Use of non-renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.
Use of net fresh water	m^3	1.70	$5.20x10^{-2}$	$5.56x10^{-2}$	1.81
	%	94%	2.9%	3.1%	100%
Waste & Outflows					
Hazardous waste	kg	$1.41x10^{-3}$	$4.26x10^{-5}$	$2.12x10^{-5}$	$1.47x10^{-3}$
	%	96%	2.9%	1.4%	100%
Bulk waste	kg	5.43	3.35	1.05	9.83
	%	55%	34%	11%	100%
Radioactive waste (high-level)	kg	$1.01x10^{-4}$	$4.46x10^{-6}$	$7.61x10^{-6}$	$1.13x10^{-4}$
	%	89%	4.0%	6.7%	100%
Radioactive waste (low-level)	kg	$9.79x10^{-4}$	$4.86x10^{-4}$	$4.77x10^{-5}$	$1.51x10^{-3}$
	%	65%	32%	3.2%	100%
Components for re-use	kg	-	-	-	-
Materials for recycling	kg	-	-	-	-
Materials for energy recovery	kg	Neg.	Neg.	Neg.	Neg.
Exported energy	MJ	Neg.	Neg.	Neg.	Neg.

INA = Indicator not assessed
Neg. = Negligible

Table 12. *Life Cycle Impact Assessment (LCIA) results for the Modernfold Glass Wall System products per 1 m². Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.* ***PureView/Glass/Anodized; PureView Plus/Glass/Anodized***

Impact Category	Unit	A1 – Raw material extraction & processing	A2 - Transport to manufacturer	A3 - Manufacturing	Total
CML-IA					
Global warming (GWP100a)	kg CO_2 eq	40.1	0.931	1.55	42.6
	%	94%	2.2%	3.6%	100%
Ozone layer depletion (ODP)	kg CFC-11 eq	$2.22x10^{-6}$	$1.72x10^{-7}$	$1.01x10^{-7}$	$2.49x10^{-6}$
	%	89%	6.9%	4.0%	100%
Acidification potential	kg SO_2 eq	0.278	$3.71x10^{-3}$	$5.72x10^{-3}$	0.287
	%	97%	1.3%	2.0%	100%
Eutrophication potential	kg $(PO_4)^{3-}$ eq	$6.85x10^{-2}$	$8.36x10^{-4}$	$3.72x10^{-3}$	$7.31x10^{-2}$
	%	94%	1.1%	5.1%	100%
Photochemical oxidation	kg C_2H_4 eq	$1.41x10^{-2}$	$1.58x10^{-4}$	$6.38x10^{-4}$	$1.49x10^{-2}$
	%	95%	1.1%	4.3%	100%
Abiotic depletion	kg Sb eq	$1.62x10^{-4}$	$2.77x10^{-6}$	$2.60x10^{-6}$	$1.67x10^{-4}$
	%	97%	1.7%	1.6%	100%
Abiotic depletion (fossil fuels)	MJ	408	14.9	18.1	441
	%	93%	3.4%	4.1%	100%
TRACI 2.1					
Global warming	kg CO_2 eq	39.7	0.927	1.43	42.0
	%	94%	2.2%	3.4%	100%
Ozone depletion	kg CFC-11 eq	$2.21x10^{-6}$	$1.72x10^{-7}$	$1.00x10^{-7}$	$2.48x10^{-6}$
	%	89%	6.9%	4.0%	100%
Acidification	kg SO_2 eq	0.275	$4.27x10^{-3}$	$5.79x10^{-3}$	0.285
	%	96%	1.5%	2.0%	100%
Eutrophication	kg N eq	0.135	$1.03x10^{-3}$	$8.66x10^{-3}$	0.145
	%	93%	0.71%	6.0%	100%
Smog	kg O_3 eq	2.59	0.100	$7.60x10^{-2}$	2.77
	%	94%	3.6%	2.7%	100%
Fossil fuel depletion	MJ eq.	33.7	2.03	2.20	37.9
	%	89%	5.4%	5.8%	100%

Table 13. *Resource use, waste and outflows for the Modernfold Glass Wall System products per 1 m^2. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.* ***PureView/Glass/Anodized; PureView Plus/Glass/Anodized***

Impact Category	Unit	A1 – Raw material extraction & processing	A2 – Transport to manufacturer	A3 - Manufacturing	Total
Resource Use					
Use of renewable primary energy excluding the renewable primary energy resources used as raw materials	MJ	46.7	0.181	46.5	93.4
	%	50%	0.19%	50%	100%
Use of renewable primary energy resources used as raw materials	MJ	-	-	-	-
	%	-	-	-	-
Use of non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA
Use of non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA
Use of secondary materials	kg	2.94	-	-	2.94
	%	100%	0.00%	0.00%	100%
Use of renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.
Use of non-renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.
Use of net fresh water	m^3	1.62	$1.03x10^{-2}$	$5.52x10^{-2}$	1.69
	%	96%	0.61%	3.3%	100%
Waste & Outflows					
Hazardous waste	kg	$1.35x10^{-3}$	$8.46x10^{-6}$	$2.08x10^{-5}$	$1.38x10^{-3}$
	%	98%	0.62%	1.5%	100%
Bulk waste	kg	4.06	0.665	0.969	5.70
	%	71%	12%	17%	100%
Radioactive waste (high-level)	kg	$8.97x10^{-5}$	$8.86x10^{-7}$	$7.53x10^{-6}$	$9.81x10^{-5}$
	%	91%	0.90%	7.7%	100%
Radioactive waste (low-level)	kg	$9.32x10^{-4}$	$9.65x10^{-5}$	$4.65x10^{-5}$	$1.07x10^{-3}$
	%	87%	9.0%	4.3%	100%
Components for re-use	kg	-	-	-	-
Materials for recycling	kg	-	-	-	-
Materials for energy recovery	kg	Neg.	Neg.	Neg.	Neg.
Exported energy	MJ	Neg.	Neg.	Neg.	Neg.

INA = Indicator not assessed
Neg. = Negligible

Table 14. *Life Cycle Impact Assessment (LCIA) results for the Modernfold Glass Wall System products per 1 m^2. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.* ***DRS/Glass/Anodized; DRS/Glass/RAL***

Impact Category	Unit	A1 – Raw material extraction & processing	A2 – Transport to manufacturer	A3 - Manufacturing	Total
CML-IA					
Global warming (GWP100a)	kg CO_2 eq	82.3	8.22	1.63	92.1
	%	89%	8.9%	1.8%	100%
Ozone layer depletion (ODP)	kg CFC-11 eq	$3.68x10^{-6}$	$1.52x10^{-6}$	$1.03x10^{-7}$	$5.30x10^{-6}$
	%	69%	29%	1.9%	100%
Acidification potential	kg SO_2 eq	0.487	$3.28x10^{-2}$	$5.82x10^{-3}$	0.525
	%	93%	6.2%	1.1%	100%
Eutrophication potential	kg $(PO_4)^{3-}$ eq	0.206	$7.38x10^{-3}$	$3.98x10^{-3}$	0.217
	%	95%	3.4%	1.8%	100%
Photochemical oxidation	kg C_2H_4 eq	$3.03x10^{-2}$	$1.39x10^{-3}$	$6.54x10^{-4}$	$3.23x10^{-2}$
	%	94%	4.3%	2.0%	100%
Abiotic depletion	kg Sb eq	$2.50x10^{-4}$	$2.44x10^{-5}$	$2.60x10^{-6}$	$2.77x10^{-4}$
	%	90%	8.8%	0.94%	100%
Abiotic depletion (fossil fuels)	MJ	820	131	18.4	970
	%	85%	14%	1.9%	100%
TRACI 2.1					
Global warming	kg CO_2 eq	81.7	8.18	1.50	91.4
	%	89%	9.0%	1.6%	100%
Ozone depletion	kg CFC-11 eq	$3.64x10^{-6}$	$1.52x10^{-6}$	$1.03x10^{-7}$	$5.26x10^{-6}$
	%	69%	29%	2.0%	100%
Acidification	kg SO_2 eq	0.487	$3.77x10^{-2}$	$5.89x10^{-3}$	0.531
	%	92%	7.1%	1.1%	100%
Eutrophication	kg N eq	0.444	$9.13x10^{-3}$	$9.33x10^{-3}$	0.462
	%	96%	2.0%	2.0%	100%
Smog	kg O_3 eq	4.14	0.887	$7.69x10^{-2}$	5.11
	%	81%	17%	1.5%	100%
Fossil fuel depletion	MJ eq.	54.2	18.0	2.23	74.4
	%	73%	24%	3.0%	100%

Table 15. *Resource use, waste and outflows for the Modernfold Glass Wall System products per 1 m^2. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.* ***DRS/Glass/Anodized; DRS/Glass/RAL***

Impact Category	Unit	A1 – Raw material extraction & processing	A2 – Transport to manufacturer	A3 - Manufacturing	Total
Resource Use					
Use of renewable primary energy excluding the renewable primary energy resources used as raw materials	MJ	124	1.60	46.5	172
	%	72%	0.93%	27%	100%
Use of renewable primary energy resources used as raw materials	MJ	-	-	-	-
	%	-	-	-	-
Use of non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA
Use of non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA
Use of secondary materials	kg	1.05	-	-	1.05
	%	100%	0.00%	0.00%	100%
Use of renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.
Use of non-renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.
Use of net fresh water	m^3	3.36	$9.12x10^{-2}$	$5.57x10^{-2}$	3.51
	%	96%	2.6%	1.6%	100%
Waste & Outflows					
Hazardous waste	kg	$2.64x10^{-3}$	$7.47x10^{-5}$	$2.12x10^{-5}$	$2.74x10^{-3}$
	%	96%	2.7%	0.77%	100%
Bulk waste	kg	10.9	5.87	1.06	17.8
	%	61%	33%	6.0%	100%
Radioactive waste (high-level)	kg	$1.59x10^{-4}$	$7.82x10^{-6}$	$7.62x10^{-6}$	$1.74x10^{-4}$
	%	91%	4.5%	4.4%	100%
Radioactive waste (low-level)	kg	$1.55x10^{-3}$	$8.52x10^{-4}$	$4.79x10^{-5}$	$2.45x10^{-3}$
	%	63%	35%	2.0%	100%
Components for re-use	kg	-	-	-	-
Materials for recycling	kg	-	-	-	-
Materials for energy recovery	kg	Neg.	Neg.	Neg.	Neg.
Exported energy	MJ	Neg.	Neg.	Neg.	Neg.

INA = Indicator not assessed
Neg. = Negligible

Table 16. *Life Cycle Impact Assessment (LCIA) results for the Modernfold Glass Wall System products per 1 m². Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.* ***GP/Glass/Stainless Steel***

Impact Category	Unit	A1 – Raw material extraction & processing	A2 – Transport to manufacturer	A3 - Manufacturing	Total
CML-IA					
Global warming (GWP100a)	kg CO_2 eq	103	7.74	1.69	113
	%	92%	6.9%	1.5%	100%
Ozone layer depletion (ODP)	kg CFC-11 eq	$4.51x10^{-6}$	$1.43x10^{-6}$	$1.05x10^{-7}$	$6.05x10^{-6}$
	%	75%	24%	1.7%	100%
Acidification potential	kg SO_2 eq	0.600	$3.08x10^{-2}$	$5.90x10^{-3}$	0.637
	%	94%	4.8%	0.93%	100%
Eutrophication potential	kg $(PO_4)^{3-}$ eq	0.268	$6.94x10^{-3}$	$4.19x10^{-3}$	0.279
	%	96%	2.5%	1.5%	100%
Photochemical oxidation	kg C_2H_4 eq	$3.88x10^{-2}$	$1.31x10^{-3}$	$6.68x10^{-4}$	$4.08x10^{-2}$
	%	95%	3.2%	1.6%	100%
Abiotic depletion	kg Sb eq	$3.35x10^{-4}$	$2.30x10^{-5}$	$2.61x10^{-6}$	$3.61x10^{-4}$
	%	93%	6.4%	0.72%	100%
Abiotic depletion (fossil fuels)	MJ	1,000	124	18.7	1,140
	%	88%	11%	1.6%	100%
TRACI 2.1					
Global warming	kg CO_2 eq	102	7.70	1.55	112
	%	92%	6.9%	1.4%	100%
Ozone depletion	kg CFC-11 eq	$4.47x10^{-6}$	$1.43x10^{-6}$	$1.05x10^{-7}$	$6.00x10^{-6}$
	%	74%	24%	1.7%	100%
Acidification	kg SO_2 eq	0.601	$3.55x10^{-2}$	$5.97x10^{-3}$	0.643
	%	94%	5.5%	0.93%	100%
Eutrophication	kg N eq	0.583	$8.59x10^{-3}$	$9.88x10^{-3}$	0.601
	%	97%	1.4%	1.6%	100%
Smog	kg O_3 eq	5.00	0.835	$7.77x10^{-2}$	5.92
	%	85%	14%	1.3%	100%
Fossil fuel depletion	MJ eq.	60.3	16.9	2.26	79.4
	%	76%	21%	2.8%	100%

Table 17. *Resource use, waste and outflows for the Modernfold Glass Wall System products per 1 m^2. Results reported in MJ are calculated using lower heating values. All values are rounded to three significant digits.* ***GP/Glass/Stainless Steel***

Impact Category	Unit	A1 – Raw material extraction & processing	A2 – Transport to manufacturer	A3 - Manufacturing	Total
Resource Use					
Use of renewable primary energy excluding the renewable primary energy resources used as raw materials	MJ	160	1.51	46.5	208
	%	77%	0.72%	22%	100%
Use of renewable primary energy resources used as raw materials	MJ	-	-	-	-
	%	-	-	-	-
Use of non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA
Use of non-renewable primary energy resources used as raw materials	MJ	INA	INA	INA	INA
Use of secondary materials	kg	1.46	-	-	1.46
	%	100%	0.00%	0.00%	100%
Use of renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.
Use of non-renewable secondary fuels	MJ	Neg.	Neg.	Neg.	Neg.
Use of net fresh water	m^3	3.94	$8.58x10^{-2}$	$5.62x10^{-2}$	4.08
	%	97%	2.1%	1.4%	100%
Waste & Outflows					
Hazardous waste	kg	$3.50x10^{-3}$	$7.03x10^{-5}$	$2.15x10^{-5}$	$3.60x10^{-3}$
	%	97%	2.0%	0.60%	100%
Bulk waste	kg	14.3	5.52	1.14	21.0
	%	68%	26%	5.4%	100%
Radioactive waste (high-level)	kg	$2.08x10^{-4}$	$7.36x10^{-6}$	$7.69x10^{-6}$	$2.23x10^{-4}$
	%	93%	3.3%	3.5%	100%
Radioactive waste (low-level)	kg	$1.89x10^{-3}$	$8.02x10^{-4}$	$4.91x10^{-5}$	$2.74x10^{-3}$
	%	69%	29%	1.8%	100%
Components for re-use	kg	-	-	-	-
Materials for recycling	kg	-	-	-	-
Materials for energy recovery	kg	Neg.	Neg.	Neg.	Neg.
Exported energy	MJ	Neg.	Neg.	Neg.	Neg.

INA = Indicator not assessed
Neg. = Negligible

5. LCA: Interpretation

The interpretation phase conforms to ISO 14044 with further guidance from the ILCD General Guide for Life Cycle Assessment. The interpretation included the use of evaluation and sensitivity checks to steer the iterative process during the assessment, and a final evaluation including completeness, sensitivity, and consistency checks, at the end of the study.

The contributions to indicator results are dominated (> 90%) by the raw material and extraction phase (*A1*) primarily due to the extraction and fabrication of metal components of the product followed by product manufacturing (A3) and upstream material transport (A2).

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