ENVIRONMENTAL PRODUCT DECLARATION

ALUMINUM BALCONY DOOR SYSTEMS

YKK AP AMERICA, ENERGFACADE® ENERGY EFFICIENT BUILDING SOLUTIONS, PROTEK® HURRICANE MITIGATION AND BLAST MITIGATION SYSTEMS

At One Bal Harbour in Miami, FL, UKK AP's terrace doors were used to create a weather resistant access to exterior spaces.

All YKK AP products are manufactured, finished and inspected for quality in the YKK AP environmentally certified, state-of-the-art facility in Dublin, GA.

YKK AP America is taking positive steps toward sustainable manufacturing helping to balance ecology and economy—improving theenvironment and society over the longterm. YKK AP® is the proud manufacturer of architectural products,including aluminum sun control systems, which provide safe and comfortable environments for building occupants and help reduce energy usage.

A dedicated partner in green building design and sustainability, YKK AP helps create innovative, high quality architectural systems that add to the strength, energy efficiency and longevity of the building envelope.

All YKK AP® products are created in a facility that is a model of environmental responsibility. YKK AP's U.S. manufacturing plant in Dublin, GA, is ISO 14001 certified and has been recognized by the U.S. Department of Energy for exceptional leadership in industrial energy efficiency.

For additional information, visit commercial.ykkap.com.

CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL ENVIRONMENT 333 PFINGSTEN RD, NORTHBROOK, IL 60062 WWW.UL.COM WWW.SPOT.UL.COM
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	Program Operator Rules v 2.7 2022
MANUFACTURER NAME AND ADDRESS	YKK AP Headquarters 101 Marietta Street NW, Suite 2700 Atlanta, GA 30303
DECLARATION NUMBER	4789555932.105.1
DECLARED PRODUCT & DECLARED UNIT	Terrace Door Systems, 2.68 m^2
REFERENCE PCR AND VERSION NUMBER	Part A: Calculation Rules for the LCA and Requirements Project Report, (IBU/UL Environment (ULE, 2022), and Part B: Requirements on the EPD for Requirements on the EPD for Windows and doors (IBU V1.7, 08.01.2019) (IBU/UL, 2014) (IBU, 2019)
DESCRIPTION OF PRODUCT APPLICATION/USE	Self-supporting façade element / Used in construction / Terrace door application
MARKETS OF APPLICABILITY	North America
DATE OF ISSUE	December 1, 2022
PERIOD OF VALIDITY	5 years
EPD TYPE	Company specific
EPD SCOPE	Cradle to gate
YEAR(S) OF REPORTED PRIMARY DATA	2019
LCA SOFTWARE & VERSION NUMBER	GaBi v10 (Sphera, 2020)
LCI DATABASE(S) & VERSION NUMBER	GaBi 2021 (CUP 2021.1)
LCIA METHODOLOGY & VERSION NUMBER	IPCC AR5 (GWP), CML-IA v4.8, (GaBi, 2021), TRACI 2.1 (Bare, 2012)
The sub-category PCR review was conducted by:	Institut Bauen und Umwelt (IBU) PCR review panel ibu-epd.com
This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report,", in conformance with ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017) ☐ INTERNAL ☒EXTERNAL	Cooper McCollum, UL Environment
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Sphera
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	James Mellentine, Thrive ESG

LIMITATIONS

The environmental impact results of steel products in this document are based on a declared unit and therefore do not provide sufficient information to establish comparisons. The results shall not be used for comparisons without knowledge of how the physical properties of the steel product impact the precise function at the construction level. The environmental impact results shall be converted to a functional unit basis before any comparison is attempted. See the results section for additional EPD comparability guidelines.

Environmental declarations from different programs (ISO 14025) may not be comparable.

Product Definition And General Information

Description of Organization

Heavy duty terrace doors create weather resistant access to exterior spaces, while offering occupants security, privacy and a barrier to the outside world. Contemporary architectural design calls for commercial terrace doors with minimally intrusive sightlines and high- performing functionality. YKK AP® terrace doors integrate seamlessly into YKK AP storefront, window wall and curtain wall systems, creating broad vistas with larger lights of glass and smaller sight lines.

Terrace doors with the ProTek® Hurricane and Blast mitigating designation are designed to protect buildings from the impacts of hurricanes and man-made disasters. These systems have been independently tested to the requirements of ASTM E1886, ASTM E1996, and the test requirements for the Florida High Velocity Hurricane Zone (TAS 201, TAS 202, & TAS 203).

All YKK AP® products are manufactured, finished and inspected for quality in YKK AP's environmentally certified, state-of-the-art facility in Dublin, GA. As a result, YKK AP products

fit together without a lot of jobsite re-work. YKK AP offers a complete suite of tools and engineering services to assist in proper system selection, specification, and installation.

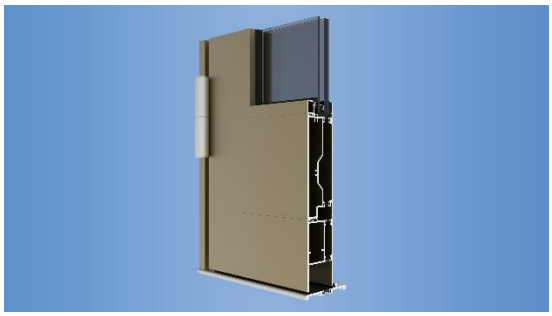
Materials & Coatings

Aluminum Alloys: 6063 T5, 6063 T6, 6061 T6

Available Finishes: ANODIZED PLUS®, AAMA 2604/2605, Painted Finishes

Product Description

The following YKK AP America aluminum storefront systems are covered by this EPD (glazing is excluded from this study):



YTD 350 TH 3-1/2" ProTek® Thermally Broken Impact Resistant Architectural Terrace Door

YTD 350 TH Terrace Doors are the ideal choice for condominiums, hotels and high-rise residential properties in hurricane prone regions, integrating smoothly with YKK AP wall systems or other wall conditions. YTD 350 TH utilizes a unique, three-way adjustable hinge and multi-point locking system, to ensure the door closes properly and creates a weather tight perimeter seal. Thermal efficiency is enhanced with YKK AP's MegaTherm® technology, which also creates dual finish capability. And with an overall U-factor of 0.44, YTD 350 TH meets the requirements of the new energy code contained in the 2010 Florida Building Code.

YTD 350 T 3-1/2" Thermally Broken Architectural Terrace Door Entrances

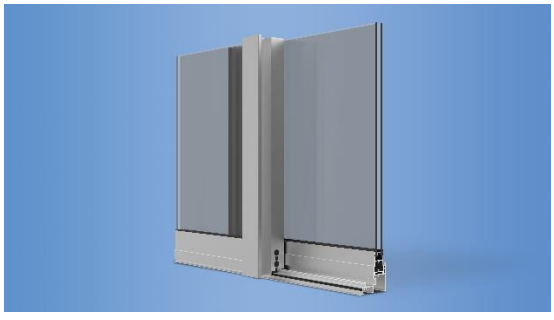
YTD 350 T Terrace Doors are the ideal choice for condominiums, hotels and high-rise residential properties, integrating smoothly with YKK AP wall systems or other wall conditions. YTD 350 T utilizes a unique, three-way adjustable hinge and multi-point locking system. This ensures alignment so the door closes properly and creates a weather tight seal around the perimeter. Thermal efficiency is enhanced with YKK AP's MegaTherm technology, which also creates dual finish capability

YSD 600 T Thermally Broken Architectural Sliding Door

The YSD 600 T is a thermally broken architectural (AW) rated sliding glass door designed to provide greater energy efficiency and occupant comfort. The engineering behind the design concept provides enhanced structural capabilities without the need to add reinforcing. This sliding door is designed to accept standard tempered 1″ thick insulating units. All panels, fixed and operable, may be pre-glazed in the shop to take advantage of a controlled environment and less expensive shop labor.

YSD 600 TH Thermally Broken, Impact Resistant Architectural Sliding Door

The YSD 600 TH is a thermally broken, impact resistant architectural (AW) rated sliding glass door designed to provide greater energy efficiency and occupant comfort. The engineering behind the design concept provides enhanced structural capabilities by using aluminum reinforcement instead of steel. This sliding door is designed to accept standard tempered 1″ or laminated 1-3/16″ thick insulating units. All panels, fixed and operable, may be preglazed in the shop to take advantage of a controlled environment and less expensive shop labor.

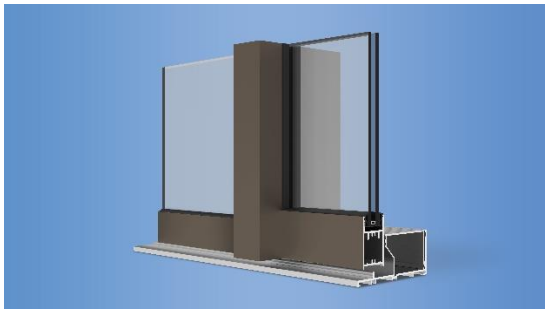


YSD 400 Heavy Duty Sliding Door

The YSD 400 is a heavy duty sliding door system designed to comply with higher structural loads while maintaining a pleasing appearance. The sliding doors are completely manufactured by YKK AP and shipped knocked-down for field assembly to reduce shipping cost. Operable and side-lite panels are factory glazed for easy installation. Standard heavy duty hardware and stainless steel tandem rollers are supplied to provide years of worry-free operation.

YSD 700 Heavy Duty Commercial Sliding Door

The YSD 700 heavy duty commercial sliding glass door is designed to provide protection from the fierce cyclical pressures and projectiles associated with hurricane force winds. The engineering behind the design concept provides enhanced structural capabilities. The YSD 700 sliding door is designed to accept monolithic or insulating glass units.



YSD 700 H Impact Resistant, Heavy Duty Commercial Sliding Door

The YSD 700 H impact resistant, heavy commercial sliding glass door is designed to provide protection from the fierce cyclical pressures and projectiles associated with hurricane force winds. The engineering behind the design concept provides enhanced structural capabilities to meet stringent building codes. This sliding door is designed to accept 9/16" laminated monolithic lites and 1" or 1-3/16" thick insulating units that may be configured to provide protection from both large and small missile impacts. Fixed lites are integrated into the sub frame for improved performance and reduced cost.

Product Average

This EPD covers a weighted average balcony door product with surface finish. The results for the final product are calculated for the Dublin, GA production site in GA.

Application

Balcony door systems are used in buildings.

Industry Standards

- AAMA: AAMA 1801, AAMA 1304, AAMA 910, AAMA 920, AAMA 507, AAMA 1503, AAMA 925, AAMA 501.5
- ASTM: ASTM E1425, ASTM E90, ASTM E413, ASTM E1332, ASTM E2235, ASTM E283, ASTM E987, ASTM F842, ASTM E2068, ASTM E330, ASTM E331, ASTM E547
- NFRC: NFRC 100, NFRC 102, NFRC 200, NFRC 500
- ProTek® hurricane and blast mitigation products: TAS 201, TAS 202, TAS 203, ASTM E1886, ASTM E1996

YKK AP does not test or rate the declared products for extraordinary effects, i.e., performance under unforeseeable influence of fire, water or mechanical destruction.

Declaration of methodological framework

A “cradle-to-gate with options” analysis using life cycle assessment (LCA) techniques was conducted for this EPD. The analysis was done according to the product category rule (PCR) for Windows and Doors published by the German Institute Construction and Environment (IBU) and followed LCA principles, requirements and guidelines laid out in the ISO 14040/14044 standards.

Material Composition

Aluminum balcony door systems are made primarily from Aluminum. Some other assembly components such as screws, sealing compounds are also used. Glazing is excluded from this EPD.

Delivery Status

YKK AP® terrace doors vary in size depending on the application.

Properties of the product delivered

Table 1: Technical Specifications

Name	Notes*	Value	Unit
Thermal Transmittance (U-Factor) AAMA 1503.1, AAMA 507, and NFRC 100	1, 2, 4	0.41-0.55	Btu/hr • ft² • °F
Solar Heat-Gain Coefficient (SHGC) NFRC 200	1, 2, 4	0.26-0.29	
Condensation Resistance Factor (CRFf) AAMA 1503.1	2, 3, 4	18-58	
Water Infiltration** ASTM E331 and AAMA 501.1	2	8 – 20	psf
Air Infiltration** ASTM E283, AAMA/NAFS 101/I.S.2/A440, NFRC 400 at 1.57 psf	2	0.10 – 0.30	cfm/ft²
Impact Resistance ASTM E1886/E1996, Testing Application Standard 201/202/203	2, 3, 4	A & D	
Window Performance Class	2	AW, HC	
Performance Grade	2	40 – 120	

* (1) Calculated based on U (Center of Glass) = 0.20 and SHGC (COG) = 0.25 (2) Varies by product type (3) Dependent on glazing specified (4) Based on products tested

** Predominantly describes the framing

Material Composition: Base and Ancillary Material

Base and Ancillary material for the weighted average product are presented for Balcony Door product family.

Table 2: Base and Ancillary material

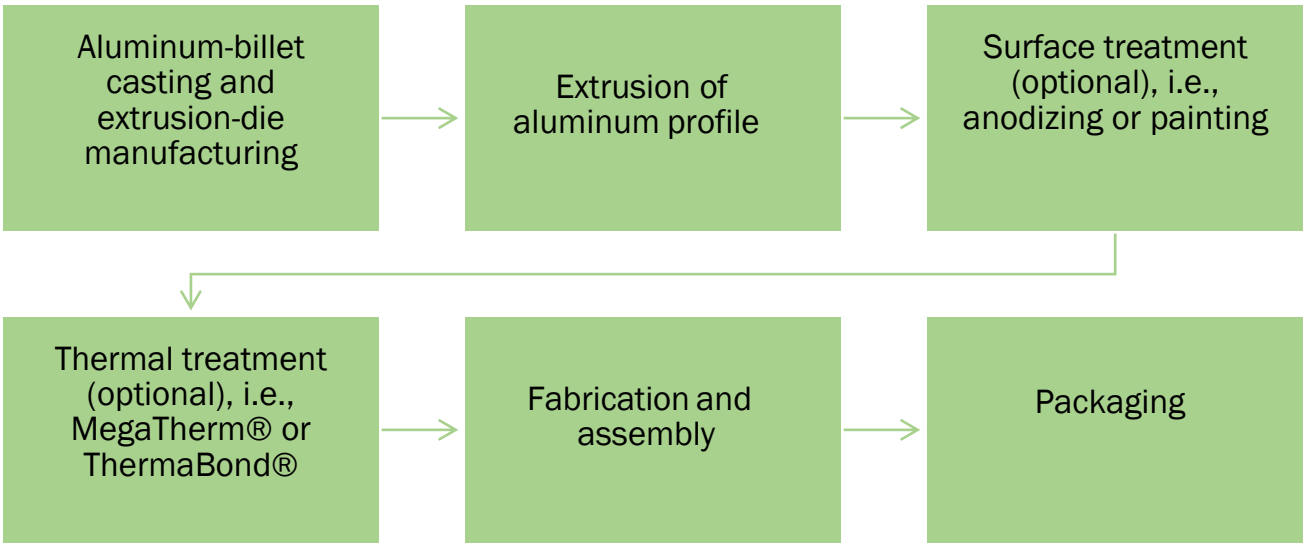
Material	Mass [kg]	Mass [%]
Aluminium extrusion profile	6.59E+01	78.10
Aluminum extrusion (mill finish)	1.05E+00	1.24
Nylon 6 compound	1.17E-01	0.14
Polyethylene-film	1.04E-03	0.00
Polypropylene part (PP)	3.07E+00	3.64
Polyvinylchloride part (PVC)	2.22E+00	2.63
PP/EPDM-part	7.05E+00	8.35
Spray Foam Set	6.63E-01	0.79
Stainless steel cold rolled coil	1.85E+00	2.19
Steel part	1.39E+00	1.65
Styrene-butadiene-rubber (SBR)	5.14E-02	0.06
ThermaBond insulation material	1.02E+00	1.21
SUM TOTAL PER DECLARED UNIT	8.44E+01	100%

Note: Glazing is excluded from this study.

Manufacturing

All YKK AP® products are manufactured, finished and inspected for quality in our environmentally certified, state-of- the-art facility in Dublin, GA.

The manufacturing process comprises the following production stages:



The main material input into the YKK AP manufacturing process is aluminum ingot. The ingot is first alloyed to the de- sired grade and cast into billets. Subsequently, the billets are extruded into profiles using steel dies that are manufactured on-site. The extruded profiles may then be anodized or painted. Optional thermal treatment, whereby a system is thermally broken, leads into the product's fabrication and assembly. Lastly, the complete assembly is packed for shipment.

All YKK AP® products are manufactured, finished and inspected for quality in our environmentally certified, state-of- the-art facility in Dublin, GA.

Packaging

Packaging data were not tracked, and was below the cut-off criteria, therefore, not included in the primary data provided by YKK. The life cycle impact of the overall product would likely be dominated by metals.

Transportation

Transportation to the customer or construction site is outside the scope of this EPD.

Product Processing/Installation

Installation is outside of the scope of this EPD (construction stage excluded).

Use

Outside of the scope of this EPD.

Reference Service Life, Condition of Use

Outside of the scope of this EPD (use stage excluded).

Recycling and Disposal

Aluminum extrusions are a highly efficient sustainable building material. Aluminum is 100% recyclable and can be recycled repeatedly. Recycled aluminum is identical to smelted aluminum but requires only 1/20 of the energy to manufacture. In building and construction aluminum scrap has a recycling rate of 95% [AA, 2013]. The remaining 5% is sent to landfill.

Table 3 Recycling and disposal

Name	Unit
Deconstruction	--
Transportation to the disposal site	100 km by truck
Waste processing	--
Disposal to landfill	5%
Recycling rate of the product	95%
Removals of biogenic carbon	N/A

Environment and Health

Product manufacturing: Plant emissions to air/soil/water are monitored (if applicable) and comply with local laws.

Product use: YKK AP® products are not expected to create exposure conditions that exceed safe thresholds for health impacts to humans or flora/fauna under normal operating conditions. Use stage is outside of the scope of this EPD.

Life Cycle Assessment Background Information

Declared Unit

The declared unit for an EPD is (1.23 m x 2.18 m) 2.68 m^2 of balcony door system.

Table 4: Declared unit

Name	Value	Unit
Declared unit	2.68	m^2
Conversion factor to kg	8.44E+01	kg/m^2

System Boundaries

Per the PCR, this “cradle-to-gate with options” analysis provides information on the Product Stage of the aluminum product life cycle, comprising modules A1–A3, and on the “options” Disposal and Credits, i.e., modules C4 and D. Module C1 and C3 are assumed to be zero. End-of-life transportation (C2) is assumed to be 100 km.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)																
PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport	Construction-installation process	Use	Maintenance	Repair	Replacement1	Refurbishment1	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse- Recovery- Recycling- potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	MND	X	X

* X = module included, MND = module not declared

Time coverage: Primary data were collected on production within calendar year 2019. Background data for upstream and downstream processes (i.e., raw materials, energy resources, transportation, and ancillary materials) were obtained from the GaBi CUP 2021.1 databases.

Technology coverage: Data were collected for the production of aluminum terrace door systems at YKK AP's manufacturing facility in the United States.

Geographical coverage: All YKK AP® products are manufactured in Dublin, Georgia, USA. As such, the geographical coverage for this study is based on United States system boundaries for all processes and products. Whenever US background data were not readily available, European data or global data were used as proxies.

Estimates and Assumptions

All of the raw materials and energy inputs have been modeled using processes and flows that closely follow actual production data on raw materials and processes. All reported material and energy flows have been accounted for.

Packaging data were not tracked therefore excluded from this EPD.

No significant assumptions have been made beyond the aforementioned.

Proxy data were applied to some materials where no matching life cycle inventories were available, as documented in the background report.

Cut-off-Criteria

As required by EN 15804, in case of insufficient input data or data gaps for a unit process, the cut-off criteria were 1% of renewable and non-renewable primary energy usage and 1% of the total mass input of that unit process. The total of neglected input flows per module was a maximum of 5% of energy usage and mass.

Product packaging information and end-of-life transportation are excluded from this study.

In practice, all inputs and outputs for which data are available have been included in the calculation. Data gaps have been filled by conservative assumptions with average or generic data. Capital items for the production processes (machines, buildings, etc.) were not taken into consideration. No known flows are deliberately excluded from this EPD.

Period Under Review

Primary data were collected for terrace door systems during the years 2019 and 2020. Background data for aluminum were taken from Aluminum Association (AA) dataset represents aluminum production during 2016. This analysis is intended to represent balcony door manufacturing in 2019 (AA, The Aluminum Association, 2022).

Data Sources

The LCA model was created using the GaBi 10 software system for life cycle engineering, developed by Sphera (Sphera, 2021). Background life cycle inventory data for raw materials and processes were obtained from the GaBi 2021 database (CUP 2021.1). Primary manufacturing data were provided by YKK.

In order to model the life cycle for the production and recycling of the extruded aluminum, the GaBi Professional software system developed by Sphera was used. All relevant background data necessary for the production of extruded aluminum were taken from the GaBi 2021 databases.

Industry average Aluminum Association (AA) dataset for primary Aluminum ingot is used to represent all primary Aluminum in this study.

Data Quality

A variety of tests and checks were performed by the LCA practitioner throughout the project to ensure high quality of the completed LCA. Checks included an extensive internal review of the project-specific LCA models.

Allocation

No multi-output (i.e., co-product) allocation was performed in the foreground system of this study.

Primary data were collected in 2 separate stages. Primary data for different unit processes (casting, extrusion, anodizing, painting, thermal) were provided by YKK for the entire Dublin (GA) facility aggregated for all products. At this stage, inputs and outputs were allocated based on the reference mass flow of each product. In the second set of data, product BOM (bill of materials) were provided for each product including the sales volume for the year of data collection. We calculated the weighted average from each product family based on the sales volume to represent that specific product. No allocation was performed at this stage.

Allocation of background data (energy and materials) taken from the GaBi 2021 databases is documented online at https://sphera.com/wp-content/uploads/2020/04/Modeling-Principles-GaBi-Databases-2021.pdf. Also please refer to the 2022 LCA report on semi-fabricated aluminum. for more information: https://www.aluminum.org/sites/default/files/2022-01/2022_Semi-Fab_LCA_Report.pdf

Per the PCR guidance, recycling and recycled content in the cradle-to-gate system are modeled using the cut-off rule (a.k.a, the recycled content rule). All materials that are recycled from unit processes are considered to have left the system boundary. Recycled content is modeled in the system only when the percent of recycled content was specified in the material purchase.

Interpreting the Results in Module D

The values in Module D include a recognition of the benefits or impacts related to aluminum recycling which occur at the end of the product's service life. The results included in Module D attempt to capture future benefits and impacts but are based on a methodology that uses current industry-average data reflecting current processes.

The net scrap approach is based on the perspective that material that is recycled into secondary material at end of life is able to substitute an equivalent amount of virgin material. Hence, a 'recycling credit' is given to account for this material substitution. A schematic of the Module D calculation is presented in Figure 1.

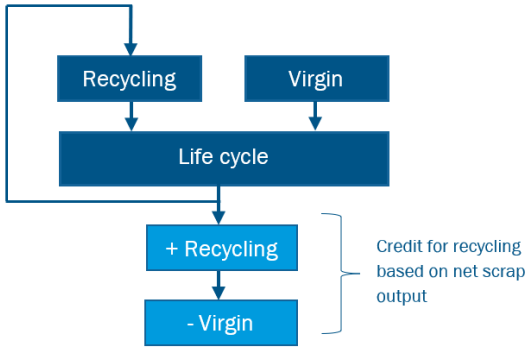


Figure 1: Schematic for the net-scrap approach (credit given at the end-of-life)

Life Cycle Assessment Results

North American life cycle impact assessment (LCIA) results are declared using TRACI 2.1 (Bare, 2012; EPA, 2012) methodology, with the exception of GWP which is reported using the IPCC AR5 (IPCC, 2013) methodology, excluding biogenic carbon. . CML -IA v4.8 results are presented as a requirement for the PCR part B. Primary energy use represents the lower heating value (LHV) a.k.a. net calorific value (NCV).

LCIA results are relative expressions and do not predict actual impacts, the exceeding of thresholds, safety margins or risks.

The result for the weighted average product are given per the declared unit of (1.23 m x 2.18 m) 2.68 m^2 of terrace door system

Table 5 Weighted Average Result for Terrace Door per Declared Unit of 2.68 m^2

Impact Category	Unit	A1	A2	A3	C2	C4	D
LIFE CYCLE IMPACTS ASSESSMENT (LCIA) RESULTS							
IPCC, AR5 (IPCC, 2013)							
Global Warming Potential	kg CO_2 eq.	8.25E+02	5.21E+00	1.50E+02	8.07E-01	9.15E-01	-4.88E+02
CML-IA v4.8							
Abiotic Depletion (ADP elements)	kg Sb eq.	5.19E-04	1.49E-06	1.37E-04	2.65E-07	3.95E-07	-1.81E-04
Abiotic Depletion (ADP fossil)	MJ	8.59E+03	6.74E+01	2.17E+03	1.18E+01	1.37E+01	-4.39E+03
Acidification Potential (AP)	kg SO_2 eq.	3.83E+00	6.36E-02	1.98E-01	1.79E-03	3.59E-03	-2.46E+00
Eutrophication Potential (EP)	kg $(PO_4)^{3-}$ eq.	2.40E-01	1.36E-02	2.61E-02	5.56E-04	4.81E-04	-1.47E-01
Ozone Layer Depletion Potential (ODP, steady state)	kg R11 eq.	5.16E-08	8.70E-16	4.81E-09	1.68E-16	3.05E-15	-1.64E-13
Photochem. Ozone Creation Potential (POCP)	kg C_2H_4 eq.	2.01E-01	3.02E-03	1.90E-01	-6.24E-04	3.41E-05	-1.22E-01
TRACI 2.1							
Acidification Potential (AP)	kg SO_2 eq.	3.59E+00	8.16E-02	2.10E-01	2.43E-03	3.90E-03	-2.28E+00
Eutrophication Potential (EP)	kg N eq.	8.69E-02	4.71E-03	1.96E-02	2.79E-04	2.17E-04	-5.06E-02
Ozone Depletion (ODP)	kg CFC 11 eq.	5.50E-08	8.70E-16	4.82E-09	1.68E-16	3.05E-15	-1.64E-13
Resources, Fossil fuels (FF)	MJ surplus energy	7.59E+02	9.00E+00	2.53E+02	1.58E+00	1.78E+00	-3.24E+02
Smog Formation Potential (SFP)	kg O_3 eq.	3.13E+01	2.46E+00	6.74E+00	5.55E-02	6.92E-02	-1.88E+01
RESOURCE USE INDICATORS							
Renewable primary resources used as energy carrier (fuel) (RPRE)	MJ	4.80E+03	1.07E+00	2.88E+02	4.91E-01	1.16E+00	-3.17E+03
Renewable primary resources with energy content used as material (RPR_M)	MJ	6.59E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Impact Category	Unit	A1	A2	A3	C2	C4	D
Non-renewable primary resources used as an energy carrier (fuel) (NRPRE)	MJ	8.75E+03	6.79E+01	1.71E+03	1.19E+01	1.40E+01	-4.46E+03
Non-renewable primary resources with energy content used as material (NRPRM)	MJ	3.18E+01	0.00E+00	5.06E+02	0.00E+00	0.00E+00	0.00E+00
Renewable secondary fuels (RSF)	MJ	--	--	--	0.00E+00	--	--
Non-renewable secondary fuels (NRSF)	MJ	--	--	--	0.00E+00	--	--
Recovered energy (RE)	MJ	--	--	--	--	--	--
Secondary material (SM)	kg	4.21E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of net fresh water resources (FW)	m³	1.60E+01	3.98E-03	5.12E-01	2.10E-03	1.92E-03	-1.05E+01
OUTPUT FLOWS & WASTE FLOWS							
Hazardous waste disposed (HWD)	kg	5.34E-04	4.26E-09	2.25E+00	9.95E-10	1.32E-09	-2.71E-06
Non-hazardous waste disposed (NHWD)	kg	2.86E+02	3.77E-03	5.37E+00	1.09E-03	4.16E+01	-1.92E+02
High-level radioactive waste, conditioned, to final repository (HLRW)	kg	9.38E-05	2.15E-07	2.39E-05	4.01E-08	1.35E-07	-3.82E-05
Intermediate- and low-level radioactive waste, conditioned, to final repository (ILLRW)	kg	2.40E-03	5.90E-06	6.57E-04	1.10E-06	3.59E-06	-9.66E-04
Components for reuse (CRU)	kg	--	--	--	--	--	--
Materials for Recycling (MFR)	kg	0.00E+00	0.00E+00	1.28E+01	0.00E+00	0.00E+00	6.36E+01
Materials for Energy Recovery (MER)	kg	--	--	--	--	--	--
Exported Electrical Energy (EEE)	kg	--	--	--	--	--	--
Exported Thermal Energy (EET)	kg	--	--	--	--	--	--

Comparability: Comparisons cannot be made between product-specific or industry average EPDs at the design stage of a project before a building has been specified. Comparisons may be made between product-specific or industry average EPDs at the time of product purchase when product performance and specifications have been established and serve as a functional unit for comparison. Environmental impact results shall be converted to a functional unit basis before any comparison is attempted.

Any comparison of EPDs shall be subject to the requirements of ISO 21930. EPDs are not comparative assertions and are either not comparable or have limited comparability when they have different system boundaries, are based on different product category rules or are missing relevant environmental impacts. Such comparison can be inaccurate and could lead to erroneous selection of materials or products which are higher impact, at least in some impact categories.

When comparing EPDs created using this PCR, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared.

Visualization of Life Cycle Impact Assessment

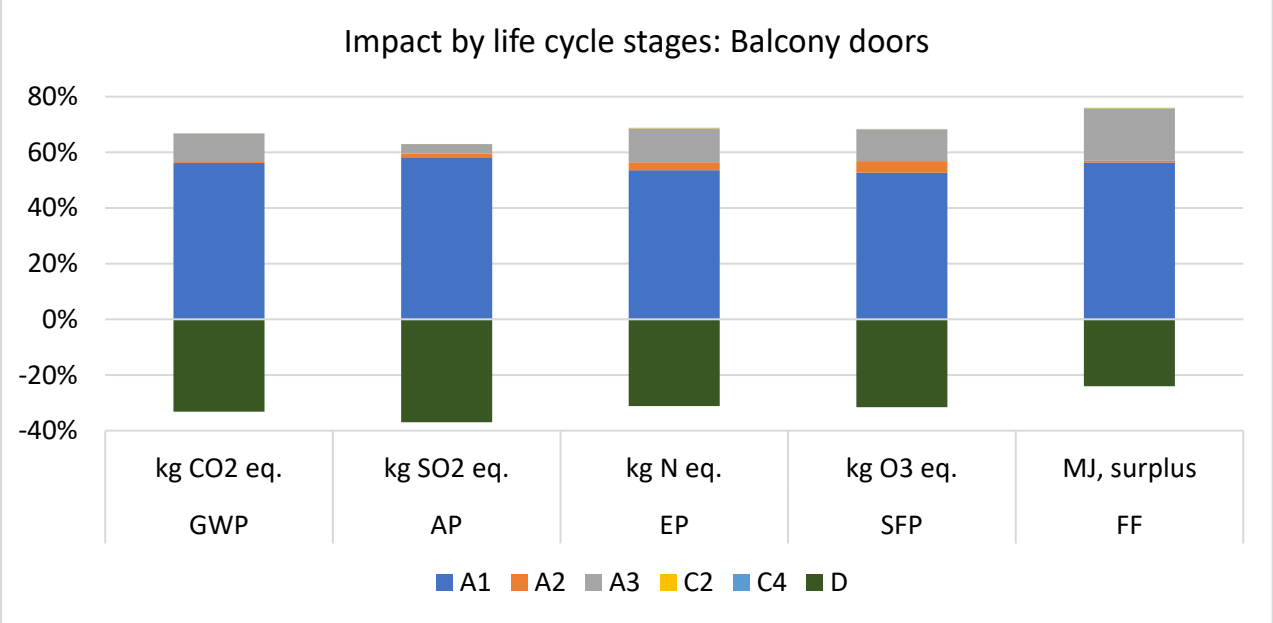


Figure 2: Balcony doors impact results per module

Interpretation

The results represent the cradle-to- gate and disposal environmental performance of the terrace door systems. As shown in the figure to the right, the results indicate that the impacts are driven by the product stage (modules A1-A3).

The primary impact is derived from upstream aluminum production in module A1 (raw material supply). The YKK AP manufacturing processes account for a relatively small part of the manufacturing impact in comparison.

As module D (material credit at the end of life) clearly impacts the results, it is important to note that the applied recycling rate of 95% represents a defensible rate for aluminum extrusion products in the building and transportation sector. This is based on a conservative calculation for global aluminum recycling from these sectors. If a higher rate is used, the credit will increase, thus lowering the net life-cycle impacts. Similarly, a lower recycling rate would raise the net life cycle impacts. As new information becomes available (e.g., the Aluminum Association publishes regional-specific recycling rates), this EPD should be modified to reflect the most current industry conditions.

Additional Environmental Information

Environment and Health During Manufacturing

Environmental, occupational health and safety practices are in accordance with OSHA and individual state requirements. The process and the products do not contain any materials or substances for which there exists a route to exposure that leads to humans or flora/fauna in the environment being exposed to said materials or substances at levels exceeding safe health thresholds.

Further Information

Further information can be found at https://www.ykkap.com/residential/company/ykk-ap-america-inc/

References

AA. (2013). The Environmental Footprint of Semi-finished Aluminum Products in North America: A Life Cycle Assessment Report. Aluminum Association.

AA. (2022, August). The Aluminum Association. Retrieved from https://www.aluminum.org/

Bare, J. (2012). Tool for the Reduction and Assessment of Chemical and other Environmental Impacts (TRACI) - Software Name and Version Number: TRACI version 2.1 - User's Manual. Washington, D.C.: U.S. EPA.

CML. (2016, September 05). CML-IA Characterisation Factors. Retrieved from Universiteit Leiden: https://www.universiteitleiden.nl/en/research/research-output/science/cml-ia-characterisation-factors

EAA. (2021). https://www.european-aluminium.eu/. Retrieved from European Aluminum Website.

EPA. (2021). Retrieved from https://www.epa.gov/environmental-topics/chemicals-and-toxics-topics

GaBi. (2021). Retrieved from https://gabi.sphera.com/support/gabi/gabi-lcia-documentation/cml-2001/

IBU. (2019). Part B: Requirements on the EPD for Requirements on the EPD for Windows and doors (IBU V1.7, 04.01.2019).

IBU. (2019). Part B: Requirements on the EPD for Self supporting façade elements based on glazed curtain walls (IBU, V1.7, 04.01.2019) .

IBU/UL. (2014). PCR Guidance-Texts for Building-Related Products and Services: Part B: Requirements on the EPD for Products of aluminium and aluminium alloys. Berlin. IBU/UL.

IBU/UL. (2018). Part A: Calculation Rules for the LCA and Requirements Project Report.

IPCC. (2014). Climate Change 2013. The Physical Science Basis. Cambridge University Press. Retrieved from http://www.ipcc.ch/report/ar5/wg1/

ISO, 2. (2017). Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services. Retrieved from https://www.iso.org/standard/61694.html

Sphera. (2020). GaBi energy databse, retrieved from Sphera Solutions Inc, http://www.gabi-software.com/support/gabi/gabi-database-2019-lci-documentation/extension-database-ii-energy/.

Sphera. (2020). GaBi LCA Database Documentation. Retrieved from Sphera Solutions, Inc.: http://www.gabi-software.com/america/support/gabi/.

Sphera. (2021). Retrieved from GaBi LCA Database Documentation: http://www.gabi-software.com/america/support/gabi/

ULE. (2022). Part A: PCR Part A for Life Cycle Assessment Calculation Rules and Report Requirements. UL Environment.

UNEP. (2011). Recycling Rates of Metals : A Status Report. Retrieved from UNE Document Repository: https://wedocs.unep.org/bitstream/handle/20.500.11822/8702/Recycling_Metals.pdf?sequence=1&isAllowed=y

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Appendix

Table 6 Results for Balcony doors YSD400 per Declared Unit of 2.68 m²

	Balcony doors YSD400					
	A1	A2	A3	C2	C4	D
IPCC GWP [kg CO2 eq.]	5.66E+02	3.43E+00	1.00E+02	5.60E-01	5.63E-01	-3.49E+02
CML-IA v4.8						
ADPe [MJ]	4.20E-04	9.78E-07	9.16E-05	1.84E-07	2.43E-07	-1.30E-04
ADPf [MJ]	5.60E+03	4.43E+01	1.44E+03	8.20E+00	8.43E+00	-3.14E+03
AP [kg SO2 eq.]	2.67E+00	4.23E-02	1.32E-01	1.24E-03	2.21E-03	-1.76E+00
EP [kg Phosphate eq.]	1.65E-01	9.05E-03	1.74E-02	3.86E-04	2.96E-04	-1.06E-01
ODP [kg R11 eq.]	8.91E-11	5.71E-16	3.21E-09	1.17E-16	1.88E-15	-1.17E-13
POCP [kg Ethene eq.]	1.40E-01	2.09E-03	1.27E-01	-4.33E-04	2.10E-05	-8.71E-02
TRACI 2.1						
AP [kg SO2 eq.]	2.50E+00	5.43E-02	1.40E-01	1.69E-03	2.40E-03	-1.64E+00
EP [kg N eq.]	5.96E-02	3.12E-03	1.31E-02	1.93E-04	1.34E-04	-3.63E-02
ODP [kg CFC 11 eq.]	8.91E-11	5.71E-16	3.22E-09	1.17E-16	1.88E-15	-1.17E-13
FF [MJ surplus energy]	4.67E+02	5.92E+00	1.69E+02	1.09E+00	1.10E+00	-2.32E+02
SFP [kg O3 eq.]	2.16E+01	1.64E+00	4.50E+00	3.85E-02	4.26E-02	-1.34E+01
LCI Indicators	**A1**	**A2**	**A3**	**C2**	**C4**	**D**
RPRE [MJ]	3.30E+03	6.81E-01	1.92E+02	3.40E-01	7.15E-01	-2.27E+03
RPRM [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRPRE [MJ]	5.72E+03	4.46E+01	1.33E+03	8.26E+00	8.61E+00	-3.20E+03
NRPRM [MJ]	0.00E+00	0.00E+00	1.45E+02	0.00E+00	0.00E+00	0.00E+00
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE [MJ]	--	--	--	--	--	--
SM [kg]	2.81E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW [m3]	1.12E+01	2.53E-03	3.41E-01	1.45E-03	1.18E-03	-7.53E+00
Output and waste flow	**A1**	**A2**	**A3**	**C2**	**C4**	**D**
HWD [kg]	6.76E-04	2.78E-09	1.50E+00	6.90E-10	8.14E-10	-1.94E-06
NHWD [kg]	1.97E+02	2.45E-03	3.57E+00	7.59E-04	2.56E+01	-1.37E+02
HLRW [kg]	6.05E-05	1.41E-07	1.59E-05	2.78E-08	8.30E-08	-2.73E-05
ILRW [kg]	1.55E-03	3.87E-06	4.38E-04	7.65E-07	2.21E-06	-6.92E-04
CRU [kg]	--	--	--	--	--	--
MFR [kg]	0.00E+00	0.00E+00	8.16E+00	0.00E+00	0.00E+00	4.58E+01
MER [kg]	--	--	--	--	--	--
EEE [MJ]	--	--	--	--	--	--
EET [MJ]	--	--	--	--	--	--

Table 7 Results for Balcony Doors YSD 600T per Declared Unit of 2.68 m²

	Balcony doors YSD 600T					
	A1	A2	A3	C2	C4	D
IPCC GWP [kg CO2 eq.	9.01E+02	5.82E+00	1.68E+02	8.47E-01	8.32E-01	-5.35E+02
CML-IA v4.8						
ADPe [MJ]	5.43E-04	1.66E-06	1.53E-04	2.78E-07	3.59E-07	-1.99E-04
ADPf [MJ]	9.26E+03	7.54E+01	2.41E+03	1.24E+01	1.24E+01	-4.81E+03
AP [kg SO2 eq.]	4.20E+00	7.09E-02	2.21E-01	1.88E-03	3.26E-03	-2.70E+00
EP [kg Phosphate eq.]	2.63E-01	1.52E-02	2.91E-02	5.84E-04	4.37E-04	-1.62E-01
ODP [kg R11 eq.]	1.59E-08	9.72E-16	5.36E-09	1.76E-16	2.78E-15	-1.80E-13
POCP [kg Ethene eq.]	2.19E-01	3.34E-03	2.12E-01	-6.55E-04	3.10E-05	-1.34E-01
TRACI 2.1						
AP [kg SO2 eq.]	3.94E+00	9.09E-02	2.34E-01	2.56E-03	3.54E-03	-2.51E+00
EP [kg N eq.]	9.41E-02	5.25E-03	2.18E-02	2.93E-04	1.97E-04	-5.55E-02
ODP [kg CFC 11 eq.]	1.69E-08	9.72E-16	5.37E-09	1.76E-16	2.78E-15	-1.80E-13
FF [MJ surplus energy]	8.13E+02	1.01E+01	2.82E+02	1.66E+00	1.62E+00	-3.56E+02
SFP [kg O3 eq.]	3.41E+01	2.74E+00	7.51E+00	5.83E-02	6.29E-02	-2.06E+01
LCI Indicators	**A1**	**A2**	**A3**	**C2**	**C4**	**D**
RPRE [MJ]	5.28E+03	1.20E+00	3.21E+02	5.15E-01	1.06E+00	-3.48E+03
RPRM [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRPRE [MJ]	9.44E+03	7.59E+01	1.99E+03	1.25E+01	1.27E+01	-4.90E+03
NRPRM [MJ]	2.18E+01	0.00E+00	4.82E+02	0.00E+00	0.00E+00	0.00E+00
RSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE [MJ]	--	--	--	--	--	--
SM [kg]	4.68E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW [m3]	1.76E+01	4.48E-03	5.70E-01	2.20E-03	1.75E-03	-1.15E+01
Output and waste flow	**A1**	**A2**	**A3**	**C2**	**C4**	**D**
HWD [kg]	4.83E-04	4.76E-09	2.50E+00	1.04E-09	1.20E-09	-2.97E-06
NHWD [kg]	3.16E+02	4.22E-03	5.98E+00	1.15E-03	3.78E+01	-2.10E+02
HLRW [kg]	9.85E-05	2.40E-07	2.67E-05	4.21E-08	1.23E-07	-4.19E-05
ILRW [kg]	2.54E-03	6.59E-06	7.32E-04	1.16E-06	3.26E-06	-1.06E-03
CRU [kg]	--	--	--	--	--	--
MFR [kg]	0.00E+00	0.00E+00	1.44E+01	0.00E+00	0.00E+00	6.97E+01
MER [kg]	--	--	--	--	--	--
EEE [MJ]	--	--	--	--	--	--
EET [MJ]	--	--	--	--	--	--

Table 8 Results for Balcony Doors YSD 600TH per Declared Unit of 2.68 m²

	Balcony doors YSD 600TH					
	A1	A2	A3	C2	C4	D
IPCC GWP [kg CO2 eq.	9.49E+02	5.82E+00	1.68E+02	1.01E+00	1.56E+00	-5.35E+02
CML-IA v4.8						
ADPe [MJ]	5.78E-04	1.66E-06	1.53E-04	3.30E-07	6.73E-07	-1.99E-04
ADPf [MJ]	1.05E+04	7.54E+01	2.41E+03	1.47E+01	2.33E+01	-4.81E+03
AP [kg SO2 eq.]	4.28E+00	7.09E-02	2.21E-01	2.23E-03	6.11E-03	-2.70E+00
EP [kg Phosphate eq.]	2.74E-01	1.52E-02	2.91E-02	6.93E-04	8.20E-04	-1.62E-01
ODP [kg R11 eq.]	2.07E-07	9.72E-16	5.36E-09	2.09E-16	5.21E-15	-1.80E-13
POCP [kg Ethene eq.]	2.29E-01	3.34E-03	2.12E-01	-7.78E-04	5.82E-05	-1.34E-01
TRACI 2.1						
AP [kg SO2 eq.]	4.03E+00	9.09E-02	2.34E-01	3.03E-03	6.64E-03	-2.51E+00
EP [kg N eq.]	1.02E-01	5.25E-03	2.18E-02	3.47E-04	3.70E-04	-5.56E-02
ODP [kg CFC 11 eq.]	2.20E-07	9.72E-16	5.37E-09	2.09E-16	5.21E-15	-1.80E-13
FF [MJ surplus energy]	9.80E+02	1.01E+01	2.82E+02	1.97E+00	3.04E+00	-3.56E+02
SFP [kg O3 eq.]	3.56E+01	2.74E+00	7.51E+00	6.91E-02	1.18E-01	-2.06E+01
LCI Indicators	**A1**	**A2**	**A3**	**C2**	**C4**	**D**
RPRE [MJ]	5.40E+03	1.20E+00	3.21E+02	6.11E-01	1.98E+00	-3.48E+03
RPRM [MJ]	3.17E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRPRE [MJ]	1.07E+04	7.59E+01	1.46E+03	1.48E+01	2.39E+01	-4.90E+03
NRPRM [MJ]	9.62E+01	0.00E+00	1.01E+03	0.00E+00	0.00E+00	0.00E+00
RSF [MJ]	2.10E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE [MJ]	--	--	--	--	--	--
SM [kg]	4.68E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW [m3]	1.78E+01	4.48E-03	5.70E-01	2.61E-03	3.28E-03	-1.15E+01
Output and waste flow	**A1**	**A2**	**A3**	**C2**	**C4**	**D**
HWD [kg]	4.89E-04	4.76E-09	2.50E+00	1.24E-09	2.25E-09	-2.97E-06
NHWD [kg]	3.16E+02	4.22E-03	5.98E+00	1.36E-03	7.10E+01	-2.10E+02
HLRW [kg]	1.22E-04	2.40E-07	2.67E-05	5.00E-08	2.30E-07	-4.19E-05
ILRW [kg]	3.09E-03	6.59E-06	7.32E-04	1.37E-06	6.12E-06	-1.06E-03
CRU [kg]	--	--	--	--	--	--
MFR [kg]	0.00E+00	0.00E+00	1.44E+01	0.00E+00	0.00E+00	6.97E+01
MER [kg]	--	--	--	--	--	--
EEE [MJ]	--	--	--	--	--	--
EET [MJ]	--	--	--	--	--	--