MF

Metal Plus Paints

MF Paints Inc.

ENVIRONMENTAL PRODUCT DECLARATION

ISO 14025:2006 and ISO 21930:2017

ASTM INTERNATIONAL

MF Paints Inc. is pleased to present this Environmental Product Declaration (EPD) for the Metal Plus Series. This EPD was developed in compliance with ISO 14025 and has been verified by Lindita Bushi from Athena Sustainable Materials Institute.
The LCA and the EPD were prepared by Vertima Inc.
The EPD includes cradle-to-grave life cycle assessment (LCA) results.

For more information about MF Paints Inc., visit https://www.peinturesmf.com/en/about/ .
For any explanatory material regarding this EPD, please contact the program operator.

1. GENERAL INFORMATION

PCR GENERAL INFORMATION			
Reference PCR	Product Category Rule for Environmental Product Declarations for Architectural Coatings. NSF International, PCR extended through June 30, 2024.		
The PCR review was conducted by:	*Dr. Thomas Gloria (chair)* *Industrial Ecology Consultants* *t.gloria@industrial-ecology.com*	*Mr. Bill Stough* *Sustainable Research Group* *bstough@ sustainableresear-chgroup.com*	*Dr. Michael Overcash* *Environmental Clarity* *mrovercash@earthlink.net*

EPD GENERAL INFORMATION		
Program Operator	ASTM Program Operator 100 Barr Harbor Drive West Conshohocken (PA) 19428-2959 USA www.astm.org	
Declared Product	**Metal Plus Series Paints**	
EPD Registration Number	**EPD Date of Issue** June 2024	**EPD Period of Validity** June 2024 - June 2029
EPD Recipient Organization	MF Paints Inc. 1605, Dagenais West Blvd. Laval QC H7L 5A3 Canada www.peinturesmf.com	

EPD Type/Scope and Functional Unit Product-specific cradle-to-grave EPD with functional unit of 1 m^2 of covered and protected substrate for a period of 60 years.	**Year of Reported Manufacturer Primary Data** 2022

Geographical Scope	**LCA Software**	**LCI Databases**	**LCIA Methodology**
North America	Open LCA version 1.11.0	Ecoinvent 3.9.1 and US LCI	TRACI v2

This LCA and EPD were prepared by:	Gatien Geraud Essoua Essoua, Ph.D., Eng. Forestry. Vertima Inc. www.vertima.ca
This EPD and LCA were independently verified in accordance with ISO 14025:2006, ISO 14040:2006 and ISO 14044:2006, as well as the NSF International PCR for Architectural Coatings, which is based on ISO 21930. ☐ Internal ☒ External	*Lindita Bushi* ________________ Lindita Bushi Athena Sustainable Materials Institute

LIMITATIONS

Environmental declarations from different programs (ISO 14025) may not be comparable. In order to support comparative assertions, this EPD meets all comparability requirements stated in ISO 14025:2006. However, differences in certain assumptions, data quality, and variability between LCA data sets may still exist. As such, caution should be exercised when evaluating EPDs from different manufacturers, as the EPD results may not be entirely comparable. Any EPD comparison must be carried out at the building level per ISO 21930 guidelines. The results of this EPD reflect an average performance by the product and its actual impacts may vary on a case-by-case basis.

2 Product Definition and Information

2.1 DESCRIPTION OF THE COMPANY

At MF Paints, our objective is to formulate paints and stains that are adapted to the Canadian climate. For more than 50 years, we have distinguished ourselves by offering premium quality and environmentally friendly products. It is thanks to our vision, values, and attention to quality that MF Paints has risen to the top of the paint and stain industry in Quebec and Canada over the last 50 years. Focused on research, development, and personalized customer service, MF Paints has succeeded in formulating premium products adapted to the needs of residential, commercial and industrial projects.

2.2 PRODUCT DESCRIPTION

The Metal Plus DTM line is the ultimate solution for protecting metal surfaces and improving its aesthetics. Manufactured with advanced technology, Metal Plus offers exceptional durability and abrasion resistance, making it ideal for both indoor and outdoor use. The Metal Plus series falls into the interior subcategory in this EPD.
Whether you want to protect a structure, metal furniture, or doors and windows, Metal Plus is the perfect choice to prolong its life and enhance its beauty for years to come. Table 1 presents each paint included in this paint series.

Product Series	Code Number	Gloss Finish
Metal Plus	4700	Semi-Gloss
Metal Plus	4740	Platinum

Table 1: Paints include in the Metal Plus series.

Semi-Gloss

Platinum

Sold in gallons or litres, MF Paints' products come in a wide range of colours. The primary United Nations Standard Products and Services Code (UNSPSC) code for paint products is 3511 and the Construction Specifications Institute (CSI) code is 09 96 00.

Figure 1: Representation of MF Paints room scene.

2.2.1 Product Average

The weighted average profile of each paint is calculated based on 2022 annual production data (on mass).

2.2.1.1 *Product-Specific EPD*

In the context of the growing popularity of sustainable building and LEED v4 and v4.1 Rating Systems, developing Type III Environmental Product Declarations (EPDs) would allow MF Paints to increase visibility for its Metal Plus series. The EPD for its Metal Plus series has been developed according to the PCR for Architectural Coatings from NSF International, developed in accordance with ISO 14025, ISO 21930 – 2017 and ISO 14044 [1, 2, 3, 4].

2.3 APPLICATION

MF Paints products' ease of use makes it the ideal material for commercial, hospitality and institutional projects. MF Paints' products have good chemical resistance, abrasion resistance, and substrate penetration, in addition to their easy application on concrete, wood, masonry, steel, aluminum substrates. The Metal Plus paint series presented in this EPD is for interior use.

2.4 DECLARATION OF METHODOLOGICAL FRAMEWORK

This LCA is a cradle-to-grave study. For this analysis, the attributional approach was followed and impacts of infrastructure have been excluded.

Life cycle stages included in the analysis are production, construction, use and end-of-life. According to the NSF International PCR for architectural coatings,[1] Table 1 and Table 2, there are two (2) lifetime scenarios for paint products. The first scenario is a market-based lifetime and the second scenario is design life. As Metal Plus series paints are high-quality paints, the product lifetime was assumed to be 15 years for the internal coating for the first scenario. In the case of the second scenario, 5 years were assumed to be the lifetime for internal use.

According to the PCR allocation procedure, mass should be used as the primary basis co-product allocation. OpenLCA software v1.11 [5], an open-source software, was used to calculate the inventory and to assess potential environmental impacts associated with the inventoried emissions.

2.5 TECHNICAL DATA

For specific properties and performance data for MF Paints, please consult the following link: https://www.peinturesmf.com/en/product-categories/. Table 2 presents the technical data for the products under study.

Table 2: Technical Details

Paint series	Surface covered (m^2)	Average amounts (kg)
Metal Plus series	1	1.43E-01

2.6 PRODUCT COMPOSITION

The composition of each paint included in the Metal Plus series is presented in Table 3.

Table 3: Material Composition for each paint in the Metal Plus series

Paint series	Gloss finish	Components	Rate (%)
Metal Plus series	Semi-Gloss and Platinum	Additives	2.37%
		Glycol, esters and ethers	3.88%
		Fillers	4.57%
		Binders	46.16%
		Titanium dioxide	20.49%
		Preservative	0.08%

Paint series	Gloss finish	Components	Rate (%)
		Water	22.45%

2.7 MANUFACTURING

Overall, the paint manufacturing process involves several critical steps to produce high-quality paint products that meet various specifications and requirements. Quality control at each step of the process is critical to ensuring that the final product meets customer expectations. Figure 2 shows the flow diagram for the manufacturing stage.

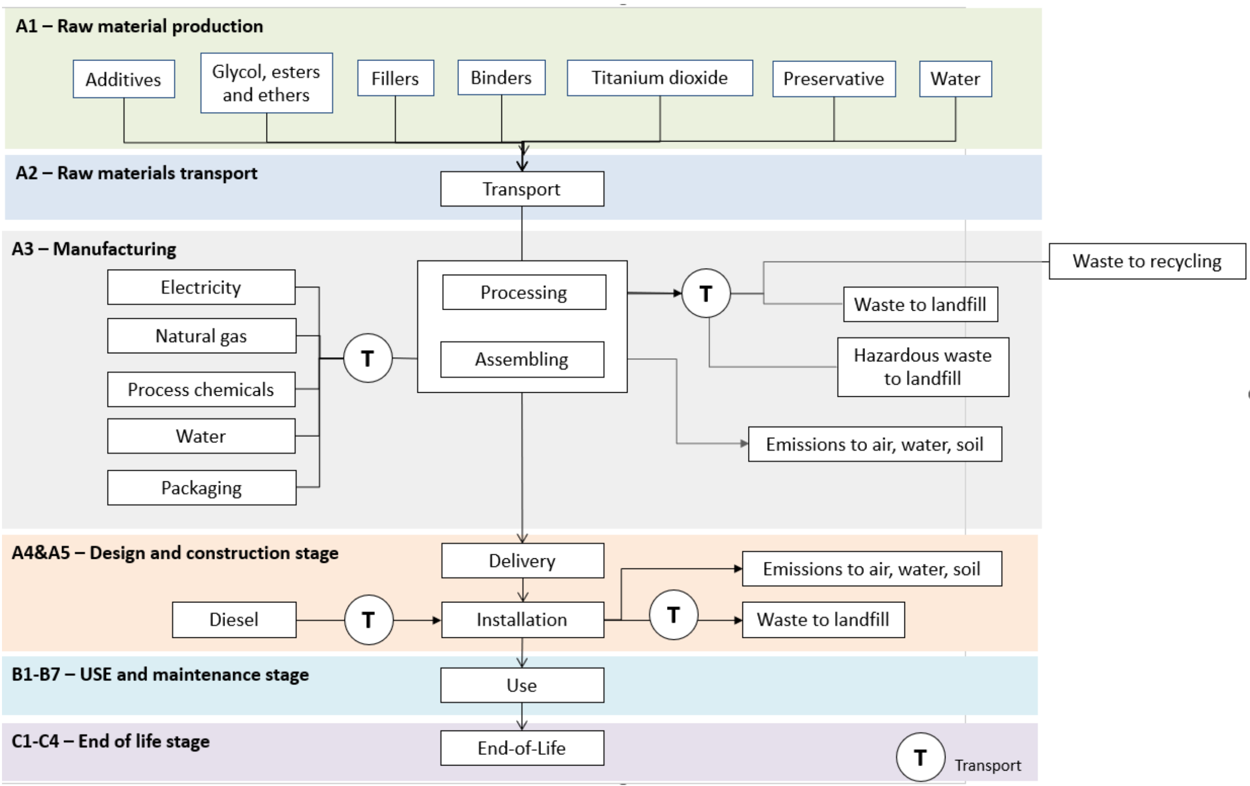


Figure 2: Flow Diagram for MF Paints manufacturing process.

2.8 PACKAGING

The paint products are packaged in a steel or plastic gallon or liter container and placed in corrugated cardboard. The product is then placed on wooden pallets, wrapped with low-density polyethylene (LDPE) and tied with polyethylene strapping. Packaging materials used are presented in section 2.8 below.

Table 4: Packaging materials used per each FU per Metal Plus series.

Materials	Metal Plus series	
	Amounts	Units
Pallet	3.79E-08	Items
Cardboard	1.65E-12	ton
Plastic	1.51E-10	ton

Materials	Metal Plus series	
Metal	5.13E-09	ton
Polyethylene	5.39E-11	ton

2.9 PRODUCT DISTRIBUTION

The distribution of MF Paint products is 85% in Quebec, 4% in Ontario, 4% in the western Canadian provinces, 4% in the Maritime provinces and the remaining 3% in the USA and the rest of the world.

2.10 PRODUCT APPLICATION

According to information received from MF Paints, no energy is needed to apply the paint product on the substrate. The percentage of un-used paint is 10%. The environmental impacts of the production stage and design and construction stage are accounted for in this module. The environmental impacts of carbon black chemicals used as colorant is accounted for in this module. The drying VOC emissions were also accounted for. The manufacturer's installation instructions should be followed [6].

Table 5: Installation inputs per FU

Items	Metal Plus series	Units	Datasets
Carbon black	1.14E-05	kg	market for carbon black | carbon black | Cutoff, U - GLO
VOC emissions	5.82E-03	gr COV/m^2	-
10% of un-used paint	(A1 to A5)*10%	-	-

2.11 USE CONDITIONS

After application of the paint on a substrate, the manufacturer does not have specific recommendation about use conditions except those indicated on the TDS sheet. As the paint is washable, it is possible to clean and to remove any dust that may settle on any surface.

2.12 REFERENCE SERVICE LIFE AND ESTIMATED BUILDING SERVICE LIFE

According to the NSF International PCR, the estimated service life (ESL) is 60 years.[1]

2.13 REUSE, RECYCLING, AND ENERGY RECOVERY

There is no re-use and energy recovery but there is recycling of waste paints.

2.14 DISPOSAL

This LCA study assumes that packaging materials such as cardboard and plastic are 100% landfilled. For metal packaging material, 100% is recycled. In landfills, based on a conservative timeline of 100 years and on the ecoinvent dataset "treatment of waste paperboard, sanitary landfill | waste paperboard | Cutoff, U - RoW" and "treatment of waste plastic, mixture, sanitary landfill | waste plastic, mixture | Cutoff, U – RoW," the degradation of paperboard is 32% over 100 years. Waste plastic degradation represents less than 1% (negligible). In this LCA, a rate of zero degradation was considered at landfill sites.

2.15 FURTHER INFORMATION

Further information about MF Paint products is available at https://www.peinturesmf.com/en/data-sheets/

MF Paints is committed to making products that contribute to a healthy living environment. This is evidenced by the fact that MF Paints are tested for VOC and formaldehyde emissions by a third-party laboratory (less than 50 g/l). MF Paints also has Health Product Declarations (HPD), in the process of being certified by a third party (Green Seal company).

3 LIFE CYCLE ASSESSMENT CALCULATION RULES

3.1 FUNCTIONAL UNIT

The functional unit (FU) analyzed is 1 m^2 of covered and protected substrate for a period of 60 years (the assumed average lifetime of a building) with an opacity of 97% after drying. Table 6 presents all products covered by this report and their respective functional unit (FU).

Table 6: Functional unit of assessed products.

Items	Amounts	Units
Functional Unit (FU)	1	m^2
Weight	1.43E-01	kg

3.2 SYSTEM BOUNDARIES

According to the NSF International PCR, the LCA is cradle-to-grave (A + B + C). All life cycle stages are included in the analysis; Production, Construction, Use and End-of-life (**Figure 3**). The production stage includes the following modules: A1) Extraction and upstream production, A2) Raw materials transportation to the manufacturing site, and A3) Manufacturing. The Construction stage includes the following modules: A4 and A5) transportation of MF Paint products from manufacturing sites to the wholesaler site in North America. The Use stage includes modules B1 to B7. The End-of-Life (EoL) stage includes modules C1 to C4.

Module B1 corresponds to the application of the paint product on the substrate. Paint is applied manually with no energy consumption. During the use stage, the resources used on rare occasions, if necessary, are negligible for module B3. For cleaning purposes, based on manufacturer recommendations, no resources are needed for maintenance (module B2). Based on the PCR, two scenarios were analyzed: design life and market-based lifetime. During the ESL of the building (60 years), the replacement (module B4) of each paint is analyzed based on both scenarios. **Figure 3** below presents both scenarios. There is no refurbishment (B5) during the estimated service life of the building. During the ESL of the building, the product doesn't require operational energy (B6) or water use (B7). In this analysis, the environmental impacts of these modules (B2, B3, B5, B6 and B7) are therefore considered as nil.

For the end of the life (EoL) stage, there is no energy consumption for the deconstruction module (C1) because there is no demolition of the paint layer in building demolition activities. For module C3, the waste goes directly from the building site to the landfill site without any energy consumption at a sorting plant. The EoL modules included in this analysis are the C2 and C4 modules for transportation from building sites to the landfill site and landfill, respectively. The distance for module C2 was assumed to be 11.27 km.

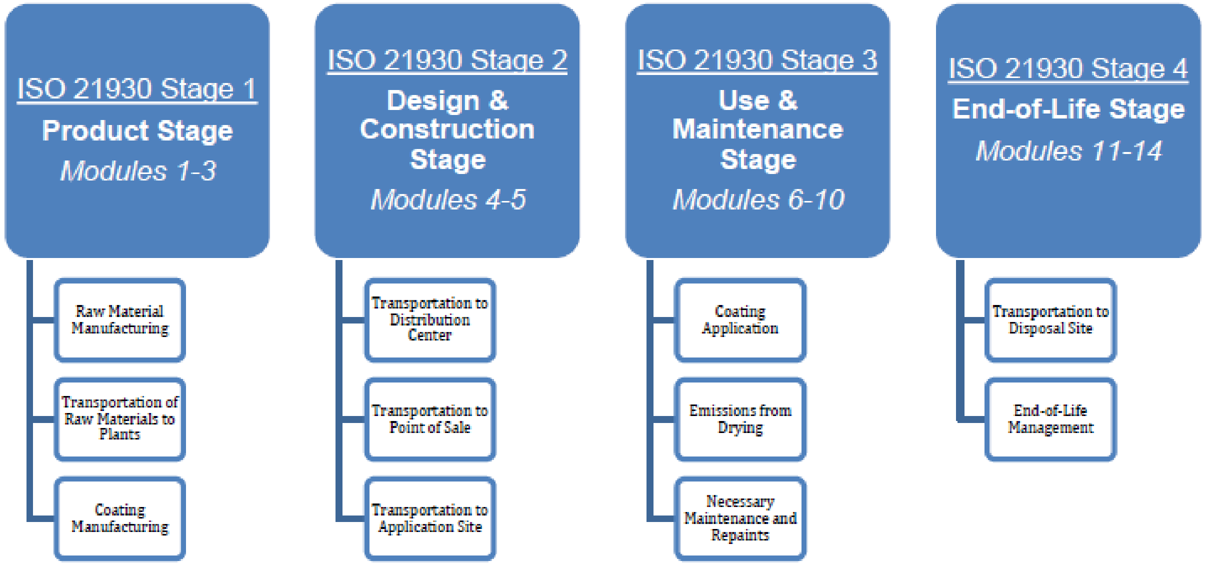


Figure 3 presents the life cycle stages, and their modules, included in the system boundaries.[1]

Table 7: Lifetime scenario of paint products studied.

Metal Plus Series - Interior subcategory	Quality Level	Design life (scenario 1)	No. of replacements for scenario 1 based on building ESL	Market-based lifetime (scenario 2)	No. of replacement for scenario 2 based on building ESL
Metal Plus (Semi-Gloss and Platinum)	High Level	15	3	5	11

Extraction and upstream production (module A1): This stage includes the extraction and manufacturing of raw materials needed to produce the paint products.

Raw materials transportation to manufacturing site (module A2): This stage includes the transportation of raw materials from suppliers to the MF Paints manufacturing site at 1605 Dagenais Boulevard West, Laval (Quebec).

Manufacturing (module A3): This stage includes water and energy (electricity, diesel and propane) consumption for the manufacturing processes, and chemicals used in the process as well as their transport to the site. Hazardous waste treatment has been accounted for as well. Finally, packaging materials to make products ready for shipment are covered by this stage.

Design and construction stage (modules A4 - A5): The design and construction process start with the packaged and finished coating leaving the production site and ends with the finished coating being delivered to the application site. Products are transported and distributed by truck in Canada (97%), mainly in the province of Quebec (85%).

Use and maintenance stage (B1 to B7): As mentioned in the PCR, "The use stage begins when the user applies the product to a substrate and ends with any leftover coating and discarded packaging entering the end-of-life stage." It was assumed that 10% of the wet paint is unused and it was also assumed that it was 100% landfilled. No energy for paint application and VOC emissions from the drying of paint were accounted for. The replacement module (B4) includes the modules A1 to A5, and modules B1, C2 and C4.

End-of-life stage (C1 to C4) Transport to waste processing and/or disposal (module C2): As mentioned in the PCR "The end-of-life stage begins when any applied or unused coating and primary packaging is ready for disposal, recycling, reuse, etc. and ends when these products are landfilled, returned to nature (deterioration), or transformed to be recycled or reused."[1] Based on the PCR, section 4.4, it was assumed that distance to the landfill site was seven (7) miles (11.27 km) and 100% of the water-based paints are landfilled [1].

3.3 CUT-OFF CRITERIA

According to section 6.3.3 of ISO 21930 [3], if a mass flow or energy flow represents less than 1% of the cumulative mass or energy flows of the system, it may be excluded from the system boundaries. However, these flows should not have a relevant environmental contribution. Also, at least 95% of the total energy and mass flows shall be included, and the cumulative mass or environmental impacts of the excluded flows shall not exceed 5% of the total mass and energy flows or potential environmental impacts.

In this study, no primary data (input material, energy consumption) was excluded from the system boundaries. Water consumption was assumed to be 100% dedicated to employees. Therefore, this water consumption was estimated negligible by the manufacturer. No primary data on the construction, maintenance or dismantling of the company's capital assets was included in the model. Also, primary data on the daily transport of employees, office work, business trips and other activities from the manufacturer's employees was not included in the model.

3.4 DATA SOURCES

Inventory data were collected from the manufacturing site located at 1605 Dagenais Boulevard West, Laval (Quebec) using a life cycle inventory (LCI) questionnaire. Data was collected via the Technical Manager and the manufacturing team. The Technical Manager and Production Manager were responsible for filling out the questionnaire. Further telephone, email and meeting discussions took place to determine certain aspects of the questionnaire, to collect additional information or to seek clarifications.

When primary data was not available, unit processes were selected from the ecoinvent database v3.9.1 or from the US LCI database, the most comprehensive LCI databases currently available [7, 8].

3.5 DATA QUALITY

Data Quality Parameter	Data Quality Discussion
Source of manufacturing data: Description of data sources	Manufacturing data was collected from the MF Paints manufacturing site located at 1605 Dagenais Boulevard West, Laval (Quebec) for the 2022 production year. Data included total production mass of products produced at the manufacturing plant, as well as the total annual units in kg and total production mass of products under study; raw materials entering the production of the products under study; losses of materials; transport modes and distance of materials; energy consumption; water consumption; emissions to the environment at the manufacturing plant; waste treatment; packaging material; and paint products distribution.
Source of secondary data: Description of sources of raw materials, energy source, transport, waste and packaging data	When appropriate, the grid mix was changed for the grid mix of the province or country where the process takes place. Otherwise, ecoinvent datasets representative of the global market or "rest-of-the-world" were mainly selected as proxies.

Data Quality Parameter	Data Quality Discussion
Geographical representativeness	The manufacturing site is located 1605 Boulevard West, Laval (Quebec); hence electricity consumption is based on the Quebec grid mix. Geographical correlation of the material supply and the selected datasets are representative of each specific area or a larger area.
Temporal representativeness	Primary data was collected to be representative of the full year 2022, while this was not always the case for ecoinvent and US LCI datasets. Nevertheless, ecoinvent and US LCI remain reference LCI databases used in this study.
Technological representativeness	Primary data, obtained from the manufacturer, is representative of the current technologies and materials used by the company.
Completeness	All relevant process steps were considered and modelled to satisfy the goal and scope. Cut-off criteria were respected.

3.6 PERIOD UNDER REVIEW

The period under review is the year 2022.

3.7 ALLOCATION

According to the PCR [1], the allocation approach used as the primary basis for co-product allocation is mass allocation. In this study, mass allocation was used for the manufacturing input and output flow and the yearly production mass of each product under study was used as a basis. Data relative to material and energy consumption was provided for all co-products by the manufacturer.

Materials undergoing recycling/reuse processes are excluded from the system boundary. A cut-off approach was used because recycled/reused material is part of raw material preparation for another product system.

4 LIFE CYCLE ASSESSMENT RESULTS

4.1 RESULTS TABLES

The life cycle assessment results are presented per FU. According to the PCR requirements, results presented derive from the life cycle impact assessment (LCIA) and the life cycle inventory (LCI). LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

According to the NSF International PCR standard, Table 3, the life cycle impact assessment shall, as a minimum, report the set of impact categories. These six impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, EPD users shall not use additional measures for comparative purposes.

The LCA results are presented in Table 8 to Table 9 Metal Plus MF Paints product group, respectively.

Table 8: Scenario 1: Metal Plus Series Life Cycle Impact Assessment Results

Impacts Categories	Units	A1	A2	A3	A4-A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
Acidification (1)	kg SO2 eq	2.78E-03	7.24E-05	3.13E-06	2.06E-04	3.06E-04	0.00E+00	0.00E+00	1.01E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.93E-07	0.00E+00	4.90E-06
Eutrophication (1)	kg N eq	8.56E-04	5.29E-06	8.18E-07	1.48E-05	8.77E-05	0.00E+00	0.00E+00	5.06E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.41E-08	0.00E+00	7.23E-04
Global Warming (2,3)	kg CO2 eq	3.37E-01	6.73E-03	2.17E-03	1.68E-02	3.63E-02	0.00E+00	0.00E+00	1.21E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.80E-05	0.00E+00	5.86E-03
Ozone Depletion (1)	kg CFC-11 eq	4.91E-09	2.33E-11	1.34E-10	5.81E-11	5.14E-10	0.00E+00	0.00E+00	1.70E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.21E-14	0.00E+00	1.97E-11
Photochemical ozone formation (1)	kg O3 eq	1.70E-02	1.97E-03	7.31E-05	5.64E-03	2.46E-03	0.00E+00	0.00E+00	8.17E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.26E-06	0.00E+00	1.27E-04
Resource depletion - fossil fuels (1)	MJ surplus	3.57E-01	1.33E-02	2.52E-04	3.31E-02	4.05E-02	0.00E+00	0.00E+00	1.34E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.54E-05	0.00E+00	1.88E-03

Table 9: Scenario 2: Metal Plus Series Life Cycle Impact Assessment Results

Impacts Categories	Units	A1	A2	A3	A4-A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
Acidification (1)	kg SO2 eq	2.78E-03	7.24E-05	3.13E-06	2.06E-04	3.06E-04	0.00E+00	0.00E+00	3.71E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.93E-07	0.00E+00	4.90E-06
Eutrophication (1)	kg N eq	8.56E-04	5.29E-06	8.18E-07	1.48E-05	8.77E-05	0.00E+00	0.00E+00	1.86E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.41E-08	0.00E+00	7.23E-04
Global Warming (2,3)	kg CO2 eq	3.37E-01	6.73E-03	2.17E-03	1.68E-02	3.63E-02	0.00E+00	0.00E+00	4.45E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.80E-05	0.00E+00	5.86E-03
Ozone Depletion (1)	kg CFC-11 eq	4.91E-09	2.33E-11	1.34E-10	5.81E-11	5.14E-10	0.00E+00	0.00E+00	6.23E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.21E-14	0.00E+00	1.97E-11
Photochemical ozone formation (1)	kg O3 eq	1.70E-02	1.97E-03	7.31E-05	5.64E-03	2.46E-03	0.00E+00	0.00E+00	3.00E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.26E-06	0.00E+00	1.27E-04
Resource depletion - fossil fuels (1)	MJ surplus	3.57E-01	1.33E-02	2.52E-04	3.31E-02	4.05E-02	0.00E+00	0.00E+00	4.90E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.54E-05	0.00E+00	1.88E-03

According to the PCR, the life cycle inventory (LCI) shall be presented for resources used and output flows, waste categories and carbon removals and emissions.[1] The environmental parameters used for inventory analysis describes the use of renewable and non-renewable material resources, renewable and non-renewable primary energy and water.

The LCI results are presented in Table 10 and Table 11 for the Metal Plus Series.

Table 10: Scenario 1: Metal Plus series of Life Cycle inventory Impact Results

Resource use																	
Parameter	Unit	Production stage			Design and construction stage	Use and maintenance stage							End-of-Life stage			
		A1	A2	A3	A4-A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
RPR_E(4)	MJ, LHV	2.70E-01	1.77E-04	4.55E-02	4.41E-04	3.16E-02	0.00E+00	0.00E+00	1.04E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.73E-07	0.00E+00	2.89E-04
RPR_M(5)	MJ, LHV	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
PERT(6)	MJ, LHV	2.70E-01	1.77E-04	4.55E-02	4.41E-04	3.16E-02	0.00E+00	0.00E+00	1.04E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.73E-07	0.00E+00	2.89E-04
$NRPR_E$(7)	MJ, LHV	3.77E+00	9.53E-02	4.61E-03	2.38E-01	4.12E-01	0.00E+00	0.00E+00	1.36E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.54E-04	0.00E+00	1.47E-02
$NRPR_M$(8)	MJ, LHV	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
PENRT(9)	MJ, LHV	3.77E+00	9.53E-02	4.61E-03	2.38E-01	4.12E-01	0.00E+00	0.00E+00	1.36E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.54E-04	0.00E+00	1.47E-02
SM(10)	kg	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
RSF (11)	MJ, LHV	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
NRSF(12)	MJ, LHV	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
FW(13)	m³	3.21E-02	0.00E+00	1.59E-07	0.00E+00	3.21E-03	0.00E+00	0.00E+00	1.06E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Output Flows and Waste																	
HWD(14)	kg	6.46E-01	5.94E-05	4.43E-04	1.48E-04	6.46E-02	0.00E+00	0.00E+00	2.13E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.59E-07	0.00E+00	5.02E-04
NHWD(15)	kg	1.30E-01	8.85E-05	1.56E-04	2.21E-04	1.30E-02	0.00E+00	0.00E+00	6.23E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.36E-07	0.00E+00	6.46E-02
HLRW(16)	m³	1.32E-10	6.83E-15	7.81E-12	1.71E-14	1.40E-11	0.00E+00	0.00E+00	4.64E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.82E-17	0.00E+00	2.74E-13
ILLRW(17)	m³	6.11E-10	4.05E-14	6.10E-12	1.01E-13	6.18E-11	0.00E+00	0.00E+00	2.04E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-16	0.00E+00	1.48E-12
CRU(18)	kg	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
MR(18)	kg	0.00E+00	0.00E+00	1.36E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.07E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER(18)	kg	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
EE, (18)	MJ, LHV	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

Table 11: Scenario 2: Metal Plus series of Life Cycle inventory Impact Results

Resource use																	
Parameter	Unit	Production stage			Design and construction stage	Use and maintenance stage							End-of-Life stage			
		A1	A2	A3	A4-A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
RPRE(4)	MJ, LHV	2.70E-01	1.77E-04	4.55E-02	4.41E-04	3.16E-02	0.00E+00	0.00E+00	3.83E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.73E-07	0.00E+00	2.89E-04
RPRM(5)	MJ, LHV	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
PERT(6)	MJ, LHV	2.70E-01	1.77E-04	4.55E-02	4.41E-04	3.16E-02	0.00E+00	0.00E+00	3.83E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.73E-07	0.00E+00	2.89E-04
NRPRE(7)	MJ, LHV	3.77E+00	9.53E-02	4.61E-03	2.38E-01	4.12E-01	0.00E+00	0.00E+00	4.99E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.54E-04	0.00E+00	1.47E-02
NRPRM(8)	MJ, LHV	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
PENRT(9)	MJ, LHV	3.77E+00	9.53E-02	4.61E-03	2.38E-01	4.12E-01	0.00E+00	0.00E+00	4.99E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.54E-04	0.00E+00	1.47E-02
SM(10)	kg	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
RSF (11)	MJ, LHV	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
NRSF(12)	MJ, LHV	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
FW(13)	m³	3.21E-02	0.00E+00	1.59E-07	0.00E+00	3.21E-03	0.00E+00	0.00E+00	3.89E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Output Flows and Waste																	
HWD(14)	kg	6.46E-01	5.94E-05	4.43E-04	1.48E-04	6.46E-02	0.00E+00	0.00E+00	7.82E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.59E-07	0.00E+00	5.02E-04
NHWD(15)	kg	1.30E-01	8.85E-05	1.56E-04	2.21E-04	1.30E-02	0.00E+00	0.00E+00	2.28E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.36E-07	0.00E+00	6.46E-02
HLRW(16)	m³	1.32E-10	6.83E-15	7.81E-12	1.71E-14	1.40E-11	0.00E+00	0.00E+00	1.70E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.82E-17	0.00E+00	2.74E-13
ILLRW(17)	m³	6.11E-10	4.05E-14	6.10E-12	1.01E-13	6.18E-11	0.00E+00	0.00E+00	7.49E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-16	0.00E+00	1.48E-12
CRU(18)	kg	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
MR(18)	kg	0.00E+00	0.00E+00	1.36E-10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E-09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER(18)	kg	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
EE, (18)	MJ, LHV	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): Calculated as per Traci v.2 methodology and OpenLCA v 1.11.

(2): GWP 100a, excludes biogenic CO_2 removals and emissions associated with biobased products and packaging; 100-year time horizon GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5). Results of biogenic carbon are presented in a separate line.

(3): Global warming potential without biogenic carbon.

(4): **RPR_E** = RPRT - RPR_M, where RPRT(6) is equal to the value for renewable energy obtained using the CED LHV.

(5): RPR_M, is calculated by multiplying the mass (kg) of the material input (or its components) by the net calorific value (lower heating value) (MJ/kg) of this input as per ACLCA ISO 21930 Guidance [9]. In the calculation of RPR_M, packaging materials were included.

(7): **$NRPR_E$** = NRPRT - $NRPR_M$, where NRPRT(9) is equal to the value for non-renewable energy obtained using the CED LHV methodology.

(8): $NRPR_M$, is calculated by multiplying the mass (kg) of the material input (or its components) by the net calorific value (lower heating value) (MJ/kg) of this input as per ACLCA ISO 21930 Guidance [9]. In the calculation of $NRPR_M$, packaging materials were included.

(10): Calculated as per ACLCA ISO 21930 Guidance [9], 6.5 Secondary material, SM: There is SM involved in the MF Paints manufacturing process.

(11): Calculated as per ACLCA ISO 21930 Guidance [9], 6.6 Renewable secondary fuels, RSF: There is no RSF involved in the MF Paints manufacturing process.

(12): Calculated as per ACLCA ISO 21930 Guidance [9], 6.7 Non-renewable secondary fuels, NRSF: There is no NRSF involved in the MF Paints manufacturing process.

(13): There is no water used in the MF Paints manufacturing process. Water mentioned comes from the upstream process.

(14): Calculated from life cycle inventory results, based on datasets marked as "hazardous."

(15): Calculated from life cycle inventory results, based on waste marked as "non-hazardous."

(16): Calculated as per ACLCA ISO 21930 Guidance [9], 10.3 High-level radioactive waste, conditioned, to final repository. It should be noted that the MF Paints manufacturing process does not generate any HLRW (High-level radioactive waste), e.g., "when generated by electricity production, consists mostly of spent fuel from reactors." (ISO 21930:2017, clause 7.2.14).

(17): Calculated as per ACLCA ISO 21930 Guidance [9], 10.4 Intermediate- and low-level radioactive waste, conditioned, to final repository. It should be noted that the MF Paints manufacturing process does not generate any ILLRW (Low- and intermediate-level radioactive wastes), e.g., when generated by electricity production, arise mainly from routine facility maintenance and operations (ISO 21930:2017, clause 7.2.14).

(18): Reused components (CRU), materials for energy recovery (MER), exported energy (EE) are nil in this analysis. Materials for recycling (MR) was accounted for.

5 LCA: INTERPRETATION

The aim of this section is to present more details on the contribution to the impacts and resource use of the different life cycle modules of Metal Plus Series products studied.

The analysis shows that the raw material manufacturing module (A1) and replacement module (B4) are the major contributors of the environmental impacts for all impacts categories. For scenario 1, the impact of module A1 is between 13% and 22% of the total impacts while the impacts of replacement module represent 75% of the total impacts for all impact categories as the paint product was replaced three (3) times in 60 years (Figure 4). In the case of scenario 2, the impact of module A1 is between 4% to 7% of the total impacts while the impacts of replacement module represent 92% of the total impacts for all impact categories as the paint product was replaced 11 times in 60 years (Figure 5).

Figure 4: Scenario 1: Contribution of each life cycle stage of Metal Plus Series paints.

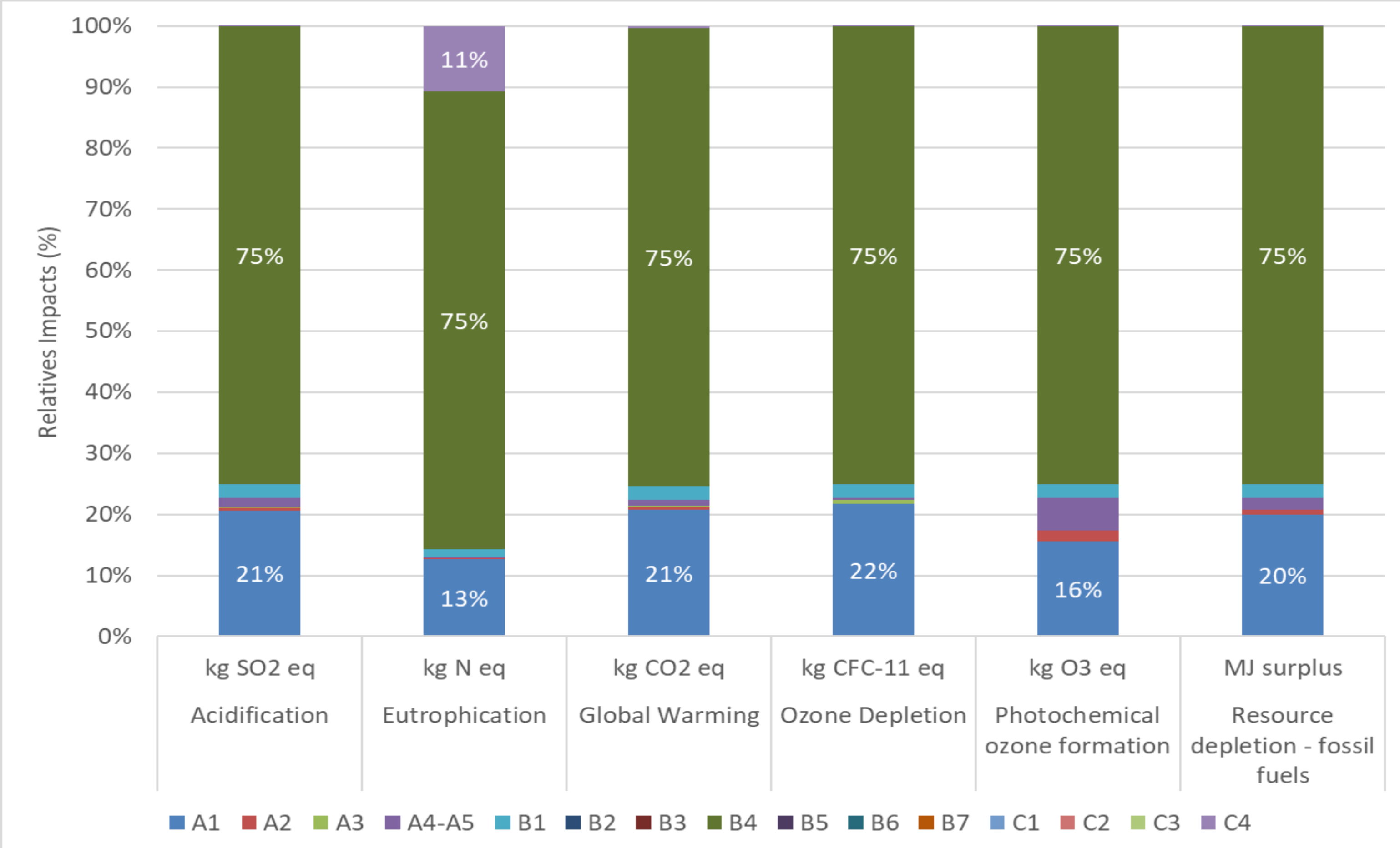
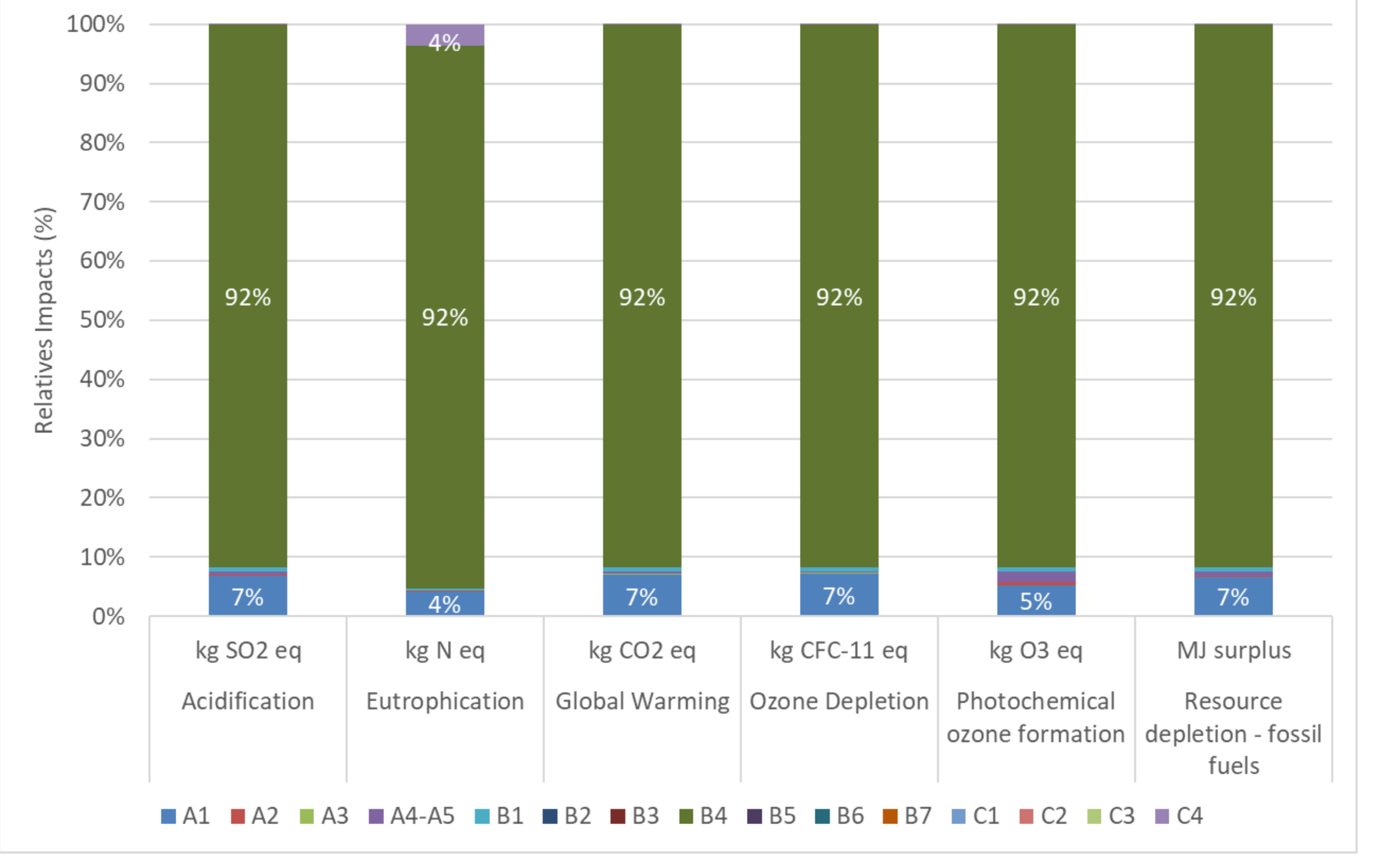


Figure 5: Scenario 2: Contribution of each life cycle stage of Metal Plus Series paints.



6 Additional Environmental Information

6.1 ENVIRONMENTAL ACTIVITIES AND CERTIFICATION

In addition, MF Paints has engaged in a third-party preparer (Green Seal company) to prepare the Health Product Declaration (HPD) for their paint products.

6.2 EXTRAORDINARY EFFECTS

There are no extraordinary effects for MF Paints products.

7 References

[1] NSF International, Product Category Rule for Environmental Product Declaration: Architectural Coatings. Extended 12 months per PCR Ext 2023-105 through June 30, 2024.

[2] ISO 14025, "Environmental labels and declarations - Type III environmental declarations - Principles and procedures." 2006.

[3] ISO 21930:2017 (E), "Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services." 2017.

[4] ISO 14044/Amd1 2017/Amd2 2020 "Environmental management - Life cycle assessment - Requirements and guidelines." 46 pp, 2006.

[5] OpenLCA, "https://www.openlca.org/?s=version+1.11," [Online]. [Accessed 18 08 2023].

[6] MF Paints, "https://www.peinturesmf.com/en/data-sheets/." [Online]. [Accessed 18 03 2024].

[7] Frischknecht R, "Overview and Methodology. ecoinvent report No. 1.," Swiss Centre for Life Cycle Inventories, Dübendorf, (2007).

[8] U.S. Life Cycle Inventory Database, "https://www.lcacommons.gov/nrel/search," National Renewable Energy Laboratory, 2012., (2012). [Online]. [Accessed 16 02 2021].

[9] American Center for Life Cycle Assessment (ACLCA), "ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930;2017," 2019.

[10] ASTM Program Operator Rules. Version: 8.0, Revised 04/29/20

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