LIFE CYCLE ASSESSMENT REPORT

WOODEN WINDOWS

ARBOR

Pproducts covered by the study :

- ARBOR 68f
- ARBOR 68s

VERSION	1
DATE DE LA VERSION	May 24th 2022
MODIFICATIONS APPORTEES	No applicable – initial version
NUMERO DE RAPPORT	N° SIP 775330
EMETTEUR	CODDE department of LCIE Bureau Veritas
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Advertisements

The information contained in this declaration is provided under the responsibility of ARBOR (producer of the FDES) according to the NF EN 15804+A1 and the national complement NF EN 15804/CN. Any exploitation, total or partial, of the information provided by this document must at least be accompanied by the complete reference to the original ESDS as well as the supplier who will be able to give a complete copy.

It is important to remember that the results of the study are based solely on facts, circumstances and assumptions that were submitted during the study. If these facts, circumstances and assumptions differ, the results may change. Furthermore, the results of the study should be considered as a whole, in relation to the assumptions, and not in isolation. The CEN standard EN 15804+A1 is used as the Product Category Definition (PCD) rule.

Reading guide:

The display of the inventory data respects the requirements of the NF EN 15804+A1 standard.
In the following tables 2,53E-06 must be read: 2,53x10 -6 (scientific writing).
The units used in the tables are:
- The kilogram " kg ",
- The gram " g ",
- The liter " L ",
- The kilowatt-hour " kWh ",
- The megajoule " MJ ".

Abbreviations :

LCA : Life Cycle Analysis
RLT : Reference lifetime
FU : Functional Unit
FDES : Fiche de Déclaration Environnementale et Sanitaire des Produits de la Construction

1. CONTEXT AND OBJECTIVES OF THE STUDY

1.1. OBJECTIVES OF THE STUDY

This study must allow the ARBOR company to :

- To have 2 FDES in conformity with the European standards NF EN 15804+A1 and NF EN 15804/CN relating to the products of construction translating the results of analysis of the life cycle and the program FDES/INIES.
- To identify the significant environmental aspects of the products.
- To propose the ARBOR FDES in the INIES base to realize LCA building

1.2. AUDIENCE

The results of this study are intended to a BtoB market (retailers, installers,…).

Environmental Product declarations are to be communicated to building professionals through INIES database.

1.3. VALIDITY OF RESULTS AND CRITICAL REVIEW

1.3.1. VALIDITY OF RESULTS

The results are valid only for the situation defined by the assumptions described in this report. The findings may change if the conditions differ. Therefore, the relevance and reliability of use by third parties or for purposes other than those mentioned in this report cannot be guaranteed by Bureau Veritas CODDE. Such utilization is therefore the sole responsibility of the user.

1.3.2. CRITICAL REVIEW

This study is aimed at critical review.

The choice of the external verifier has been made by LCIE Bureau Veritas among the verifier list of the INIES programme. It is Etienne Lees Perasso from TIDE activity driven by 3bis society.

1.4. RÉFÉRENCES SUPPORT DE L'ÉTUDE

The main references supporting this study are :

- ISO 14040 : Environmental management -- Life cycle assessment -- Principles and framework (2006)
- ISO 14025 : Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures (2006)
- NF EN 15804 + CN : Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction (2012
- EIME v5 guides for the modelling of the different processes.

2. SCOPE OF THE STUDY

2.1. PRODUIT PRODUCT, FUNCTION, FUNCTIONAL UNIT AND REFERENCE FLOW

2.1.1. STUDIED PRODUCTS

The report and the FDES describe the environmental information related to the life cycle of ARBOR's pine double glazed windows manufactured at its site in Turkey

This study covers the following commercial references:

Feature	Product description	Product references
Pine and aluminum double glazed window	Double glazed window with three-ply laminated wood joinery trimmed with aluminum	Wooden window ARBOR 68f
Pine double glazed window	Double glazed window with three-ply laminated wood joinery	Wooden window ARBOR 68s

Tableau 1 : Description of reference products

All calculations are related to the declared unit, i.e. to 1m² of product.

2.1.2. PHYSICAL CHARACTERISTICS

Parameters	ARBOR 68f				ARBOR 68s			
	At the scale of the reference window		At the scale of the FU		At the scale of the reference window		At the scale of the FU	
Dimensions	1,23m x 1,48m	mm²	1mx 1m	mm²	1,23m x 1,48m	mm	1mx 1m	mm²
Average product weight	35,47	kg	19,49	kg/UF	34,50	kg	18,96	kg/UF
Average packaging weight	37	kg	20,33	kg/UF	37	kg	20,33	kg/UF
Total masses	**72,47**	**kg**	**39,82**	**kg/UF**	**71,50**	**kg**	**39,29**	**kg/UF**

Tableau 2 : Physical characteristics of the products

The considered product having a total surface of 1,82 m², a ratio of 1/1,82 was applied on the environmental impacts of the product to be reduced to 1 m².

The reference lifetime is 25 years.

2.1.3. SANITARY AND COMFORT CHARACTERISTICS

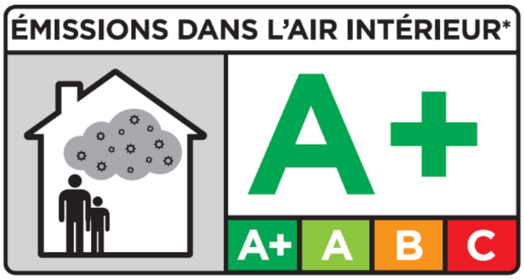
Sanitary characteristics	
VOC emission to indoor air (grade between A+ and C)	
Indoor air emissions of hazardous substances	Not applicable
Behavior towards micro-organisms	Equivalent class 4 durability of wood
Odors	The product does not emit any odor
Emissions radioactive	No issues to keep
Water quality characteristics	Not applicable because this product is not in contact with water intended for human consumption, nor with runoff water, seepage water, groundwater or surface water.

Tableau 3 : Sanitary characteristics

Confort characteristics	
Confort hygrothermique	This product does not claim any hygrothermal performance
Confort acoustique	Provides a sound reduction of 29 dB
Confort Screwuel	This product has an aesthetic function and can be available in several colors.
Confort olfactif	This product does not claim any olfactory performance

Tableau 4 : Comfort characteristics

2.1.4. TECHNICAL SPECIFICATIONS

Parameters	68f	68s
Declared product properties and finish	25 years	25 years
Theoretical application parameters, including references to appropriate practices	Pine wood and aluminum window, factory finish paint to be chosen by the customer, ready to install	Pine wood window, factory finish paint to be chosen by the customer, ready to install
Assumed quality of work, where installation is in accordance with manufacturer's instructions	Pine and aluminum window	Pine wood window
Outdoor environment (for outdoor applications), e.g. weather, pollutants, UV and wind exposure, building orientation, shading, temperature	Respect of the design rules and constraints validated during the execution phase	Respect of the design rules and constraints validated during the execution phase
Indoor environment (for indoor applications) e.g. temperature, humidity, chemical exposure	Outdoor resistance against weather and UV rays. Resistance to temperatures below 50°C continuously and 70°C occasionally. See technical data sheet.	Outdoor resistance against weather and UV rays. Resistance to temperatures below 50°C continuously and 70°C occasionally. See technical data sheet.
Conditions of use, e.g. frequency of use, mechanical exposure	Outdoor resistance against weather and UV rays. Resistance to temperatures below 50°C continuously and 70°C occasionally. See technical data sheet.	Outdoor resistance against weather and UV rays. Resistance to temperatures below 50°C continuously and 70°C occasionally. See technical data sheet.
Maintenance, e.g. required frequency, type and quality and replacement of replaceable components	Once installed, the products are used according to the desires of the users and the weather conditions. The frequency of opening is variable.	Once installed, the products are used according to the desires of the users and the weather conditions. The frequency of opening is variable.
Declared product properties and finish	Every 2 years, have the wood checked.	Every 2 years, have the wood checked.

Tableau 5 : Description of the parameters

2.1.5. FUNCTIONAL UNIT

The main function of the windows is to let the light enter the room and provide decent room ventilation.

According to the standard ISO 14040:2006, the functional unit (FU) consists of the "quantified performance of a system of products for use as a reference unit in a lifecycle analysis. Thus, the functional unit is made from the main technical characteristics of a product. This makes it possible to compare several products with one another and thus to evaluate the best practices for the eco-design of each product.

Based on the information regarding the functions of the product under study, the functional unit chosen for both products will be:

« To allow the light to enter through a 1m² wall surface with a light transmission factor of 80%, while ensuring a 1.3W/(m².X) thermal insulation, a 29 dB acoustic reduction, and allowing to open for ventilation during 25 years»

This functional unit follows NF EN 15804 + CN standard for the environmental evaluation of building products (A1-D steps).

The windows dimensions are:

- 1,230 mm x 1,480 mm window (1.820 m²)
- 1,150 mm x 1,385 mm frame (1.598 m²)
- 962 mm x 1,217 mm glass surface (1.171 m²)

Values have been adapted to a window surface of 1m² (ratio of 1.82).

2.1.6. REFERENCE FLOW

The reference flow is the measure of process deliverables, in each system of products, to perform the function as expressed by the functional unit. It should include:

- The reference product allowing the realization of the function describing the service given to customers
- The packaging of the reference product
- Elements necessary for installation
- Elements necessary for the use of the product
- Process losses.
- In this study, the reference flow is expressed in kg/FU. To answer this functional unit, the reference flow will answer the function for the installation of 1 m² of window,

The reference product flow for the two products is as follows :

Life cycle sage	Description	ARBOR 68f	ARBOR 68s	
		Quantity	Quantity	(unit/UF)
[A1-A3]	Product without packaging	19,49	18,96	kg
	Wood	7,857	9,176	kg
	Glue	0,165	0,165	kg
	Aluminium	1,62	-	kg
	Glass	6,73	6,73	kg
	Steel	1,65	1,65	kg
	Varnish	0,0056	0,0056	kg

	Paint	0,44	0,44	kg
	Primer	0,09	0,09	kg
	Screw (steel)	0,03	0,03	kg
	Silicone	0,18	0,18	kg
	Naim (steel)	0,005	0,005	kg
	Angled connections (aluminum)	0,11	-	kg
	Plastique clips	0,11	-	kg
	Seals	0,49	0,49	kg
	Packaging	20,33	20,33	kg
	Bubble pack	1,10	1,10	kg
	OSB box	8,24	8,24	kg
	Pallet	10,99	10,99	kg
	Consumption			
	Electricity	2,19	1,96	kWh
	Raw materials packaging end of life			
	Film polyethylene	0,0520	0,0440	kg
	Pallet	0,12	0,12	kg
	Expanded polystyrene	0,000	0,000	kg
	Cardbaord	0,08	0,08	kg
	Bucket (steel)	0,07	0,07	kg
	Wastes end of life			
	Wood	6,81	5,49	kg
	Aluminium	0,06	-	kg
	Paint	0,09	0,09	kg
	Apprêt	0,04	0,04	kg
	Emissions (evaporation)			
	Vernis	0,13	0,13	kg
	Peinture	0,58	0,58	kg
	Primer	0,08	0,08	kg
[A4)	-	-		-
[A5]	Materials necessary for the installation			
	Screw	0,08	0,08	kg
	Angle iron	0,10	0,10	kg
	Silicone	0,15	0,15	kg
	Compribande	0,05	0,05	kg
	EPDM band	0,01	0,01	kg
	Consumption			
	Electricity	0,08	0,08	kWh
	Packaging end of life	20,33	20,33	kg
	Bubble pack	1,10	1,10	kg
	OSB box	8,24	8,24	kg
	Pallet	10,99	10,99	kg
[B1-B7]	Varnish	0,02	0,02	kg
	Varnisj (evaporation emissions)	0.0038	0.0038	kg
[C1-C4]	Product end of life	19,49	18,96	kg

Tableau 6 : Description of the reference flow

2.1.7. SYSTEME BOUNDARIES

2.1.7.1. INCLUDED STAGE AND FLOWS

End of life stages included in the study are the following: manufacturing, distribution, use and end if life.

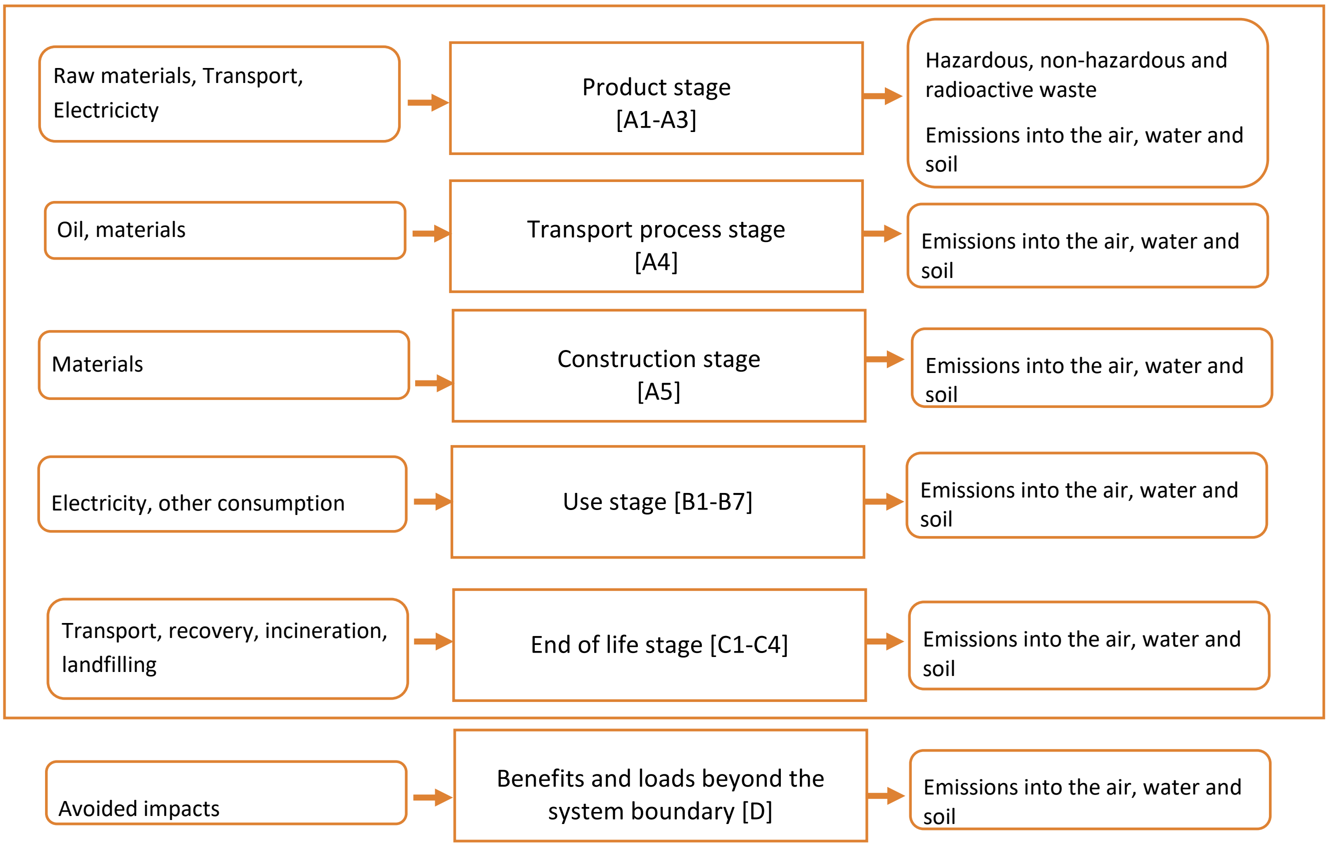


Figure 1 : Synopsis of the life-cycle steps considered in this study

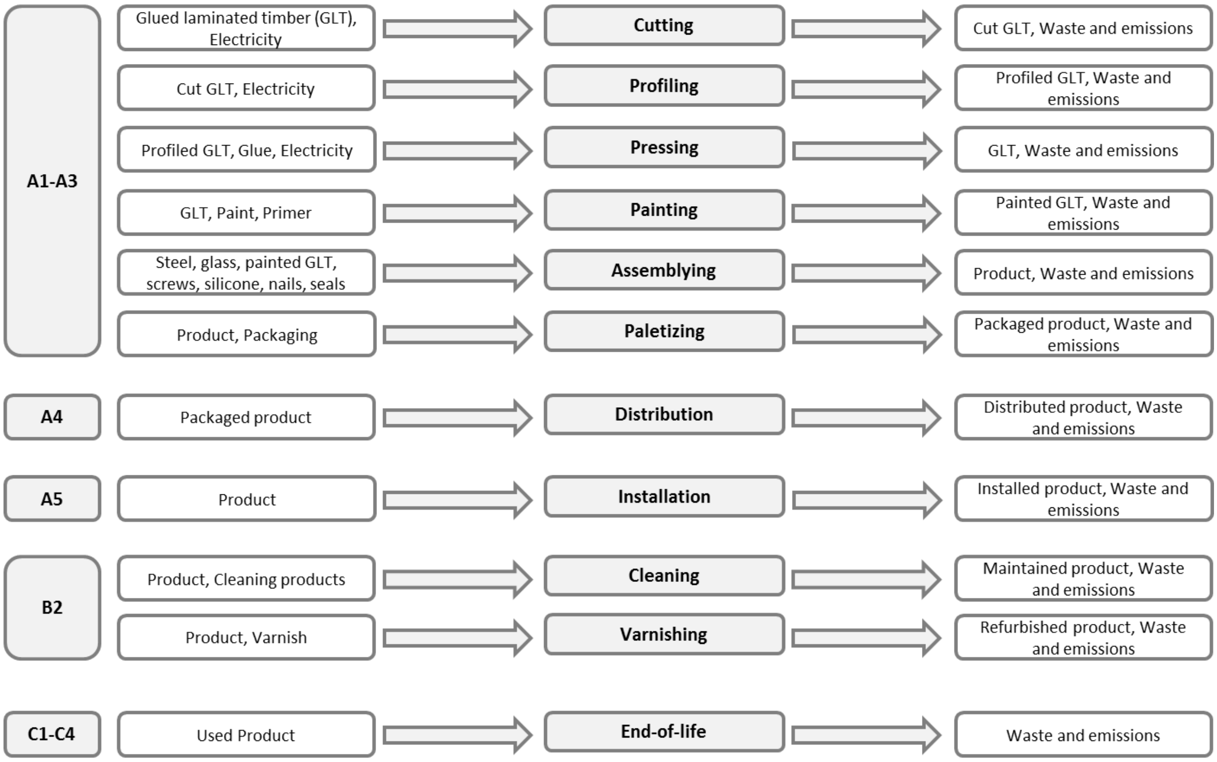


Figure 2 : Synopsis of the product manufactuting

2.1.7.2. MODULES AS IN NF EN 15804+CN

The environmental comparison is based on the module description as depicted in NF EN 15804 +CN. All modules were chosen in agreement with ARBOR in order to ensure a cradle-to-grave assessment.

Building assessment information																
Product stage			Construction process stage		Use stage							End of life stage				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport	Construction - installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction - demolition	Transport	Waste processing	Disposal	Reutilization, Recovery
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	MND
X = Included in the system; MND = Module Not Declared																

Tableau 7 : Modules included for the evaluation of the three processes

- Product stage:
  - A1-A3 :
    - Raw material extraction and processing
    - Production of aggregates from raw materials and their transformation, including water and energy supply
    - Upstream transport of raw materials
    - Management and treatment of production waste until the end-of-life status of waste.
    - All eventual co-products are treated as wastes, 100% allocated to the studied products.

- Construction process stage, information modules:
  - A4 : Transport by truck from the factory gate to the construction site in France
  - A5 : Installation of the product in the building.
    - Production, supply and use of additional elements necessary for the installation of the product
    - Treatment of waste generated by the disposal of packaging and product offcuts generated by the construction process, up to the end-of-waste status
- Use stage
  - B1: use or application of the installed product
  - B2: maintenance
  - B3: repair
  - B4: replacement
  - B5: refurbishment
  - B6: operational energy use (e.g. operation of heating system and other building related installed services)
  - B7: operational water use

- End of life stage :
  - C1: de-construction, demolition
  - C2: transport to waste processing
  - C3: waste processing for reuse, recovery and/or recycling
  - C4: disposal

- Benefits and loads beyond the system boundary:
  - Loads of incineration emissions (other than the ones emitted by the incineration for the current scenario)

2.1.7.3. EXCLUSIONS

Flows that can be excluded from the study because of the difficulty of attributing them to a particular reference flow are conventionally the following:

- The lighting, heating, sanitation, and cleaning of facilities
- The transportation of employees
- The manufacture and maintenance of production tools
- The construction and maintenance of infrastructures
- The systems and infrastructures
- The flows from administrative, management, and R&D departments
- The product marketing and the staff catering facilities

2.1.8. CUT-OFF RULES

It is possible to identify a cut-off rule:

A rule is linked to a flow category. Ex: weight rule.

Each rule is associated with a cut-off criterion, giving the threshold to respect. Ex: 1% of the total weight of the reference flow.

Each cut-off criterion must be respected in the life-cycle inventory. The objective is to prevent the results from a too high incertitude. It is thus necessary to assess the compliance with each cut-off criterion.

The following procedure shall be followed for the exclusion of inputs and outputs:

In case of insufficient input data or data gaps for a unit process, the cut-off criteria shall be 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, e.g. per module A1-A3 and module D shall be a maximum of 5 % of energy usage and mass:

Reference products	Real weight for the reference flow (kg)	Modeled weight for the reference flow (kg)	Variation (%)
ARBOR 68f	39,82	39,82	0%
ARBOR 68s	39,29	39,29	0%

Tableau 8 : Verification of the weight cut-off rule of the products

The proportion of non-modelled elements is in compliance with the 1%-in-weight cut-off rule and the 5%-in-energy cut-off rule, over the life-cycle considers:

- All inputs for which LCI data are available are included in the product LCI
- No specific exclusions were made for this study.

3. LIFE CYCLE INVENTORY

3.1. ORIGIN OF THE DATA USED FOR THE STUDY

3.1.1. PRODUCER OF COLLECTION DATA ON THE MANUFACTURE OF PRODUCTS

ll the data related to production, distribution, life in use and end of life are from the manufacturer's data and have been meticulously collected. It is thus legitimate to affirm that these data are representative of the production of window by the company ARBOR.

The following table summarizes the origin of the supporting data for this study.

Environmental aspects	Parameter	Method of data production	Type of data
Material production	Mass and material	Manufacturer data	Primary data
Processes	Nature and quantity	Manufacturer data	Primary data
Packaging	Mass and material	Manufacturer data	Primary data
Upstream transport	Distances and transport means	Manufacturer data	Primary data
Distribution	Distances and transport means	Manufacturer data	Primary data
Installation Use	Installation mode, mass and nature of materials	Data based on experience	Secondary data
	Mass, material and distances	Manufacturer data	Primary data
End-of-life	Nature and end of life potentials	Literature data	Secondary data
Material production	Mass and material	Manufacturer data	Primary data

Tableau 9 : General information on collected data on aggregate production processes

Note

Primary data / Secondary data

The data collected as a basis for the Life Cycle Assessment can be of primary or secondary origin. There are two types of data:

- Primary data: data collected on the field specific to the studied system.
- Secondary data: generic data issued from literature review and research.

The choice of a type of data is made depending on their availability and the level of quality necessary for this study.

Data were collected from February 2022 to April 2022 under the supervision of the CODDE department of Bureau. A collection file model was developed in accordance with the European standards NF EN 15804+A1 and NF EN 15804/CN. A kick-off meeting as well as follow-up meetings and the setting up of a telephone/email support allowed to validate the data progressively. All the data collected is available in the folders «ARBOR_FDES_68f_Fichier de collecte», «ARBOR_FDES_68s_Fichier de collecte». There is not missing data.

To be noted :

- For this study, primary data were preferred within the means available to collect the information.
- The data are representative of a manufacturing in Turkey.

ARBOR was responsible for identifying:

- Manufacturing stage :
    - weights and materials of all components of the products and packaging.
    - the places of supply of the parts and materials.
    - Energy consumption during the manufacturing phase.
    - Masses, materials and treatment scenario of all waste generated during the manufacturing phase
- Distribution stage :
    - Distribution of products from the last logistic platform to the construction site
- Installation stage:
    - Weights and nature of auxiliary materials
- Use stage :
    - Product maintenance scenario
- End of life stage:
    - Product end of life treatment

The selection of ICV modules was made by the Bureau Veritas CODDE team, which has expertise in the creation and use of this database.

No LCI modules were created specifically for this study.

3.1.2. DATA QUALITY ASSESSMENT

The quality assessment of the secondary data used is presented below. For each data item, the relevant and recent data in the EIME database was used.

Quality	Note
Very good	1
Good	2
Low	3
Poor	4
Very poor or unknown	5

Name	Ecobilan identifier	Completeness	Methodological appropriateness and consistency	Time representativeness	Technological representativeness	Geographical representativeness	Parameter uncertainty	Data Quality Rating (DQR)	Reference year	Valid until
Diesel oil combustion; in engine, including diesel oil production; consumption mix, at consumer; 42 MJ/kg net calorific value; RER	CODDE-0082	5	5	5	5,0	1994	CODDE-0082	5	5	5
Polyethylene low density (PE-LD) film; production mix, at plant; RER	CODDE-0101	5	5	5	5,0	2005	CODDE-0101	5	5	5
Scots pine wood; to manufacturing site; RER	CODDE-0172	5	5	5	5,0	2008	CODDE-0172	5	5	5
Unspecified inorganic chemicals; average production; production mix, at plant; RER	CODDE-0347	5	5	5	5,0	2000	CODDE-0347	5	5	5
Unspecified organic chemicals; average production; production mix, at plant; RER	CODDE-0348	5	5	5	5,0	2000	CODDE-0348	5	5	5
Vinyl Acetate; at plant; CN	CODDE-0464	4	1	3	2,7	2000	CODDE-0464	4	1	3
Aluminium; 48% recycled from clean scrap; production mix, at plant; RER	CODDE-1092	5	5	5	5,0	2005	CODDE-1092	5	5	5
Landfill of packaging cardboard (19.6% water content); landfill including air, water emissions, flue gas cleaning and leachate treatment; technology mix, at landfill site; RER	CODDE-2082	5	5	5	5,0	1994	CODDE-2082	5	5	5

Landfill of paint waste (0% water content); landfill including air, water emissions, flue gas cleaning and leachate treatment; technology mix, at landfill site; RER	CODDE-2088	5	5	5	5,0	1994	CODDE-2088	5	5	5
Water consumption; for process; consumption mix, at consumer; 1L; TR	CODDE-2192	2	3	3	2,7	2003	CODDE-2192	2	3	3
Waste recycling; in compliance with stock method; GLO	CODDE-2234	1	5	4	3,3	2014	CODDE-2234	1	5	4
Waste incineration with energy recovery; in compliance with stock method; GLO	CODDE-2235	1	5	4	3,3	2014	CODDE-2235	1	5	4
Electricity mix; Low voltage; France, FR	CODDE-2548	2	3	1	2,0	2018	CODDE-2548	2	3	1
Electricity mix; Low voltage; Turkey, TR	CODDE-2584	2	3	1	2,0	2018	CODDE-2584	2	3	1
Ethylene Propylene Diene copolymer (EPDM); from ethylene, propylene and ethylidene norbornene; production mix, at plant; US	ECO-002-	5	5	5	5,0	1992	ECO-002-	5	5	5
Polyamide resin 6.6 (PA 6.6); production mix, at plant; without additives; RER	ECO-006-	5	5	5	5,0	2011	ECO-006-	5	5	5
Polystyrene (PS); in expandable form; production mix, at plant; RER	ECO-016-	5	5	5	5,0	2005	ECO-016-	5	5	5
Silicone rubber; catalyzed polymerisation; production mix, at plant; US	ECO-027-	5	5	5	5,0	1983	ECO-027-	5	5	5
Stainless steel; primary production; 15% Cr; RER	ECO-030-	5	5	5	5,0	2006	ECO-030-	5	5	5
Titanium dioxide (TiO2) powder; chlorine process, from ilmenite; production mix, at plant; RER	ECO-057-	5	5	5	5,0	1992	ECO-057-	5	5	5
Corrugated cardboard; 5 layers; production mix, at plant; 85% recycled; RER	ECO-101-	5	5	5	5,0	1993	ECO-101-	5	5	5
Plain wood; for pallet; to manufacturing site; 42% maritime pine, 32% poplar and 26% scot pine; FR	ECO-102-	5	5	5	5,0	1994	ECO-102-	5	5	5
Polyurethane (PU) flexible foam; production mix, at plant; RER	ECO-183-	5	5	5	5,0	2013	ECO-183-	5	5	5
Landfill of ferro metals; landfill including leachate treatment and without collection, transport and pre-treatment; at landfill site; EU-27	ELCD-0107	5	5	5	5,0	2006	ELCD-0107	5	5	5

Landfill of glass/inert waste; landfill including leachate treatment and without collection, transport and pre-treatment; at landfill site; EU-27	ELCD-0108	5	5	5	5,0	2006	ELCD-0108	5	5	5
Landfill of plastic waste; landfill including landfill gas utilisation and leachate treatment and without collection, transport and pre-treatment; at landfill site; EU-27	ELCD-0114	5	5	5	5,0	2006	ELCD-0114	5	5	5
Landfill of untreated wood; landfill including landfill gas utilisation and leachate treatment and without collection, transport and pre-treatment; at landfill site; EU-27	ELCD-0116	5	5	5	5,0	2006	ELCD-0116	5	5	5
Landfill of wood products (OSB, particle board); landfill including landfill gas utilisation and leachate treatment and without collection, transport and pre-treatment; at landfill site; EU-27	ELCD-0117	5	5	5	5,0	2006	ELCD-0117	5	5	5
Oriented Strand Board; OSB III; production mix, at plant; 4,8% water content; EU-27	ELCD-0132	5	5	5	5,0	2005	ELCD-0132	5	5	5
Waste incineration of untreated wood (10,7% water content); average European waste-to-energy plant, without collection, transport and pre-treatment; at plant; EU-27	ELCD-0282	5	5	5	5,0	2006	ELCD-0282	5	5	5
Waste incineration of plastics (PE, PP, PS, PB); average European waste-to-energy plant, without collection, transport and pre-treatment; at plant; EU-27	ELCD-0284	5	5	5	5,0	2006	ELCD-0284	5	5	5
Glass; for windows; 18,7% recycled; production mix, at plant; RER	M-TR-046	5	5	5	5,0	1996	M-TR-046	5	5	5
Styrene Butadiene Rubber (SBR); production mix, at plant; RER	TEX-0085	5	5	5	5,0	1997	TEX-0085	5	5	5

3.1.2.1. TIME REPRESENTATIVITY

The data that has been the subject of data collection are representative of the period 2021. Collection was conducted between February 2022 and April 2022. Data for ARBOR was analyzed and processed in May 2022.

The reference years of the ICV modules used are indicated in the EIME software. For the same geographical and technological representativeness, the most recent data have been selected.

3.1.2.2. GEOGRAPHIC REPRESENTATIVITY

The primary data are representative of manufacturing in Turkey and of a distribution, installation and use i France.

The geographical area of the ICV modules used is indicated in the EIME software. Most of the modules used are for European coverage (materials), French and Turkish coverage (electricity).

3.1.2.3. TECHNOLOGICAL REPRESENTATIVITY

The primary data for ARBOR steel products are representative of the design of wooden window (pine) double glazing.

The technological application of the ICV modules used is indicated in the EIME software.

3.1.2.4. REPRESENTATIVITY

The primary data collected is representative of the production of ARBOR products for the year 2021.

The representativeness of the ICV modules of the EIME software is evaluated according to 3 levels: temporal/technological/geographical representativeness. This evaluation is available in the EIME software for each ICV module.

3.1.2.5. GENERIC INVENTORY DATABASE USED

LCI data base used is the BDD CODDE-2022-01 (updated in January 2022) and ELCD version 3.2 (October 2015).

The various inventories used in this study are available upon request.

3.1.2.6. TRACEABILITY

Life Cycle Inventory was realized by Bureau Veritas LCIE in December 2021 and the compilation of data results from the calculations made by EIME (Environmental Improvement Made Easy) v5.9.3 LCA software2.

3.1.3. MANAGEMENT OF UNCERTAINTIES AND INTERPRETATION OF RESUSLTS

3.1.3.1. LCI DATASET DATA BASE

To date, the uncertainty inherent in the inventory data in the EIME database is assessed qualitatively. A completeness indicator and a reliability indicator are associated with each of the data. For each of these indicators, three levels of quality are integrated (high/medium/low).

These concepts allow for a more reliable interpretation of the study results.

Data reliability: RELIABILITY	
High	Inventory data from primary data from at least 3 industrial sites
Medium	Inventory data from primary data from 1-2 industrial sites, with explicit documentation of the scope of the study.
Low	Data from bibliographic or poorly documented databases.
Data completeness : COMPLETENESS	
High	The scope of the inventory is complete. All significant steps of the manufacturing process are covered by the inventory and the knowledge of the inputs is established by respecting the criterion of 98% of the mass.
Medium	The scope of the inventory is not complete. Some significant process steps have not been studied or the knowledge of the inputs is not respecting the criterion of 98% of the mass.
Low	Only the material composition is indicated.

Tableau 10 : Management of uncertainty in the EIME database

In addition, when creating life cycle inventories in the EIME database, if more than one data source is available, the sensitivity threshold determining the aggregation of source data is as follows:

- If the differences between the assessment results by data source are less than 20% for each indicator, then the data are considered representative of the same technology.
- If a difference of more than 20% is observed for at least one of the indicators, then multiple LCI modules will need to be created.

Thus, the uncertainty of the generic LCI data used through the EIME database can be 20% at most.

The data collected is less than 5 years old. The manufacturer, ARBOR, is committed to the data collected.

For the landfill modeling, the ELCD module was used. All of them indicate that the impacts considered are those of a landfill for 100 years.

In accordance with the EIME methodology, infrastructure is not included.

Cut-off rules for each unit process: coverage of at least 98% of the mass and energy of the input and output streams, and 99% of their environmental relevance (based on expert judgment).

All data respect the allocation principles.

3.1.3.2. DATA COLLECTION

Each technical data element is collected with an accuracy of a few per cents related to the method of measurement (accuracy of the measurement instruments, for example human parameter).

When data is collected by the organization requesting the study, or when the data is derived from secondary sources that do not disclose the level of uncertainty of the measurement, then the accuracy is not known. Uncertainty in the measurement of data is therefore not considered and is beyond the scope of responsibility of Bureau Veritas LCIE.

When Bureau Veritas LCIE is appointed to conduct direct data collection, then, when the measurement tools permit, the uncertainty in the accuracy of the instruments is considered.

3.1.3.3. REFERENCE FLOW AND FUNCTIONAL UNIT

The comparison between systems is provided using the same functional unit and an equivalent scope (same boundaries, same technological, geographical, and temporal representativeness of the inventory data, same collection methodology, and same methodologies for characterizing impacts).

The material flows included in the functional unit are considered and any failure or approximation is recorded in the inventory phase.

3.1.4. ENVIRONMENTAL INDICATORS

The aim of this paragraph is to present the environmental indicators and their characterization method, i.e. methodologies allowing the calculation of flow and impact indicators from the inventory of inputs and outputs within the boundaries of each system studied.

Long-term emission streams are specifically identified and are excluded at the module level.

LCIA results are relative expressions and do not predict final impacts by category, threshold exceedance, safety margins

3.1.4.1. FLOW INDICATORS

The 17 flow indicators assessed in the life cycle impact assessment in EIME v5.3 are established in compliance with EN 15804 and are classified in several categories:

- Describing resource use:
    - ERP: Use of renewable primary energy excluding renewable primary energy resources used as raw materials (in MJ)
    - ERM: Use of renewable primary energy resources used as raw materials (in MJ)
    - ER: Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials) (in MJ)
    - ENRP: Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials (in MJ)
    - ENRM: Use of non-renewable primary energy resources used as raw materials (in MJ)
    - ENR: Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials) (in MJ)
    - USM: Use of secondary material (in kg)
    - URSF: Use of renewable secondary fuels (in MJ)
    - UNRSF: Use of non-renewable secondary fuels (in MJ)
    - NUFW: Net use of fresh water (in m3)

- Describing waste categories:
    - HWD: Hazardous waste disposed (in kg)
    - NHWD: Non-hazardous waste disposed (in kg)
    - RWD: Radioactive waste disposed (in kg)

- Describing output flows:
    - CRU: Components for re-use (in kg)
    - MRE: Materials for recycling (in kg)
    - MER: Materials for energy recovery (in kg)
    - EE: Exported energy (in MJ).

3.1.4.2. INDICATEURS D'IMPACTS

The 9 impact indicators assessed in the life cycle impact assessment in EIME v5.3 are established in compliance with EN 15804 and DHUP:

- GWP: global warming (in kg CO_2-eq)
- ODP: ozone depletion (in kg CFC11-eq)
- AP: acidification of soil and water (in kg SO_2-eq)
- EP: eutrophication (in kg PO_4^{3-} -eq)
- POCP: photochemical ozone creation (in kg C_2H_4-eq)
- ADPe: depletion of abiotic resources (elements) (in kg Sb-eq)
- ADPf: depletion of abiotic resources (fossil) (in MJ)
- WP: water pollution (in m3)
- AP: air pollution (in m3).

The characterization methods of all the impacts (except air and water pollution) are the CML methods. The characterization factors are those of CML and recalled in annex C of NF EN 15804.

For air and water pollution, the characterization factors are in annex C of NF EN 15804/CN

3.1.5. MÉTHODOLOGY

EIME methodology integrates a weighting of 1 for each indicator, so to consider all indicators, as critical as the others. An eco-design approach demands, when possible, to reduce all of them.

Each entity can prefer one or several indicators depending on its location and activity sector.

The weighting of different indicators in a single indicator introduces subjectivity.

3.1.6. LIFE CYCLE STAGES

Excel folders «ARBOR_FDES_68f_Fichier de collecte» and «ARBOR_FDES_68s_Fichier de collecte» present all the information collected to model the products.

The following paragraphs are intended to clarify the assumptions made in the modeling.

The scenarios included are representative and current of most other existing practices.

The values presented in this section are related to a reference window. For the functional unit of 1m², all values must be multiplied by 1/1.82.

3.1.6.1. BIOGENIC CARBON ACCOUNTING

This part is based on the NF EN 16485.

The wood extraction is performed in Europe. Therefore, we consider the carbon neutrality.

In that regard, for every kg of wood extracted, we consider the resource extraction of 1.12kg of CO_2.

This resource extraction has been accounted as a negative emission flow in the model, due to the non-consideration of CO_2 resource extraction in the impact indicator model.

Example: product 68s

Step 3 – Profiling / sizing wood wastes: 7.3 kg

Associated CO_2 resource extraction: 7.3 x 1.12 = 8.176 kg CO_2 eq/UF

Modeled with an elementary flow of carbon dioxide (emission to air, unspecified)

3.1.6.2. [A1-A3] MANUFACTURING STAGE

The manufacturing stage considers:

- The production and upstream transportation of materials needed to manufacture the products and packaging.
- The industrial processes of transformation of the materials.
- The end-of-life treatment of waste.

Production of materials: The identification of the materials was made by ARBOR. The materials considered are those necessary for the manufacture of products and packaging

Upstream transports: the formula used in the FD P01-015 has been used. It considers a 24T capacity truck, 100% loaded, with a 30% empty return rate. The amount of diesel combusted is calculated with the following formula:

38/100*km*(1/3*Cr/24+2/3+(2/3)*0,3)*N

Where:

km: transport distance
Cr (kg): truck load (24T in case of a 100% load)
Q (kg) mass of the transported goods

N=Q/Cr: number of trucks necessary to transport the quantity Q.

Energy mix: the energy consumption at the production site has been modeled by the Turkish electricity mix. Source : IEA - 2018es emballages des matières premières ainsi que les pertes de fabrication ont été considérées comme

End of life waste treatment: Raw material packaging and manufacturing losses were considered as 100% landfilled.

The transport of wastes is based on the FD P01-015 (30 km by truck for all the wastes obtained during the manufacturing stage.

Exclusion: due to their low environmental significance, and the difficulty to trace their impact, the transformation processes of small elements (screws, seals, etc.) have been neglected. The material productions, transports and wastes have been considered.

Allocation principle: The quantities needed to manufacture a product in terms of raw materials, energy and waste are based on one year of production and cross-referenced to a product (mass allocation).

The possible co-products that would have been generated throughout the life cycle have been allocated at 100% to the studied products and have been considered as waste.

Modularity principle: all impacts are allocated to the module where they are generated. It is mainly the case concerning process wastes where the production, transport and end of life impacts are allocated at the step when the wastes are generated. Example concerning the 68s: the transport and production of 2.7kg of wood is considered in the “cutting” step, and 7.3kg is considered in the “profiling/sizing” step

3.1.6.3. [A4] DISTRIBUTION STAGE

The distribution phase includes the transportation from the place of manufacture of the products (Turkey) to the construction site in France. The location of the customers has been defined according to the main sales of ARBOR. The following table gathers the hypotheses of the distribution phase modeling:

	68f			68s		
Localisation	Istanbul-France	Ile de France	Normandie	Istanbul-France	Ile de France	Normandie
% sell	100%	87%	13%	100%	87%	13%
Distance (km)	2800	220	300	2800	220	300
Means of transport	Lorry 24T					
Masse transportée	39,82 kg			39,29		
Load rate	100%					
Empty return rate	0 %					

Tableau 11 : Distribution scenario

3.1.6.4. [A5] INSTALLATION STAGE

Installation stage includes packaging end of life and the auxiliary materials manufacturing.

Wastes treatment: his stage includes the end of life of the waste generated at the installation site as well as the transportation from the installation site to the treatment site The scenario used for the end-of-life of packaging waste is based on statistical data published in 2016 by INSEE in its report "Non-hazardous waste from industry in 2016" which provides information on the end-of-life of waste in industry. The ratios used are presented in the following table:

Waste type	Recovery	Incineration with energy recovery	Incineration without energy recovery	Landfill
Plastic	71%	3%	1%	25%
Paper and cardboard	80%	1%	-	19%
Wood	33%	26%	1%	40%

Tableau 12: End-of-life treatment of packaging waste based on INSEE data

A collection transport over 30 km was considered.

The installation processes of the product are considered according to three different application modes: outdoor, indoor and tunnel. The consumption in terms of raw material related to these three modes of application are summarized in the table below:

Parameters	Unit	68f	68f
Indoor application (40%)			
Screw	Kg/UF	0,018	
Iron corner	Kg/UF	0,035	
Silicone	Ml/UF	33,0	
Compribande	Kg/UF	0,011	
Electricity	Wh/UF	33,0	
Outdoor application (20%)			
Screw	Kg/UF	0,009	
Iron corner	Kg/UF	0,018	
Silicone	Ml/UF	16,48	
Compribande	Kg/UF	0,005	
Electricity	Wh/UF	16,48	
Tunnel (40%)			
Screw	Kg/UF	0,018	
Silicone	Ml/UF	33,0	
Compribande	Kg/UF	0,011	
Electricity	Wh/UF	33,0	
Electricity consumption	kWh/UF	The energy consumption (82 kW) on the installation site was modeled by the French electrical mix Source : IEA - 2018	

Tableau 13 : Description of the installation process

3.1.6.5. [B1-B7] USE STAGE

Maintenance : we consider that the cleaning process varies deeply depending on the installation configuration and final client wishes. Therefore, it has not been taken into account in this study.

Reparation :

- Tt is considered that the windows have to be varnished once during their life span. It has been considered one varnish every 5 years, so 4 times during the product lifetime
- Is considered to have an 8L/100km consumption of diesel
- We consider that the whole truck is dedicated to the varnishing of one window
- We consider the same varnish as in the product stage (TEKNOS AQUA 1410-01 Colorless)

Parameter	Unit	68f	68s
Auxiliary inputs Varnish	Kg/UF	0,022	
Waste generated during repair	Kg/UF	No losses are considered. VOCs and water evaporate (1.98-4 kg/UF of VOCs and 2.09E-2 kg/UF of water per coating operation).	

Tableau 14 : Description of the repair scenario

3.1.6.6. [C1-C4] END OF LIFE STAGE

Deconstruction: The deconstruction operation is considered to not generate any environmental impact.

Transport: 30 km by truck, based on FD P 01-015 for non-hazardous wastes

End of life treatment : End of life has been considered to be 100% landfill of non-hazardous wastes, considering elimination in France, with actual technologies.

3.1.6.7. [D] BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY

Module D is not considered

4. ENVIRONMENTAL IMPACTS RESULTS– 68F

The impact results have been calculated thanks to the NF EN 15804+A1 and the NF EN 15804+CN characterization factor lists and are presented in the following table :

Impact indicators	Manufacturing stage	Construction stage			Use stage								End of life stage						
	Total A1-A3	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste processing	C4 Disposal	**Total C1-C4**	**Total Life Cycle**	**D Benefits and loads beyond the system boundary**
Global warming kg CO2 eq/UF	**4,71E+01**	5,86E+00	7,13E+00	**1,30E+01**	0,00E+00	3,50E-01	4,05E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**4,40E+00**	0,00E+00	3,38E-02	0,00E+00	1,26E+01	**1,26E+01**	**7,72E+01**	MND
Ozone depletion kg CFC 11 eq/UF	**1,15E-05**	4,30E-06	1,73E-06	**6,02E-06**	0,00E+00	2,28E-09	2,97E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,97E-06**	0,00E+00	2,47E-08	0,00E+00	3,13E-08	**5,61E-08**	**2,06E-05**	MND
Acidification of soil and water kg SO2 eq/UF	**1,32E-01**	3,58E-02	1,18E-02	**4,76E-02**	0,00E+00	7,61E-04	2,47E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,55E-02**	0,00E+00	2,06E-04	0,00E+00	4,83E-03	**5,03E-03**	**2,10E-01**	MND
Eutrophication kg (PO4)3- eq/UF	**3,44E-02**	9,44E-03	3,93E-03	**1,34E-02**	0,00E+00	2,39E-04	6,53E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**6,76E-03**	0,00E+00	5,44E-05	0,00E+00	2,15E-02	**2,15E-02**	**7,61E-02**	MND
Photochemical ozone creation Ethene eq/UF	**1,16E-02**	1,05E-03	1,49E-03	**2,54E-03**	0,00E+00	4,10E-05	7,23E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**7,64E-04**	0,00E+00	6,03E-06	0,00E+00	2,88E-03	**2,89E-03**	**1,78E-02**	MND
Depletion of abiotic resources - elements kg Sb eq/UF	**1,21E-03**	1,11E-09	6,71E-05	**6,71E-05**	0,00E+00	1,22E-08	8,20E-10	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,30E-08**	0,00E+00	6,39E-12	0,00E+00	6,15E-08	**6,15E-08**	**1,28E-03**	MND
Depletion of abiotic resources - fossil fuels MJ/UF	**6,53E+02**	7,65E+01	3,70E+01	**1,14E+02**	0,00E+00	9,86E-01	5,29E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**5,39E+01**	0,00E+00	4,40E-01	0,00E+00	1,12E+01	**1,17E+01**	**8,32E+02**	MND
Water pollution m3/UF	**4,20E+03**	8,95E+02	4,24E+02	**1,32E+03**	0,00E+00	3,50E+00	6,19E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**6,22E+02**	0,00E+00	5,15E+00	0,00E+00	5,52E+01	**6,04E+01**	**6,21E+03**	MND
Air pollution m3/UF	**7,57E+03**	9,23E+02	4,68E+02	**1,39E+03**	0,00E+00	4,25E+00	6,38E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**6,42E+02**	0,00E+00	5,31E+00	0,00E+00	3,35E+02	**3,41E+02**	**9,95E+03**	MND

Resources use	Manufacturing stage	Construction stage			Use stage								End of life stage					Total Life Cycle	D Benefits and loads beyond the system boundary
	Total A1-A3	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste processing	C4 Disposal	**Total C1-C4**		
Use of renewable primary energy excluding renewable primary energy resources used as raw materials MJ/UF	**2,21E+02**	5,02E-04	3,97E-01	**3,97E-01**	0,00E+00	1,14E-02	3,48E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,17E-02**	0,00E+00	2,89E-06	0,00E+00	3,74E-01	**3,74E-01**	**2,22E+02**	MND
Use of renewable primary energy resources used as raw materials MJ/UF	**4,78E+02**	0,00E+00	1,48E-01	**1,48E-01**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**4,78E+02**	MND
Total use of renewable primary energy resources MJ/UF	**6,99E+02**	5,02E-04	5,45E-01	**5,45E-01**	0,00E+00	1,14E-02	3,48E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,17E-02**	0,00E+00	2,89E-06	0,00E+00	3,74E-01	**3,74E-01**	**7,00E+02**	MND
Use of non-renewable primary energy excluding renewable primary energy resources used as raw materials MJ/UF	**7,24E+02**	7,67E+01	3,72E+01	**1,14E+02**	0,00E+00	1,07E+00	5,30E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**5,41E+01**	0,00E+00	4,42E-01	0,00E+00	1,23E+01	**1,28E+01**	**9,04E+02**	MND
Use of non-renewable primary energy resources used as raw materials MJ/UF	**1,02E+02**	0,00E+00	3,69E+00	**3,69E+00**	0,00E+00	0,00E+00	1,47E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,47E-02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**1,06E+02**	MND
Total use of non-renewable primary energy resources MJ/UF	**8,26E+02**	7,67E+01	4,09E+01	**1,18E+02**	0,00E+00	1,07E+00	5,30E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**5,41E+01**	0,00E+00	4,42E-01	0,00E+00	1,23E+01	**1,28E+01**	**1,01E+03**	MND
Use of secondary material kg/UF	**2,09E+00**	0,00E+00	4,67E-02	**4,67E-02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**2,14E+00**	MND
Use of renewable secondary fuel MJ/UF	**1,26E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**1,26E+00**	MND
Use of non-renewable secondary fuel MJ/UF	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	MND
Net use of fresh water m3/UF	**3,19E-01**	7,28E-03	6,51E-02	**7,24E-02**	0,00E+00	1,25E-03	5,04E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**6,29E-03**	0,00E+00	4,19E-05	0,00E+00	3,63E-03	**3,67E-03**	**4,01E-01**	MND

Waste category	Manufacturing stage	Construction stage			Use stage								End of life stage					Total Life Cycle	D Benefits and loads beyond the system boundary
	Total A1-A3	A4 Transport	A5 Installation	Total A4-A5	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	Total B1-B7	C1 Deconstruction/ demolition	C2 Transport	C3 Waste processing	C4 Disposal	Total C1-C4		
Hazardous waste disposed kg/UF	**8,97E+01**	5,11E-03	4,87E+00	**4,87E+00**	0,00E+00	4,22E-05	3,55E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**3,59E-03**	0,00E+00	2,94E-05	0,00E+00	6,75E-03	**6,78E-03**	**9,46E+01**	MND
Non-hazardous waste disposed kg/UF	**4,00E+01**	4,21E-02	4,87E+00	**4,91E+00**	0,00E+00	8,76E-02	2,91E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,17E-01**	0,00E+00	2,42E-04	0,00E+00	2,11E+01	**2,11E+01**	**6,61E+01**	MND
Radioactive waste disposed kg/UF	**2,41E-02**	1,23E-03	6,07E-04	**1,83E-03**	0,00E+00	2,67E-05	8,47E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**8,74E-04**	0,00E+00	7,06E-06	0,00E+00	3,91E-04	**3,98E-04**	**2,72E-02**	MND

Output flows		Manufacturing stage	Construction stage			Construction stage								End of life stage					Total Life Cycle	D Benefits and loads beyond the system boundary
		Total A1-A3	A4 Transport	A4 Transport	A4 Transport	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	Total B1-B7	C1 Deconstruction/ demolition	C2 Transport	C3 Waste processing	C4 Disposal	Total C1-C4		
Components for re-use kg/UF		**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	MND
Materials for recycling kg/UF		**0,00E+00**	0,00E+00	3,54E+00	**3,54E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**3,54E+00**	MND
Materials for energy recovery kg/UF		**0,00E+00**	0,00E+00	2,18E+00	**2,18E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**2,18E+00**	MND
Exported energy J/UF	**0,00E+00**	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	MND
	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	MND
	6,14E+00	**6,14E+00**	0,00E+00	2,87E+00	**2,87E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	7,59E+00	**7,59E+00**	**1,66E+01**	MND

4.1. CONTRIBUTION ANALYSIS ON THE WHOLE LIFE CYCLE

The following contribution analysis aims to identify the life cycle phases that contribute most to the different indicators.

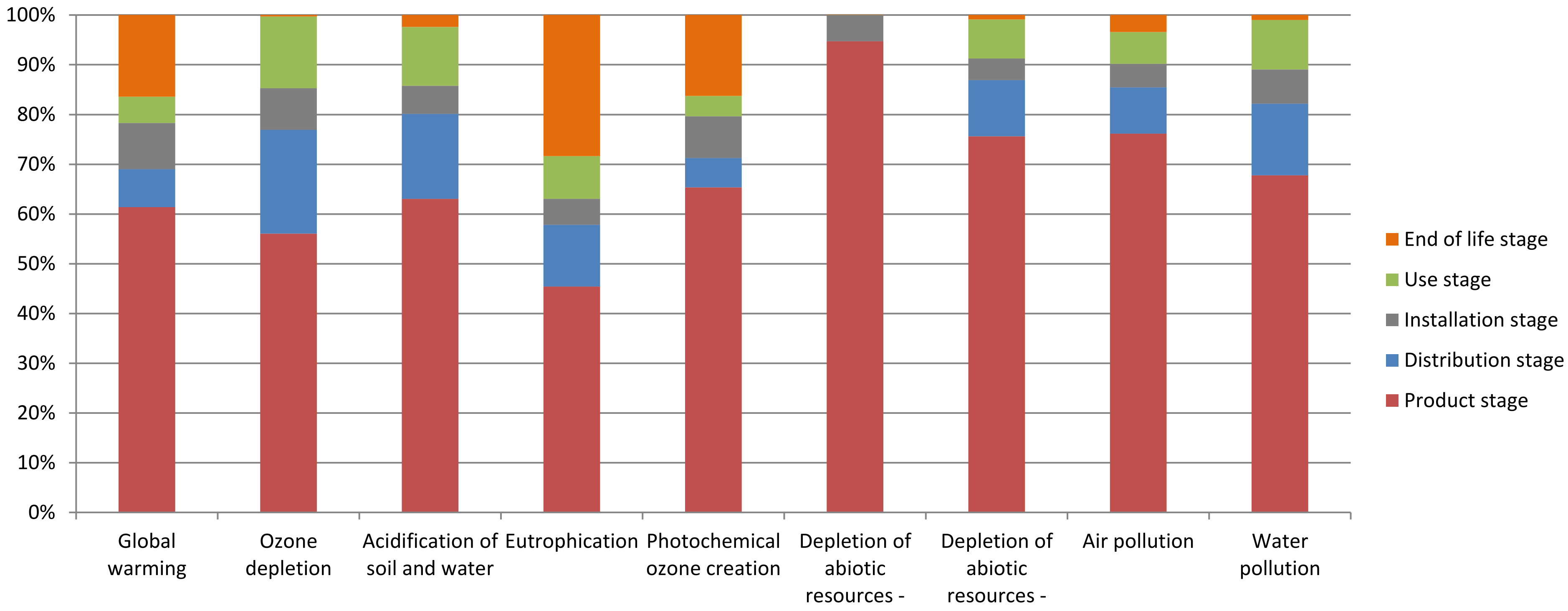


Figure 3 : Contribution analysis on the whole life cycle – 68f

The manufacturing phase was found to be the largest contributor to the impacts of all indicators.
The distribution phase contributes significantly to ozone depletion, water and soil acidification, and water pollution.
The end-of-life phase has a significant impact on global warming, eutrophication, and photochemical ozone creation.
The use phase has a significant impact on the depletion of the ozone layer and the acidification of water and soil.
The installation phase contributes about 10% or less to all indicators.

4.2. CONTRIBUTION ANALYSIS ON THE MANUFACTURING STAGE

The following graph presents the contribution analysis of the manufacturing phase (A1-A3)

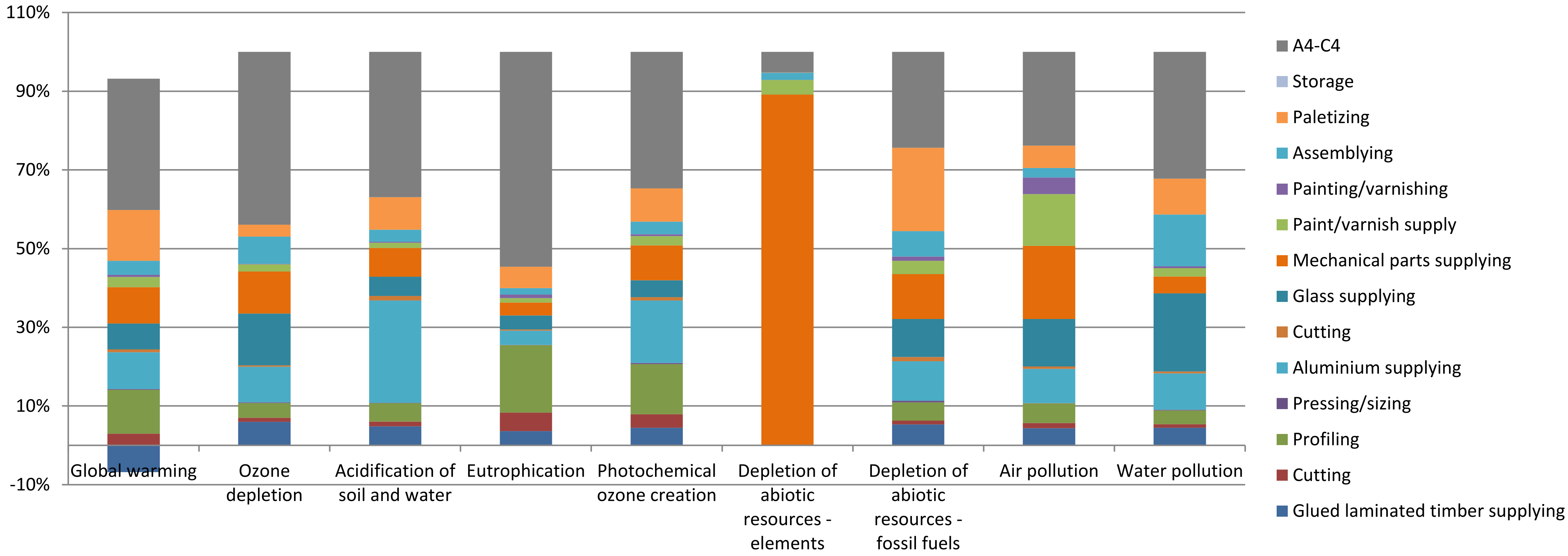


Figure 4 : Contribution analysis to the manufacturing stage (A1-A3) – 68f

This contribution analysis shows that most elements have a significant environmental impact. Overall, the supply of materials has the most impact due to the processes involved in producing the materials.

Specifically, the supply of mechanical parts accounts for most of the abiotic depletion impacts. This is due to the rare materials used in the stainless-steel alloy, such as molybdenum.

In addition, the sourcing of materials generates more impacts than the manufacturing processes implemented at ARBROR's manufacturing site.

Wood, although the most used material in terms of mass, generates little impact because its production requires little material and energy.

4.3. CONTRIBUTION ANALYSIS TO THE OTHER LIFE CYCLE STAGES

The graph below shows the contribution of the other phases of the life cycle:

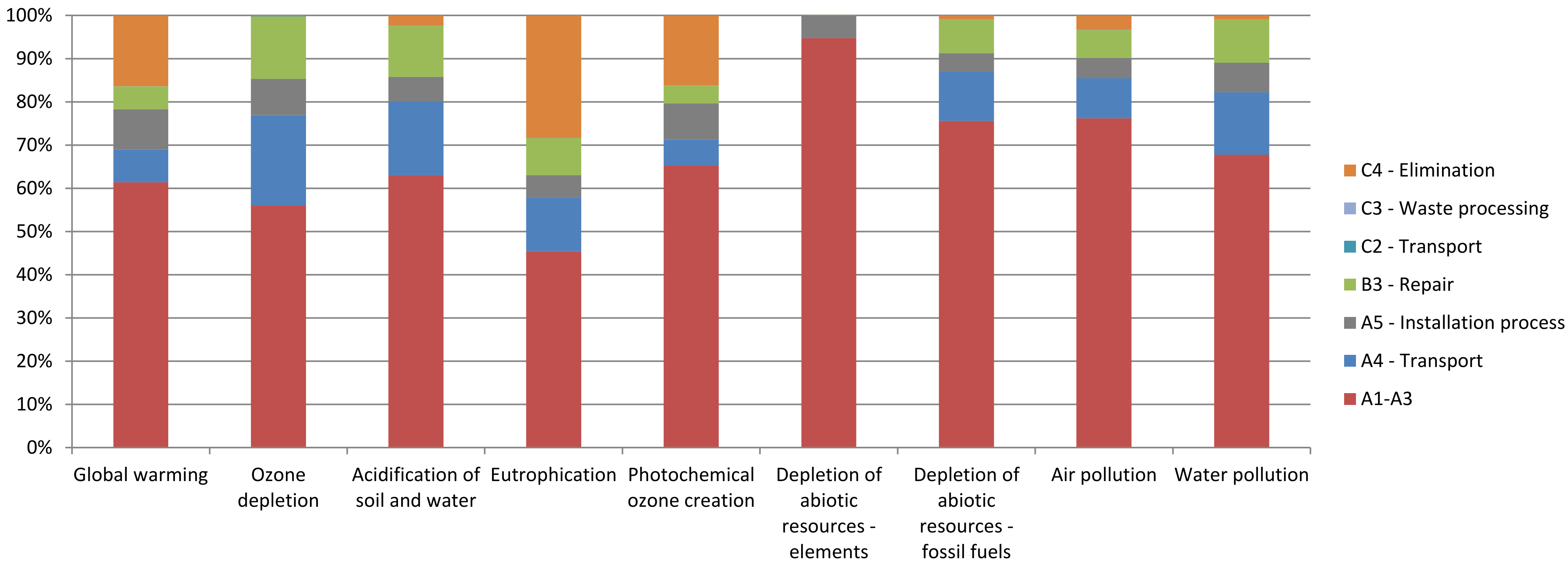


Figure 5 : Contribution analysis to the other life cycle stages – 68f

The transportation phase has a significant impact on ozone depletion, water and soil acidification, and water pollution. This is due to the emissions that occur during the combustion of diesel. The use phase is mainly caused by the transportation of a technician for 100 km every 5 years and is therefore also reflected in the same three indicators.

The impact of the end-of-life phase on global warming, eutrophication and the creation of photochemical ozone is mainly due to the burial of wood.

The impact of the installation phase on global warming as well as on the creation of photochemical ozone is mainly due to the end of life of the wooden part of the packaging (wooden support or pallet) and to the impacts generated by its burial.

5. ENVIRONMENTAL IMPACT RESULTS – 68S

The impact results have been calculated thanks to the NF EN 15804+A1 and the NF EN 15804+CN characterization factor lists and are presented in the following table :

Impact indicators	Manufacturing stage	Construction stage			Use stage								End of life stage					Total Life Cycle	D Benefits and loads beyond the system boundary
	Total A1-A3	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste processing	C4 Disposal	**Total C1-C4**		
Global warming kg CO2 eq/UF	**3,35E+01**	5,76E+00	7,13E+00	**1,29E+01**	0,00E+00	3,50E-01	4,05E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**4,40E+00**	0,00E+00	3,21E-02	0,00E+00	1,45E+01	**1,45E+01**	**6,53E+01**	MND
Ozone depletion kg CFC 11 eq/UF	**9,38E-06**	4,22E-06	1,73E-06	**5,95E-06**	0,00E+00	2,28E-09	2,97E-06	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,97E-06**	0,00E+00	2,35E-08	0,00E+00	3,43E-08	**5,78E-08**	**1,84E-05**	MND
Acidification of soil and water kg SO2 eq/UF	**6,91E-02**	3,52E-02	1,18E-02	**4,70E-02**	0,00E+00	7,61E-04	2,47E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**2,55E-02**	0,00E+00	1,96E-04	0,00E+00	5,30E-03	**5,50E-03**	**1,47E-01**	MND
Eutrophication kg (PO4)3- eq/UF	**2,78E-02**	9,28E-03	3,93E-03	**1,32E-02**	0,00E+00	2,39E-04	6,53E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**6,76E-03**	0,00E+00	5,17E-05	0,00E+00	2,34E-02	**2,34E-02**	**7,12E-02**	MND
Photochemical ozone creation Ethene eq/UF	**7,93E-03**	1,03E-03	1,49E-03	**2,52E-03**	0,00E+00	4,10E-05	7,23E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**7,64E-04**	0,00E+00	5,72E-06	0,00E+00	3,30E-03	**3,30E-03**	**1,45E-02**	MND
Depletion of abiotic resources - elements kg Sb eq/UF	**1,21E-03**	1,09E-09	6,71E-05	**6,71E-05**	0,00E+00	1,22E-08	8,20E-10	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,30E-08**	0,00E+00	6,07E-12	0,00E+00	6,70E-08	**6,70E-08**	**1,28E-03**	MND
Depletion of abiotic resources - fossil fuels MJ/UF	**5,20E+02**	7,52E+01	3,70E+01	**1,12E+02**	0,00E+00	9,86E-01	5,29E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**5,39E+01**	0,00E+00	4,18E-01	0,00E+00	1,21E+01	**1,26E+01**	**6,98E+02**	MND
Water pollution m3/UF	**3,10E+03**	8,80E+02	4,24E+02	**1,30E+03**	0,00E+00	3,50E+00	6,19E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**6,22E+02**	0,00E+00	4,90E+00	0,00E+00	5,84E+01	**6,33E+01**	**5,08E+03**	MND
Air pollution m3/UF	**6,48E+03**	9,07E+02	4,68E+02	**1,37E+03**	0,00E+00	4,25E+00	6,38E+02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**6,42E+02**	0,00E+00	5,05E+00	0,00E+00	3,73E+02	**3,79E+02**	**8,88E+03**	MND

Resource use	Manufacturing stage	Construction stage			Use stage								End of life stage					Total Life Cycle	D Benefits and loads beyond the system boundary
	Total A1-A3	A4 Transport	A5 Installation	**Total A4-A5**	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste processing	C4 Disposal	**Total C1-C4**		
Use of renewable primary energy excluding renewable primary energy resources used as raw materials MJ/UF	**1,85E+02**	4,93E-04	3,97E-01	**3,97E-01**	0,00E+00	1,14E-02	3,48E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,17E-02**	0,00E+00	2,74E-06	0,00E+00	4,05E-01	**4,05E-01**	**1,86E+02**	MND
Use of renewable primary energy resources used as raw materials MJ/UF	**5,03E+02**	0,00E+00	1,48E-01	**1,48E-01**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**5,03E+02**	MND
Total use of renewable primary energy resources MJ/UF	**6,88E+02**	4,93E-04	5,45E-01	**5,45E-01**	0,00E+00	1,14E-02	3,48E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,17E-02**	0,00E+00	2,74E-06	0,00E+00	4,05E-01	**4,05E-01**	**6,89E+02**	MND
Use of non-renewable primary energy excluding renewable primary energy resources used as raw materials MJ/UF	**5,38E+02**	7,54E+01	3,72E+01	**1,13E+02**	0,00E+00	1,07E+00	5,30E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**5,41E+01**	0,00E+00	4,20E-01	0,00E+00	1,33E+01	**1,38E+01**	**7,18E+02**	MND
Use of non-renewable primary energy resources used as raw materials MJ/UF	**9,91E+01**	0,00E+00	3,69E+00	**3,69E+00**	0,00E+00	0,00E+00	1,47E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,47E-02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**1,03E+02**	MND
Total use of non-renewable primary energy resources MJ/UF	**6,37E+02**	7,54E+01	4,09E+01	**1,16E+02**	0,00E+00	1,07E+00	5,30E+01	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**5,41E+01**	0,00E+00	4,20E-01	0,00E+00	1,33E+01	**1,38E+01**	**8,21E+02**	MND
Use of secondary material kg/UF	**1,26E+00**	0,00E+00	4,67E-02	**4,67E-02**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**1,30E+00**	MND
Use of renewable secondary fuel MJ/UF	**1,26E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**1,26E+00**	MND
Use of non-renewable secondary fuel MJ/UF	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	MND
Net use of fresh water m3/UF	**2,24E-01**	7,16E-03	6,51E-02	**7,23E-02**	0,00E+00	1,25E-03	5,04E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**6,29E-03**	0,00E+00	3,98E-05	0,00E+00	4,11E-03	**4,15E-03**	**3,06E-01**	MND

Waste category	Manufacturing stage	Construction stage			Use stage								End of life stage					Total Life Cycle	D Benefits and loads beyond the system boundary
	Total A1-A3	A4 Transport	B4 Replacement	C1 Deconstruction/ demolition	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste processing	C4 Disposal	**Total C1-C4**		
Hazardous waste disposed kg/UF	**8,87E+01**	5,02E-03	4,87E+00	**4,87E+00**	0,00E+00	4,22E-05	3,55E-03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**3,59E-03**	0,00E+00	2,79E-05	0,00E+00	7,28E-03	**7,31E-03**	**9,36E+01**	MND
Non-hazardous waste disposed kg/UF	**1,48E+01**	4,14E-02	4,87E+00	**4,91E+00**	0,00E+00	8,76E-02	2,91E-02	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**1,17E-01**	0,00E+00	2,30E-04	0,00E+00	2,05E+01	**2,05E+01**	**4,03E+01**	MND
Radioactive waste disposed kg/UF	**5,07E-03**	1,20E-03	6,07E-04	**1,81E-03**	0,00E+00	2,67E-05	8,47E-04	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**8,74E-04**	0,00E+00	6,71E-06	0,00E+00	4,28E-04	**4,35E-04**	**8,19E-03**	MND

Output flows		Manufacturing stage	Construction stage			Use stage								End of life stage					Total Life Cycle	D Benefits and loads beyond the system boundary
		Total A1-A3	A4 Transport	B4 Replacement	C1 Deconstruction/ demolition	B1 Use	B2 Maintenance	B3 Repair	B4 Replacement	B5 Refurbishment	B6 Operational energy use	B7 Operational water use	**Total B1-B7**	C1 Deconstruction/ demolition	C2 Transport	C3 Waste processing	C4 Disposal	**Total C1-C4**		
Components for re-use kg/UF		**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	MND
Materials for recycling kg/UF		**4,95E-03**	0,00E+00	3,54E+00	**3,54E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**3,55E+00**	MND
Materials for energy recovery kg/UF		**0,00E+00**	0,00E+00	2,18E+00	**2,18E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**2,18E+00**	MND
Exported energy J/UF	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	MND
	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	**0,00E+00**	MND
	0,00E+00	**4,98E+00**	0,00E+00	2,87E+00	**2,87E+00**	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	**0,00E+00**	0,00E+00	0,00E+00	0,00E+00	8,74E+00	**8,74E+00**	**1,66E+01**	MND

5.1. CONTRIBUTION ANALYSIS ON THE WHOLE LIFE CYCLE

The following contribution analysis aims to identify the life cycle phases that contribute most to the different indicators.

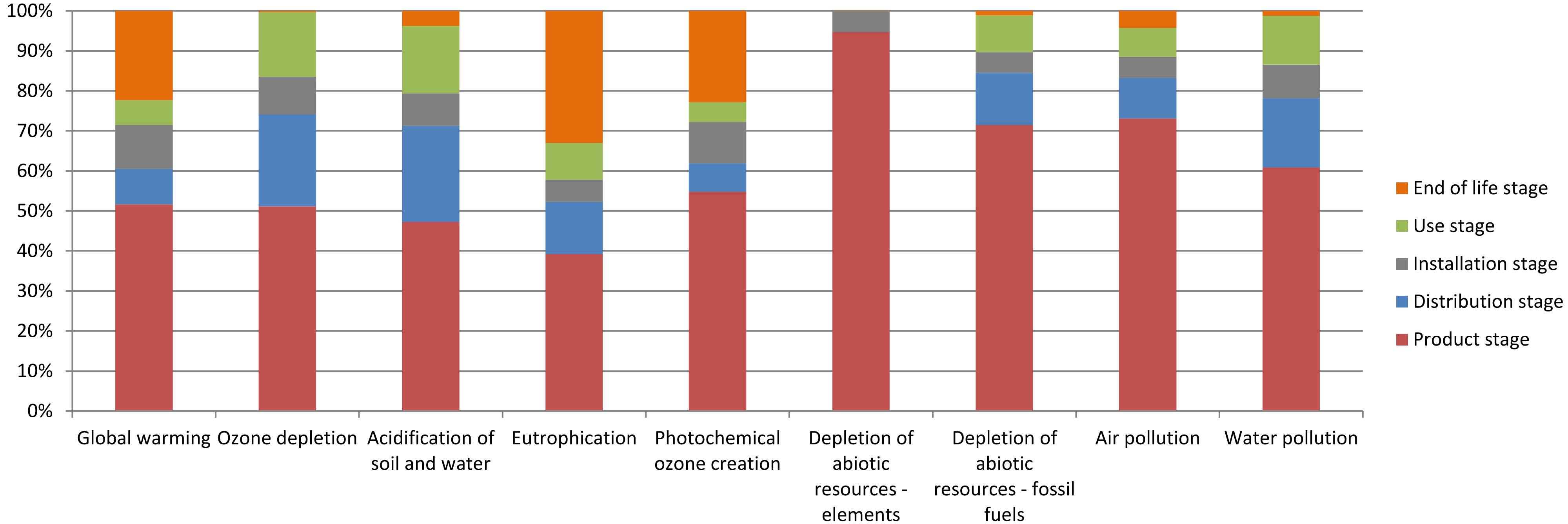


Figure 6 : Contribution analysis on the whole life cycle - 68s

The manufacturing phase was found to be the largest contributor to the impacts of all indicators.
The distribution phase contributes significantly to ozone depletion, water and soil acidification, and water pollution.
The end-of-life phase has a significant impact on global warming, eutrophication, and photochemical ozone creation.
The use phase has a significant impact on the depletion of the ozone layer and the acidification of water and soil.
The installation phase contributes about 10% or less to all indicators.

5.2. CONTRIBUTION ANALYSIS ON THE MANUFACTURING LIFE CYCLE

The following graph presents the contribution analysis of the manufacturing phase (A1-A3):

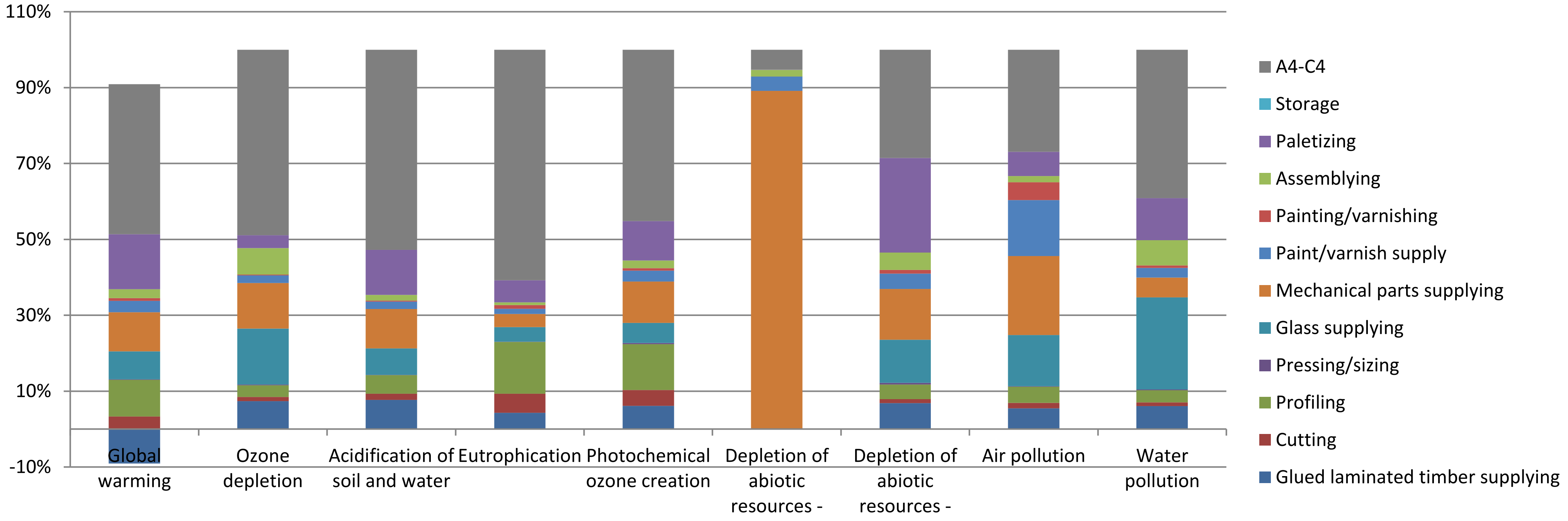


Figure 7 : Contribution analysis on the manufacturing stage (A1-A3) - 68s

This contribution analysis shows that most elements have a significant environmental impact. Overall, the supply of materials has the most impact due to the processes involved in producing the materials.

Specifically, the supply of mechanical parts accounts for most of the abiotic depletion impacts. This is due to the rare materials used in the stainless-steel alloy, such as molybdenum.

In addition, the sourcing of materials generates more impacts than the manufacturing processes implemented at ARBROR's manufacturing site.

Wood, although the most used material in terms of mass, generates little impact because its production requires little material and energy.

5.3. CONTRIBUTION ANALYSIS ON THE OTHER LIFE CYCLE STAGES

The graph below shows the contribution of the other phases of the life cycle:

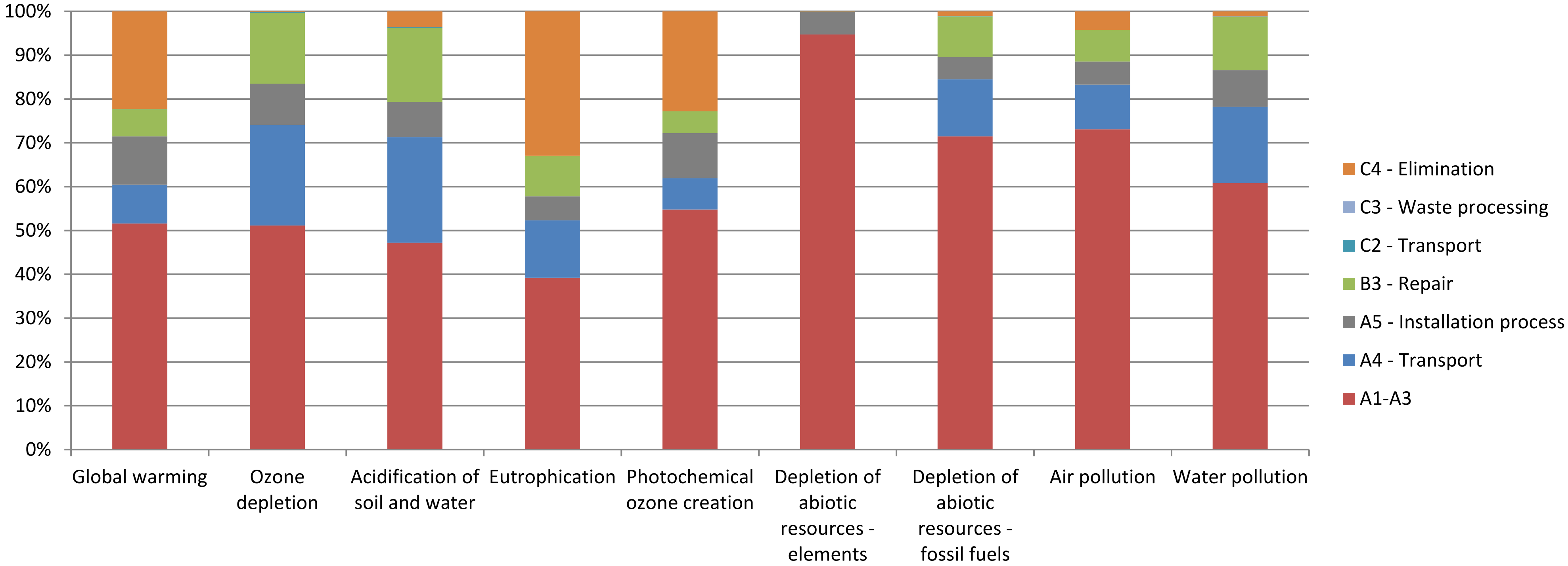


Figure 8: Contribution analysis on the other life cycle stages

The transportation phase has a significant impact on ozone depletion, water and soil acidification, and water pollution. This is due to the emissions that occur during the combustion of diesel. The use phase is mainly caused by the transportation of a technician over 100 km every 5 years and is also reflected in these three indicators.

The impact of the end-of-life phase on global warming, eutrophication and the creation of photochemical ozone is mainly due to the burial of wood.

The impact of the installation phase on global warming as well as on the creation of photochemical ozone is mainly due to the end of life of the wooden part of the packaging (wooden support or pallet) and to the impacts generated by its burial.

6. CONCLUSION

The ARBOR company wished to make available on the INIES/regulatory database 2 Environmental Product Declarations relating to the product ranges:

- 68f
- 68s

The present report will thus be used as a basis for the drafting of the associated FEDS in accordance with the requirements of the NF EN 15804+A1 and its national complement NF EN 15804/CN.

The main significant environmental aspects for both products are:

- The manufacture of the raw materials (mechanical parts, glass and aluminum)
- The transport of the product from its production site to the implementation site
- The burial of the wood at the end of its life