Laurentide re/sources

Boomerang
Interior recycled latex paints

Environmental Product Declaration

This document constitutes the Environmental Product Declaration (EPD) of **Laurentide re/sources' white and coloured recycled latex paint manufactured in Quebec, Canada** This EPD was developed in compliance with CAN/CSA-ISO 14025, ISO 21930 and has been verified by Lindita Bushi, Athena Sustainable Materials Institute.

This **cradle-to-gate with options** EPD presents the life cycle assessment (LCA) results for raw material supply, transport and manufacturing stages as well as downstream stages such as the transport to the application site, use, maintenance and end-of-life management of paint and packaging. The LCA and EPD was performed by Groupe AGÉCO.

For more information about Laurentide re/sources, please go to www.peintureboomerang.com.

Issue date: 19th January 2018

ENVIRONMENTAL PRODUCT DECLARATION

This environmental product declaration (EPD) for recycled latex paints is in accordance with CAN/CSA-ISO 14025 and ISO 21930. EPDs within the same product category but from different programs may not be comparable. This EPD reports environmental impacts based on established life cycle impact assessment methods. The reported environmental impacts are estimates, and their level of accuracy may differ for a particular product line and reported impact. LCAs do not generally address site-specific environmental issues of related to resource extraction or toxic effects of products on human health. Unreported environmental impacts include (but are not limited to) factors attributable to human health, land use change and habitat destruction. EPDs do not report product environmental performance against any benchmark.

Program operator	CSA Group 178 Rexdale Blvd, Toronto, ON, Canada M9W 1R3 www.csagroup.org
Product	Boomerang – Interior recycled latex paints
EPD registration number	1761-3445
EPD recipient organization	Laurentide re/sources 345, rue Bulstrode, Victoriaville, Quebec, Canada G6T 1P7 www.peintureboomerang.com
Reference PCR	2012:01 Construction products and construction services (version 2.2), CPC code: 3511 The International EPD® System Valid until March 3, 2019
Date of issue (approval)	January 19, 2018
Period of validity	January 19, 2018 – January 18, 2023

The PCR review was conducted by:	Martin Erlandsson (IVL Swedish Environmental Research Institute)
The LCA was performed by:	Groupe AGÉCO www.groupeageco.ca
This EPD and related data were independently verified by an external verifier, Lindita Bushi, according to CAN/CSA-ISO 14025:2006 and ISO 21930:2007.	__ Internal _x_ **External** Lindita Bushi ______________________ Lindita Bushi, Ph.D. Athena Sustainable Materials Institute 119 Ross Avenue, Suite 100, Ottawa, Ontario, Canada K1Y 0N6 lindita.bushi@athenasmi.org www.athenasmi.org

Boomerang interior recycled latex paint

Environmental Product Declaration Summary Sheet

This is a summary of the environmental product declaration (EPD) describing the environmental performance of **Boomerang, an interior recycled latex paint** manufactured by **Laurentide re/sources** in Quebec, Canada.

EPD commissioner and owner	Period of validity	Program operator and registration number	Product Category Rule	LCA and EPD consultants
Laurentide re/sources	January 19, 2018 to January 18, 2023	CSA Group 1761-3445	Construction products and construction services v.2.2 (2017)	Groupe AGÉCO

Product description

White and coloured recycled latex paint for indoor application.

Declared unit

1 m^2 of interior coated surface with recycled latex paint for residential and commercial building applications using two coats for an opacity of 99%

Material content (% of total product mass)

	Coloured paint	White paint
Recycled paint:	92.15%	45.15%
Virgin paint:	0%	47.0%
Thickener:	2.5%	2.5%
Soda ash:	5.0%	5.0%
Biocide:	0.35%	0.35%

Life cycle stages included:

Raw material supply (A1), raw material transport (A2), manufacturing (A3), transport to site (A4), installation (A5) and end-of-life management (C2-C4) stages.

What is a Life Cycle Assessment (LCA)?

LCA is a science-based and internationally recognized tool to evaluate the relative potential environmental and human health impacts of products and services throughout their life cycle, beginning with raw material extraction and including all aspects of transportation, production, use, and end-of-life treatment. The method is defined by the International Organization for Standardization (ISO) 14040 and 14044 standards.

Why an Environmental Product Declaration (EPD)?

Laurentide is seeking to communicate its environmental performance to clients and to position its products through a rigorous and recognized approach, an EPD. By selecting products with an EPD, building projects can earn credits towards the Leadership in Energy and Environmental Design (LEED) rating system certification. In the latest version of the program (LEED v4), points are awarded in the Materials and Resources category.

This EPD summary provides an overview of the full ISO 14025 compliant EPD registered with CSA Group.

Boomerang interior recycled latex paint

Environmental Product Declaration Summary Sheet

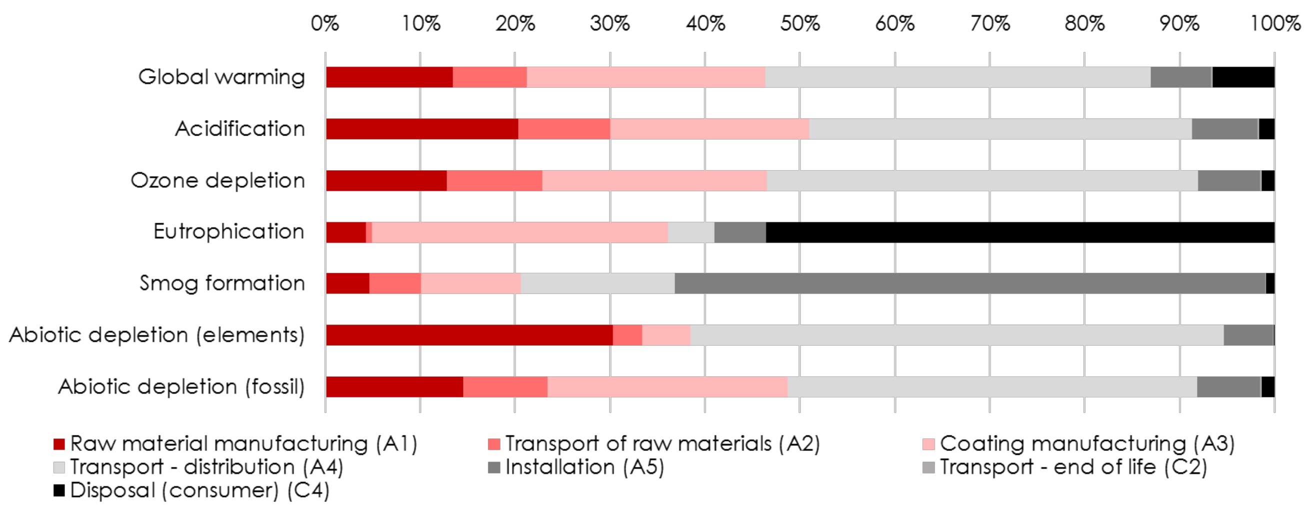
Environmental impacts

The environmental impacts of interior recycled latex paint used **to cover 1 square meter (m^2) of surface in residential and commercial buildings** are summarized below for the main environmental indicators (based on life cycle impact assessment methods TRACI 2.1). Refer to the LCA report or full EPD for more detailed results.

Indicators	Coloured recycled latex paint	White recycled latex paint
Global warming (kg CO_2 eq.)	0.28	0.53
Ozone depletion (kg CFC-11 eq.)	5.30×10^{-8}	8.23×10^{-8}
Acidification of land and water (kg SO_2 eq.)	1.05×10^{-3}	2.70×10^{-3}
Eutrophication (kg N eq.)	4.30×10^{-3}	4.82×10^{-3}
Smog formation (kg O_3 eq.)	4.35×10^{-2}	5.89×10^{-2}
Depletion of abiotic resources (elements) (kg Sb eq.)	2.11×10^{-6}	3.19×10^{-6}
Depletion of abiotic resources (fossil) (MJ)	3.94	7.25

Relative contribution of each life cycle stage to the overall environmental impacts (for coloured paint)

See the full EPD for a more detailed graphical representation of the results for coloured and white paint.



Additional environmental information

Boomerang products are **made of post-consumer paints** and are packaged in **containers with 100% recycled content and 100% recyclable plastics**. On average, Boomerang paints contain **43 grams of VOC per liter** which is in conformity with national standards and LEED requirements. The VOC content was measured according to EPA 24 and ASTM D-2369 standard methods. It is important to note that these products are made from post-consumer paints with various VOC contents that would have otherwise been landfilled. **In 2016, Laurentide re/sources picked up 8 million kg of residues made of paint and containers of which 82% was recycled and thus, diverted from landfills.**

For more information: www.peintureboomerang.com

1. Description of Laurentide re/sources

Laurentide re/sources is Canada's leader in the recycling of paints, stains and varnishes. Located in Victoriaville, Quebec, this division of Société Laurentide is committed to find solutions to reduce the environmental risks posed by post-consumer materials. The company ensures the sorting, management, recycling, reuse and recovery of these materials. Thanks to the cooperation of municipalities, Eco-Peinture and large retail chains, the company was able to establish an innovative leftover paint collection network in all Quebec regions. In 2016, Laurentide re/sources picked up 8 million kg of residues made of paint and containers of which 82% was recycled. While recycling is a major contribution to sustainability, the company also works relentlessly to make its products meet high environmental standards and ensure that they respond to current needs without compromising the ability of future generations to respond to their own needs.

In line with its sustainability policy, Laurentide re/source also proudly invests in the social and economic pillars of sustainability through philanthropic activities and the development of business opportunities with local suppliers.

2. Description of product

2.1. Definition and product classification

Boomerang interior recycled latex paints are classified under UN CPC Code 3511. They are made from unused recovered domestic paints and can be applied on most interior walls and ceilings to provide a durable, washable low-luster finish. While these products are available in a variety of ready-mixed colours, this EPD presents a separate profile for 2 products: **white and coloured paints**. Boomerang paints are manufactured in Quebec, Canada and are packaged in 3.78- and 18.9-liter cans. Cans are made from 100% recycled materials and 100% recyclable plastics.

The quantity of Boomerang paint needed to cover 1 m^2 of interior surface is presented in section 3.1. More information on Boomerang paints is available on the product's website: www.peintureboomerang.com.

2.2. Material content

The main ingredients of the two products (white and coloured paints) are presented in **Table 1**.

Table 1: Main ingredients for the production of recycled latex paints (coloured and white)

Materials	Weight %		Origin of raw materials	Average distance (km)	Transportation mode
	Coloured	White			
Recycled paint	92.15%	45.15%	Quebec, Canada	233	Truck
Virgin paint	-	47.0%	Quebec, Canada	100	Truck
Thickener	2.5%	2.5%	Canada or USA	1,207	Truck
Soda ash	5.0%	5.0%	Canada or USA	1,207	Truck
Biocide	0.35%	0.35%	Canada or USA	1,207	Truck

2.3. Production of recycled latex paint

Boomerang recycled latex paints are made from unused recovered domestic paint collected from municipalities and large retail chains. Steel and plastic cans collected with the unused paint are recycled while dry paint and other materials are landfilled by specialized companies. Upon their reception at Laurentide re/sources' fully automated facility, recovered paints are sorted and inspected to select only the reusable latex paint to be used in the final product. To guarantee the quality of Boomerang paints, virgin materials such as biocide, soda ash and thickener are also added to the mix, providing adequate and consistent performance to the finished product. After a filtration process, the finished recycled latex paints are packaged into 3.78- and 18.9-liter cans, ready to be shipped. Figure 1 illustrates the life cycle stages included in this EPD.

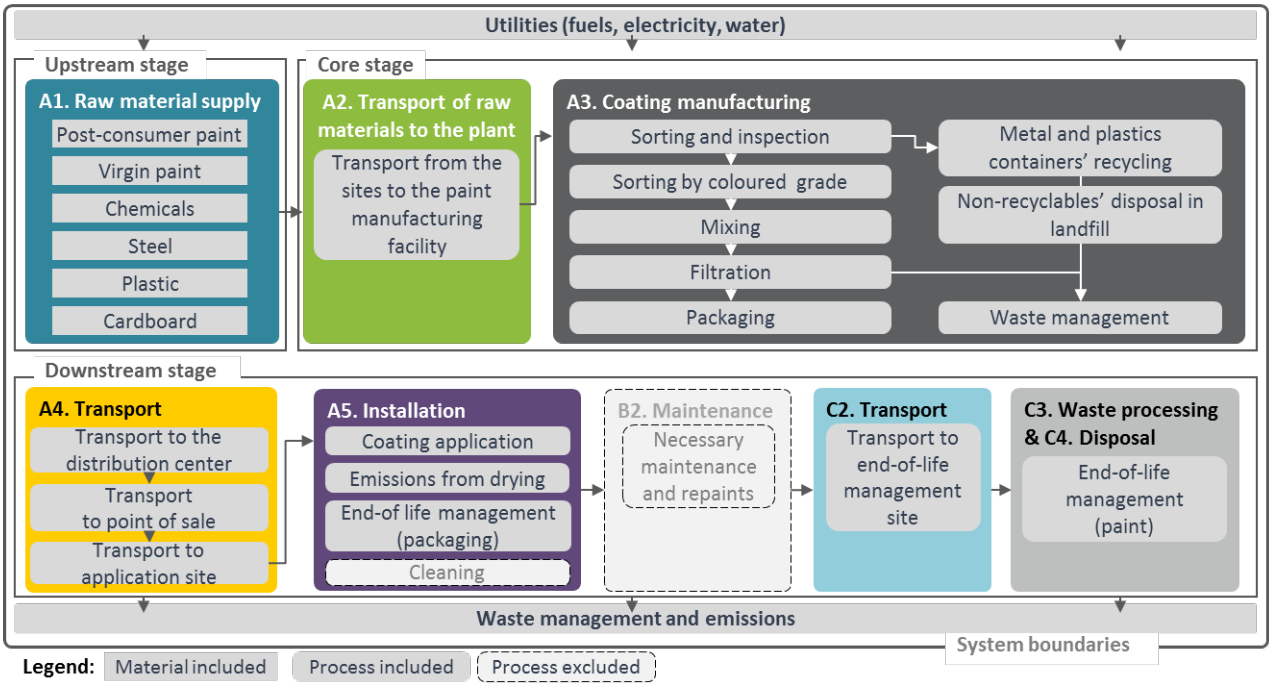


Figure 1: Process flow for the life cycle of recycled latex paint

3. Scope of EPD

3.1. Declared unit

A declared unit is used in lieu of a functional unit since this cradle-to-gate with options EPD does not include all of the life cycle stages (i.e. the maintenance stage is not considered). It is the reference unit on which the quantities of material inputs, energy inputs, emissions and waste are based for the modeling of the life cycle of Boomerang products. LCA results are also reported on the basis of this reference unit. The declared unit is defined as follows:

1 m² of interior coated surface with recycled latex paint for residential and commercial building applications using two coats for opacity of 99%

Two coats are recommended by Laurentide re/sources to achieve a better finish (i.e. 99% of opacity achieved). Therefore, **0.205 kg of paint is required to cover 1 m².**

Table 2 presents some properties of both coloured and white recycled latex paints.

Table 2: Parameters related to the properties of recycled latex paint

Parameter	Value	Source
Number of coats for one application	2	Laurentide re/sources
Coverage (m²/L)	12	
Paint density (kg/L)	1.23	

If one wants to calculate the results in terms of 1 m² of covered and protected substrate for a period of 60 years, Table 3 presents the performance data to consider.

Table 3: Performance criteria for recycled latex paint to cover and protect 1 m² of substrate over 60 years

Parameter	Data	Source	Note
Amount of paint required over a period of 60 years (number of repaints for maintenance) based on:			
Design life of 3 years (kg)	**4.10**	Calculated with specific data	20 repaints over 60 years (based on a 3-year RSL). It is assumed that repaints require 2 layers of coating.
Market-based lifetime of 5 years (kg)	**2.46**	Calculated with specific data	12 repaints over 60 years (based on a 5-year RSL). It is assumed that repaints require 2 layers of coating.

3.2. System boundaries

The upstream, core and downstream stages included in this cradle-to-gate with option EPD are shown in Table 4.

Table 4: Life cycle stages considered according to EN 15804

Upstream	Core		Downstream												Other environmental information
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	Manufacturing	Transport	Construction – installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction, demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	MND

Legend: *x* - Considered in the cradle-to-gate LCA *MND* - Module not declared

More precisely, the life cycle stages include the following processes:

A1. Raw Material Supply

This stage includes the extraction and processing of raw materials such as ingredients for paint manufacturing (biocide, soda ash and thickener) and recycling process of secondary materials such as plastic used to manufacture the paint containers, generation of electricity, extraction and refining of natural gas used in the manufacturing process. This stage also includes the manufacturing of virgin paint used to provide adequate and consistent performance to the white latex recycled latex paint.

A2. Transport of raw materials to the plant

All raw and secondary materials are transported from the suppliers to Laurentide re/sources. This stage also includes the post-consumer paint transfer from Quebec municipalities to the recycling site.

A3. Coating manufacturing

The automated recycling of latex paint requires energy and water. The first step consists of sorting and inspecting the paints, i.e. distinguish between oil-based paints (outside the scope), reusable latex paints and non-reusable latex paints. Following this step, the reusable latex paint containers are emptied based on their paint colour before they can be formulated and mixed. Empty metallic and plastic containers are compressed and transported to recycling facilities while paint wastes are transported to landfill sites. The newly mixed paints are then filtered afterwards to remove particles and comply with industry standards. Processed paints are packaged into 3.78- and 18.9-liter containers.

A4. Transportation to distribution center, to point of sale and application site

All packaged paints are transported from the plant to distribution centers and then to different points of sales (i.e. retailers) or directly to points of sale located all across Canada. When purchased the packaged paints are then delivered to the application site. This stage thus includes all the transportation done by truck and car from the plant to the application site.

A5. Installation: coating application, emissions from drying, end-of-life management of leftover paint and packaging

Once the paint product is delivered to the application site, it is applied to a substrate with a coating applicator. There is no energy required for this stage and processes associated with the production and cleaning of the coating applicator are excluded from this study. During the application and drying process, VOC emissions are released and these are accounted in this stage. As per NSF's PCR[1], it is assumed that leftover paint represents 10% of the wet mass of the coating purchased. The production, transport and waste processing and disposal of the leftover paint as well as the end-of life management of the paint containers are all considered in this stage (as per EN 15804). Paint containers are recycled at a rate of 50%[2] and 95% of leftover paints is recycled[3].

C2. Transportation to end-of-life management site

This stage includes the transportation by truck of leftover paint and primary packaging (i.e. plastic container) to the landfill sites or recycling facilities.

C3 & C4. Waste processing and disposal

Since the paint applied to the surface is rarely removed through chemical or mechanical means, but rather painted-over, it is assumed that it is all disposed at the landfill with the substrate material (i.e. covered surface) at the end of life of the latter.

3.3. Geographical and temporal boundaries

The geographical boundaries are representative of current equipment and processes associated with recycled latex paint manufacturing, use and disposal in Quebec (Canada). Since the data were collected for the years 2014 and 2016, they are considered temporally representative (i.e. less than 5 years old).

[1] There is a PCR for coatings developed by NSF International (PCR for Architectural Coatings, 2015) that is only applicable to virgin paints and therefore not applicable to the products included in this study. The scope of the PCR was confirmed by the program operator (NSF) and the chair of the PCR review panel. However, some of the assumptions reported in NSF's PCR were used to provide some coherence between EPDs.

[2] The recycling rate is based on data for the province of Quebec (where more than 80% of the studied paints are distributed). In 2008, 77,000 tonnes of paints were sold across the province and 1,396 tonnes of paint containers were collected at their end of life (RECYC-Québec, 2010). With the assumption that 1 kg of paint requires 0.04 kg of container, the calculated recycling rate is approximately 50% for paint containers.

[3] Of the 4,400 tonnes of paint residues (leftover) that could have been collected by recyclers in Quebec, 4,198 tonnes were actually collected (RECYC-Québec, 2010) This means that 95% of leftover paints has the potential to be recycled. With more the 80% of Laurentide re/sources' products sold in Quebec, it is assumed that this rate is representative of all paints sold by the company across the country.

4. Environmental impacts

This cradle-to-gate with options life cycle assessment has been conducted according to ISO 14040 and 14044 standards and the Product Category Rules for 2012:01 Product Category Rule (PCR) for Construction products and construction services, version 2.2 (The International EPD® System, 2017). Environmental impacts were calculated with the impact assessment method TRACI 2.1 and CML baseline 3.04. The description of these indicators reported are provided in the glossary (section 6).

4.1. Assumptions

The main assumptions included in this LCA were related to the average weight of containers for post-consumer paint collection, the average distance for post-consumer paint collection, the electricity consumption for virgin paint manufacturing, the ratio of polypropylene and steel in paint containers and the transportation mode and average load for raw materials and waste.

4.2. Criteria for the exclusion of inputs and outputs

Processes or elementary flows may be excluded if the life cycle inventory (LCI) data amounts to a minimum of 95% of total inflows in terms of mass and energy to the upstream and core module. All product components and production processes are included when the necessary information is readily available or a reasonable estimate can be made. Based on Groupe AGÉCO's past experience or the relatively low contribution of the life cycle stages to which they pertain, the following processes were excluded:

- Production, maintenance and disposal of machinery and buildings[4].
- Cleaning products.
- Containers for the post-consumer paint transport (reused at least 10 times).
- Employee commuting impacts.
- Research and development activities.
- Business travel.
- Any secondary packaging (e.g. pallets).
- Coating applicator.

4.3. Data quality

Data sources

Specific data were collected from Laurentide re/sources for operations occurring in the years 2014 and 2016 (less than 5 years old). **Generic data** collected for the upstream and downstream stages were representative of the Quebec context and technologies used.

The LCA model was developed with the SimaPro 8.3 software using ecoinvent 3.3 database which was released in 2016 (less than 1 year). Since most of the data within ecoinvent is of European origin and represent European industrial conditions and processes, several data were adapted to enhance their representativeness of the products and contexts being examined. ecoinvent is the most complete and recognized internationally LCA database.

Data quality

The overall data quality ratings show that the data used were either very good or good. This data quality assessment confirms the high reliability, representativeness (technological, geographical and time-related), completeness and consistency of the information and data used for this study.

[4] As per the PCR, the infrastructure, construction, production equipment and tools that are not directly consumed in the production process were also excluded.

4.4. Allocation

When a process in the life cycle of recycled latex paint generates coproducts or is directly connected to another system (i.e. the life cycle of another product), the following allocations methods were applied to distribute the impacts between the co-products or linked systems.

Allocation for energy consumption at Laurentide re/sources' facility

Since Laurentide re/source has other activities than paint recycling (e.g. oil and anti-freeze products, batteries and light bulbs collection) and energy data were obtained for the entire plant, a mass allocation based on the total production of the facility was used to calculate the electricity and natural gas consumption of the different activities.

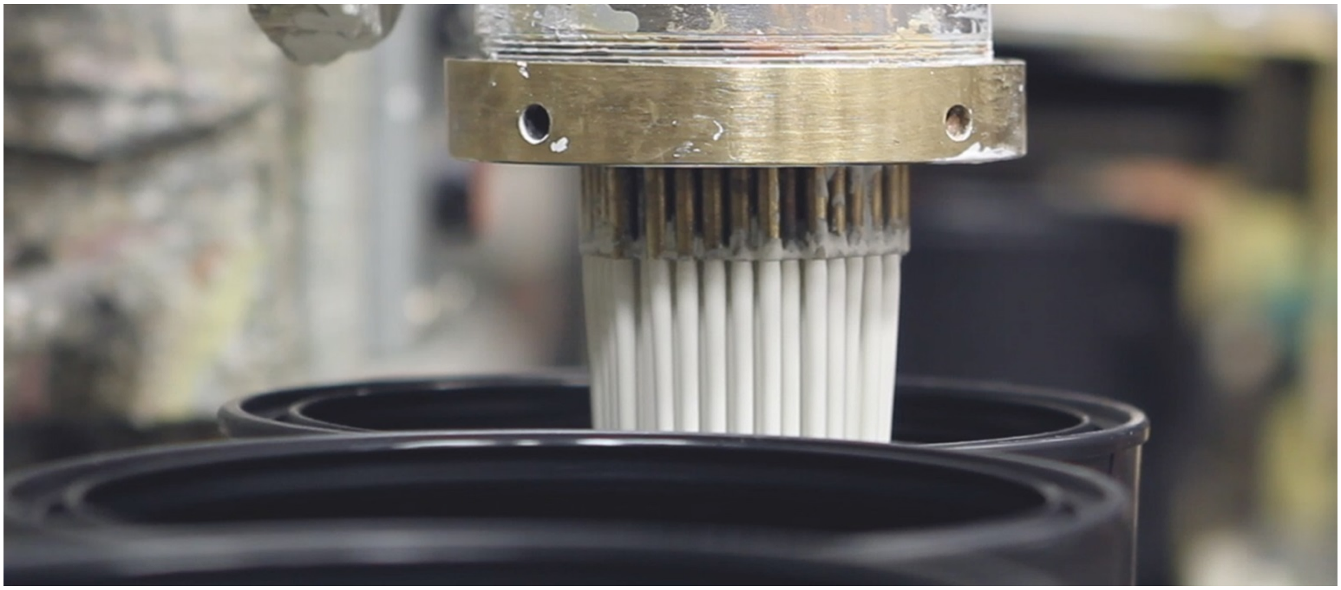
Allocation for recycling

Since Laurentide re/sources only processes steel and plastic as bundles to be sent in USA, the recycled content approach was used for the allocation related to plastic and steel recycling from post-consumer paint containers. No credit was calculated for subsequent recycling. Furthermore, Laurentide re/sources in only an intermediate step in the recycling process of these materials, hence no allocation is required.

The Polluter Pays (PP) allocation method (see section 6.5.5 in the PCR) is applied to allocate the environmental burdens associated with the use of recycled material (i.e. recycled paint).

ecoinvent processes with allocation

Many of the processes in the ecoinvent database also provide multiple functions, and allocation is required to provide inventory data per function (or per process). This study accepts the allocation method used by ecoinvent for those processes. The ecoinvent system model used was "Allocation, recycled content". It should be noted that the allocation methods used in ecoinvent for background processes (i.e. processes representing the complete supply chain of a good or service used in the life cycle of recycled paint) may be inconsistent with the approach used to model the foreground system (i.e. to model the manufacturing of recycled paint with data collected in the literature and from manufacturers). While this allocation is appropriate for foreground processes, continuation of this methodology into the background datasets would add complexity without substantially improving the quality of the study.



4.5. Life cycle impact assessment - results

The following tables show the results separately for coloured and white recycled latex paints for each life cycle stage analyzed. These results are for 1 m^2 of coated surface with recycled latex paint.

Table 5: Potential environmental impacts per m^2 of coated surface with recycled paint[5]

Potential environmental impacts	Stage	Coloured	White
Global warming - kg CO_2 eq	Upstream (raw material) (A1)	0.04	0.26
	Core (transport/manufact.) (A2-A3)	0.09	0.09
	Downstream (transport) (A4)[6]	0.11	0.11
	Downstream (installation) (A5)	0.02	0.05
	Downstream (end-of-life) (C2-C4)	0.02	0.02
	Total	0.28	0.53
Acidification - kg SO_2 eq	Upstream (raw material) (A1)	2.15×10^{-4}	1.63×10^{-3}
	Core (transport/manufact.) (A2-A3)	3.22×10^{-4}	3.80×10^{-4}
	Downstream (transport) (A4)[6]	4.23×10^{-4}	4.23×10^{-4}
	Downstream (installation) (A5)	7.24×10^{-5}	2.46×10^{-4}
	Downstream (end-of-life) (C2-C4)	1.91×10^{-5}	1.91×10^{-5}
	Total	1.05×10^{-3}	2.70×10^{-3}
Ozone depletion - kg CFC-11 eq	Upstream (raw material) (A1)	6.83×10^{-9}	3.30×10^{-8}
	Core (transport/manufact.) (A2-A3)	1.78×10^{-8}	1.79×10^{-8}
	Downstream (transport) (A4)[6]	2.40×10^{-8}	2.40×10^{-8}
	Downstream (installation) (A5)	3.43×10^{-9}	6.64×10^{-9}
	Downstream (end-of-life) (C2-C4)	8.36×10^{-10}	8.36×10^{-10}
	Total	5.30×10^{-8}	8.23×10^{-8}
Eutrophication - kg N eq	Upstream (raw material) (A1)	1.87×10^{-4}	1.14×10^{-3}
	Core (transport/manufact.) (A2-A3)	1.36×10^{-3}	7.32×10^{-4}
	Downstream (transport) (A4)[6]	2.09×10^{-4}	2.09×10^{-4}
	Downstream (installation) (A5)	2.35×10^{-4}	4.41×10^{-4}
	Downstream (end-of-life) (C2-C4)	2.30×10^{-3}	2.30×10^{-3}
	Total	4.30×10^{-3}	4.82×10^{-3}
Smog formation - kg O_3 eq	Upstream (raw material) (A1)	2.02×10^{-3}	1.48×10^{-2}
	Core (transport/manufact.) (A2-A3)	6.93×10^{-3}	7.84×10^{-3}
	Downstream (transport) (A4)[6]	7.05×10^{-3}	7.05×10^{-3}
	Downstream (installation) (A5)	2.70×10^{-2}	2.87×10^{-2}
	Downstream (end-of-life) (C2-C4)	4.36×10^{-4}	4.36×10^{-4}
	Total	4.35×10^{-2}	5.89×10^{-2}
Abiotic depletion (elements) - kg Sb eq	Upstream (raw material) (A1)	6.41×10^{-7}	1.60×10^{-6}
	Core (transport/manufact.) (A2-A3)	1.72×10^{-7}	1.76×10^{-7}
	Downstream (transport) (A4)[6]	1.18×10^{-6}	1.18×10^{-6}
	Downstream (installation) (A5)	1.10×10^{-7}	2.21×10^{-7}
	Downstream (end-of-life) (C2-C4)	3.98×10^{-9}	3.98×10^{-9}
	Total	2.11×10^{-6}	3.19×10^{-6}
Abiotic depletion (fossil fuels) - MJ	Upstream (raw material) (A1)	0.58	3.57
	Core (transport/manufact.) (A2-A3)	1.34	1.30
	Downstream (transport) (A4)[6]	1.70	1.70
	Downstream (installation) (A5)	0.26	0.62
	Downstream (end-of-life) (C2-C4)	0.06	0.06
	Total	3.94	7.25

[5] Values may not add up due to rounding.

[6] Transport to application site includes truck transportation and car transportation between the retailer and the application site.

Table 6: Use of resources per m² of coated surface with recycled paint[7]

Parameters	Stage	Coloured	White
Use of renewable primary energy excluding the renewable primary energy resources used as raw materials – MJ, net calorific value	Upstream (raw material) (A1)	0.05	0.51
	Core (transport/manufact.) (A2-A3)	0.19	0.16
	Downstream (transport) A4)	0.04	0.04
	Downstream (installation) (A5)	0.03	0.08
	Downstream (end-of-life) (C2-C4)	0.00	0.00
	Total	0.31	0.78
Use of renewable primary energy resources used as raw material - MJ, net calorific value	Upstream (raw material) (A1)	0	0
	Core (transport/manufact.) (A2-A3)	0	0
	Downstream (transport) A4)	0	0
	Downstream (installation) (A5)	0	0
	Downstream (end-of-life) (C2-C4)	0	0
	Total	0	0
Total use of renewable energy resources (primary energy and primary energy resources used as raw materials – MJ, net calorific value	Upstream (raw material) (A1)	0.05	0.51
	Core (transport/manufact.) (A2-A3)	0.19	0.16
	Downstream (transport) A4)	0.04	0.04
	Downstream (installation) (A5)	0.03	0.08
	Downstream (end-of-life) (C2-C4)	0.00	0.00
	Total	0.31	0.78
Use of non-renewable primary energy (excluding the non-renewable primary energy resources used as raw materials) – MJ, net calorific value	Upstream (raw material) (A1)	0.51	3.27
	Core (transport/manufact.) (A2-A3)	1.34	1.31
	Downstream (transport) A4)	1.70	1.70
	Downstream (installation) (A5)	0.26	0.62
	Downstream (end-of-life) (C2-C4)	0.06	0.06
	Total	3.87	6.96
Use of non-renewable primary energy resources used as raw material – MJ, net calorific value	Upstream (raw material) (A1)	0.07	0.30
	Core (transport/manufact.) (A2-A3)	0	0
	Downstream (transport) A4)	0	0
	Downstream (installation) (A5)	0	0
	Downstream (end-of-life) (C2-C4)	0	0
	Total	0.07	0.30
Total use of non-renewable energy resources (primary energy and primary energy resources used as raw materials) – MJ, net calorific value	Upstream (raw material) (A1)	0.58	3.57
	Core (transport/manufact.) (A2-A3)	1.34	1.31
	Downstream (transport) A4)	1.70	1.70
	Downstream (installation) (A5)	0.26	0.62
	Downstream (end-of-life) (C2-C4)	0.06	0.06
	Total	3.94	7.26
Use of secondary materials - kg	Upstream (raw material) (A1)	0.20	0.10
	Core (transport/manufact.) (A2-A3)	0	0
	Downstream (transport) A4)	0	0
	Downstream (installation) (A5)	0.02	0.01
	Downstream (end-of-life) (C2-C4)	0	0
	Total	0.22	0.11
Use of renewable secondary fuels - MJ	Upstream (raw material) (A1)	0	0
	Core (transport/manufact.) (A2-A3)	0	0
	Downstream (transport) A4)	0	0
	Downstream (installation) (A5)	0	0
	Downstream (end-of-life) (C2-C4)	0	0
	Total	0	0
Use of non-renewable secondary fuels - MJ	Upstream (raw material) (A1)	0	0
	Core (transport/manufact.) (A2-A3)	0	0
	Downstream (transport) A4)	0	0
	Downstream (installation) (A5)	0	0
	Downstream (end-of-life) (C2-C4)	0	0
	Total	0	0

[7] Values may not add up due to rounding.

Parameters	Stage	Coloured	White
Freshwater consumption - m^3	Upstream (raw material) (A1)	7.2×10^{-4}	4.6×10^{-3}
	Core (transport/manufact.) (A2-A3)	1.18×10^{-3}	1.04×10^{-3}
	Downstream (transport) A4)	4.56×10^{-4}	4.56×10^{-4}
	Downstream (installation) (A5)	2.22×10^{-4}	6.63×10^{-4}
	Downstream (end-of-life) (C2-C4)	5.92×10^{-5}	5.92×10^{-5}
	Total	2.63×10^{-3}	6.87×10^{-3}

Table 7: Waste generated per m² of coated surface with recycled paint[8]

Parameters	Stage	Coloured	White
Hazardous waste disposed[9] - kg	Upstream (raw material) (A1)	0	0
	Core (transport/manufact.) (A2-A3)	0.12	1.40
	Downstream (transport) A4)	0	0
	Downstream (installation) (A5)	0.01	0.16
	Downstream (end-of-life) (C2-C4)	0	0
	Total	0.13	1.56
Non-hazardous waste disposed - kg	Upstream (raw material) (A1)	0	0
	Core (transport/manufact.) (A2-A3)	0.07	0.03
	Downstream (transport) A4)	0	0
	Downstream (installation) (A5)	0.01	0.02
	Downstream (end-of-life) (C2-C4)	0.21	0.21
	Total	0.29	0.26
Radioactive waste disposed - kg	Upstream (raw material) (A1)	0	0
	Core (transport/manufact.) (A2-A3)	0	0
	Downstream (transport) A4)	0	0
	Downstream (installation) (A5)	0	0
	Downstream (end-of-life) (C2-C4)	0	0
	Total	0	0

4.6. Life cycle impact assessment - interpretation

Potential environmental impacts

As observed in Figure 2, for the white recycled latex paint, emissions from the **raw material manufacturing** are the main contributors to the impacts on climate change (50%), depletion of stratospheric ozone (40%), acidification of land and water (60%), abiotic depletion (elements) (50%) and abiotic depletion (fossil) (49%). The main impacts are coming from the **virgin latex paint** production (47% of the recycled white latex paint composition) and more particularly from pigment and plasticizer production. Virgin latex paint production represents between 20 and 53% of the raw material manufacturing impacts, regardless of the environmental impact category. The remaining impacts are due to soda ash, thickening, biocide and packaging (recycled PP) production. The second main contributor for 5 indicators out of 7 is the **transport of purchased paint to the application site** by consumers. The transport of the paint by car between the retailer and the application site is responsible for the majority of these impacts. **Coating manufacturing** is the third main source of impacts. Waste transportation (old containers and paint) by truck for disposal or recycling is the primary driver of the coating manufacturing impacts (38-86%), except for the eutrophication indicator for which the disposal of non-recyclable paint collected is the main contributor due to leaching from landfill into water. The same observation can be made to explain the high impact

8 Values may not add up due to rounding.

9 Contaminated water is considered under the hazardous waste category since it contains paint, a hazardous waste in many jurisdictions, including Canada. This is why values reported for this parameter may seem high.

of the disposal of paint at its end of life. For all the indicators assessed, the coating manufacturing step has less environmental impacts for the white paint than for the coloured paint since there is less recycled paint in the formulation. Thus, environmental impacts associated with the energy consumption due to the sorting stage contribute more to the environmental impacts associated with the production of the coloured recycled paint than those of the white recycled paint. For the smog formation indicator, **VOC emissions** released as a result of paint application represent 44% of the impacts covered by this indicator. Finally, the **transport of raw materials** represents between 1 to 13% of the total impact depending of the environmental category.

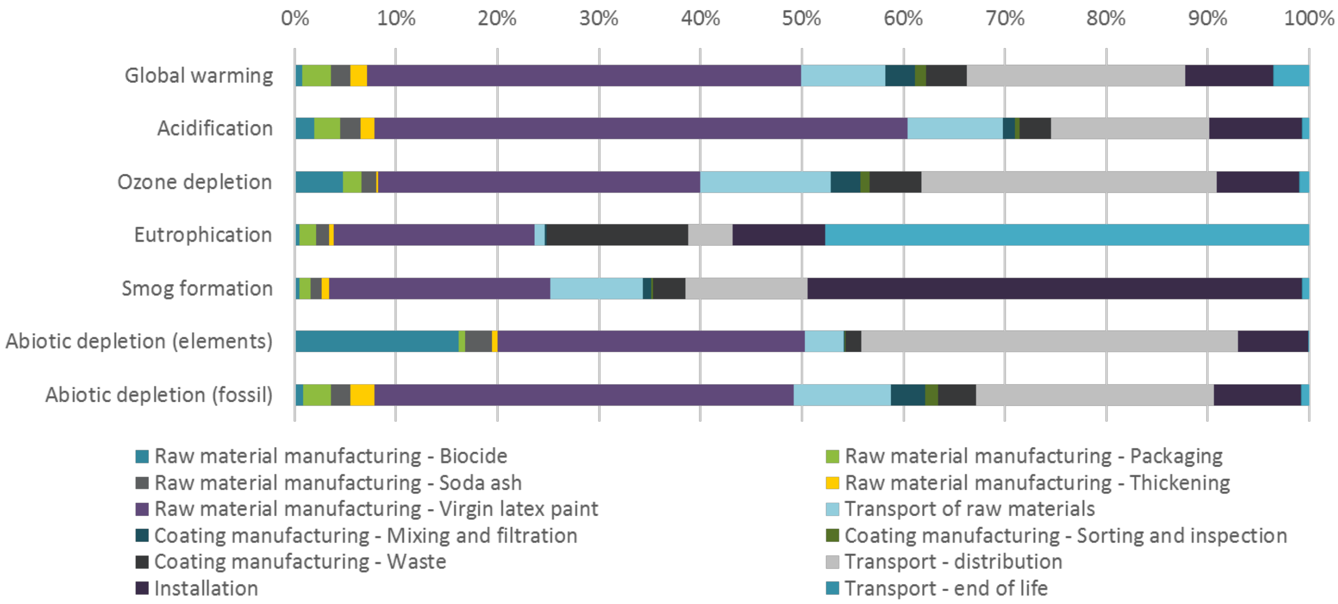


Figure 2: Relative contributions of the main processes in the production of recycled white paint

For the coloured recycled latex paint, the main source of impacts comes from the transportation of purchased paint to the application site for 5 indicators out of 7. Again, the transport of the paint by car between the retailer and the application site is responsible for the majority of these impacts. The second main contributor is the emissions generated by the **coating manufacturing** as they have significant impacts on climate change (25%), depletion of stratospheric ozone (24%), acidification of land and water (21%), eutrophication (31%) and abiotic depletion (fossil) (25%). The contribution of this stage is significant as there is no virgin paint in the formulation of the coloured paint. Thus, **1.5 kg of old paint** are transported and sorted to produce 1 kg of coloured recycled paint (vs. 1.3 kg for 1 kg of white recycled paint). The main contributors to this stage are **waste transportation** (old containers and paint wastes) by truck for disposal or recycling, **natural gas consumption** and **disposal of non-recyclable paint**, except for the eutrophication indicator for which the **disposal of non-recyclable paint collected** is the main contributor due to leaching from landfill into water. The same observation can be made to explain the high impact of the disposal of paint at its end of life. As there is no virgin latex paint added to the coloured recycled paint, raw material manufacturing stage only contributes to between 4 and 30% of the total impact. The main contributors to the raw material manufacturing stage are **soda ash**, **thickening, biocide** and **packaging** (recycled PP) production. For the smog formation indicator, **VOC emissions** released as a result of paint application represent 59% of the impacts covered by this indicator. Finally, the **transport of**

raw materials contributes to between 1 and 10% of the total impact depending of the environmental category.

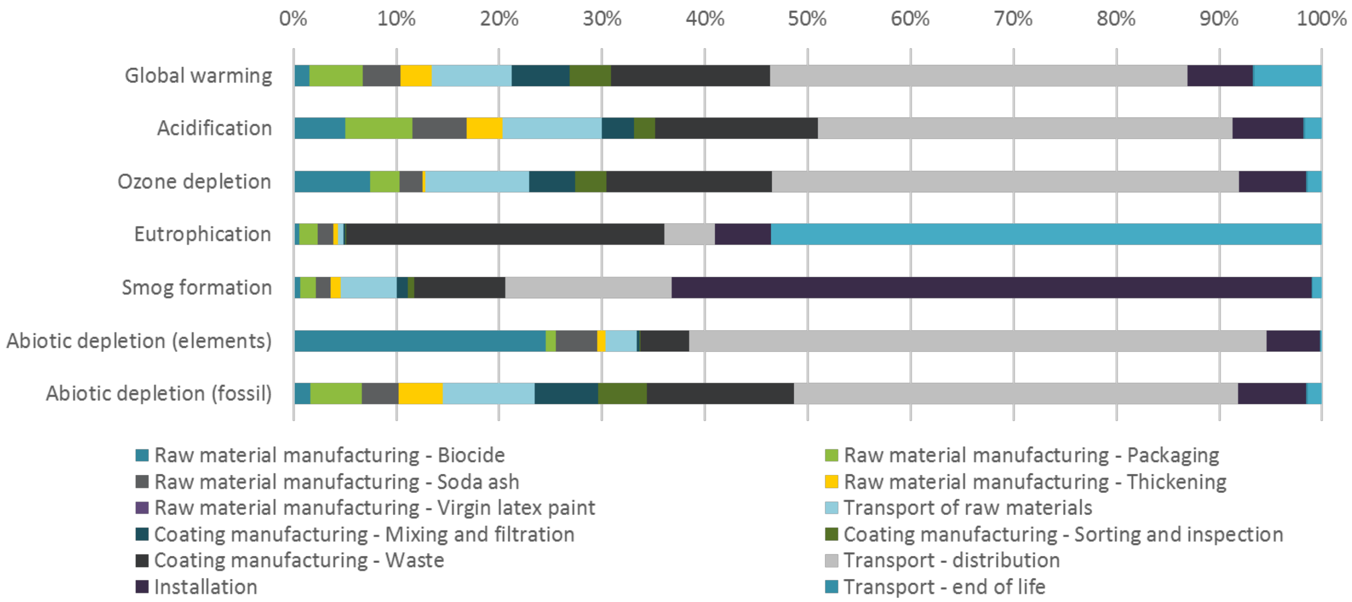


Figure 3: Relative contributions of the main processes in the production of recycled coloured paint

Use of resources indicators

Natural gas, coal (in the electricity grid mix) and petroleum are the main non-renewable energy resources used to **produce chemicals used in the virgin latex paint** (pigment and plasticizer) for the white recycled latex paint production. Natural gas is also used during the **coating manufacturing to heat the factory**. Crude oil is a raw material in **polyurethane resin** used in the production of virgin paint (for the white latex paint only) and in the production of the thickening agent for both the white and coloured latex paints. Crude oil is also a raw material in the **pigment** used in the production of virgin paint (for the white latex paint only).

Waste generation indicators

Hazardous wastes are mainly composed of contaminated water[10], paint sludge from old container wash and residues from paint filtration stages. Non-hazardous wastes mainly include plastic and steel wastes from old containers which are recycled. **It is important to note that Boomerang products are made from post-consumer paints and are therefore contributing to the diversion of leftover domestic paints (considered as hazardous waste) away from landfills.**

[10] See footnote #9 for more information on the inclusion of contaminated water.

5. Additional environmental information

Recycled content

Boomerang products are made of post-consumer paints (between 45.15% and 92.15%) and are packaged in containers with 100% recycled content and 100% recyclable plastics.

VOC content

On average, Boomerang paints contain 43 grams of VOC per liter which is in conformity with national standards and LEED requirements. The VOC content was measured according to EPA 24 and ASTM D-2369 standard methods. It is important to note that these products are made from post-consumer paints with various VOC contents that would have otherwise been landfilled.

Choice of the PCR

There is a PCR for coatings developed by NSF International (PCR for Architectural Coatings, 2015) that is only applicable to virgin paints and therefore not applicable to the products included in this study. While it is not clearly stated in the PCR that post-consumer paints are excluded from the scope, the program operator (NSF) and the chair of the PCR review panel confirmed this exclusion in the discussions we had together. Post-consumer recycled paints would call for different assumptions, durability tests and reporting requirements not covered in NSF’s PCR. For these reasons, we decided to use the generic PCR for Construction Products and Construction Services for Laurentide re/sources’ products instead of NSF’s PCR. However, some of the assumptions reported in NSF’s PCR were used to provide some coherence between EPDs. It is important to note that it is not possible to directly compare EPDs developed under these different PCRs.

6. GLOSSARY

6.1. Acronyms

CFC-11	Trichlorofluoromethane
CH_4	Methane
CO_2	Carbon dioxide
CSA	Canadian Standards Association
EPD	Environmental Product Declaration
eq.	Equivalent
GHG	Greenhouse gas
ISO	International Organization for Standardization
kg	kilogram
CFC 11	Trichlorofluoromethane
CO_2	Carbon dioxide
km	Kilometer
LCA	Life cycle assessment
LCI	Life cycle inventory
LEED	Leadership in Energy and Environmental Design
MJ	Megajoule
m^2	Square meter
m^3	Cubic meter
N	Nitrogen
NO_x	Nitrogen oxide
NSF	NSF International – program operator
PCR	Product Category Rules
O_3	Ozone
Sb	Antimony
SO_2	Sulfur dioxide
VOC	Volatile organic compound

6.2. Environmental impact categories and parameters assessed

The **acidification of land and water** refers to the change in acidity (i.e. reduction in pH) in soil and water due to human activity. The increase in CO_2 emissions and other air pollutants (e.g. NO_x and SO_2) generated by the transportation and manufacturing sectors are the main causes of this impact category. The acidification of land and water has multiple consequences: degradation of aquatic and terrestrial ecosystems, endangering numerous species and food security. The concentration of the gases responsible for the acidification is expressed in sulphur dioxide equivalents **(kg SO_2 equivalent).**

The **depletion of abiotic resources (elements/fossil)** measures the reduction of raw natural resources available (e.g. minerals, coal, crude oil, natural gas, uranium) due to their extraction from the earth's crust at a faster pace than their natural renewal. The production of electricity, heat and fuels are the main consumers of non-renewable resources. The depletion of minerals is expressed in units of kg of antimony equivalents according to concentration reserves and rate of de-accumulation **(kg Sb equivalent)**. The depletion of fossil fuels is expressed in megajoules on the basis of the net calorific value of the resources extracted **(MJ, net calorific value)**.

The **eutrophication potential** measures the enrichment of an aquatic or terrestrial ecosystem due to the release of nutrients (e.g. nitrates, phosphates) resulting from natural or human activity (e.g. the discharge of wastewater into watercourses). In an aquatic environment, this activity results in the growth of algae which consume dissolved oxygen present in water when they degrade and thus affect species sensitive to the concentration of dissolved oxygen. Also, the increase in nutrients is soils makes it difficult for the terrestrial environment to manage the excess of biomass produced. The concentration of nutrients causing this impact is expressed in nitrogen equivalents **(kg N equivalent)**.

Freshwater consumption accounts for the imbalance in the natural water cycle created by the water evaporated, consumed by a system or released to a different watershed (i.e. not its original source). This imbalance can cause water scarcity and affect biodiversity. Freshwater consumption refers to the waste of the resource rather than its pollution. Also, it does not refer to water that is used but returned to the original source (e.g. water for hydroelectric turbines, cooling or river transportation) or lost from a natural system (e.g. due to evaporation of rainwater). The quantity of freshwater consumed is expressed as a volume of water in meter cube **(m^3 of water consumed)**.

The **global warming potential** refers to the impact of a temperature increase on the global climate patterns (e.g. severe flooding and drought events, accelerated melting of glaciers) due to the release of greenhouse gases (GHG) (e.g. carbon dioxide and methane from fossil fuel combustion). GHG emissions contribute to the increase in the absorption of radiation from the sun at the earth's surface. These emissions are expressed in units of kg of carbon dioxide equivalents **(kg CO_2 equivalent)**.

The **ozone depletion** indicator measures the potential of stratospheric ozone level reduction due to the release of some molecules such as refrigerants used in cooling systems (e.g. chlorofluorocarbons). When they react with ozone (O_3), the ozone concentration in the stratosphere diminishes and is no longer sufficient to absorb ultraviolet (UV) radiation which can cause high risks to human health (e.g. skin cancers and cataracts) and the terrestrial environment. The concentration of molecules that are responsible of ozone depletion is expressed in kilograms of trichlorofluoromethane equivalents **(kg CFC 11 equivalent).**

The **smog formation** indicator covers the emissions of pollutants such as nitrogen oxides and volatile organic compounds (VOCs) into the atmosphere. They are mainly generated by motor vehicles, power plants and industrial facilities. When reacting with the sunlight, these pollutants create smog which can affect human health and cause various respiratory problems. The concentration of pollutants causing smog are expressed in kg of ozone equivalents **(kg O_3 equivalent)**.

The **renewable/non-renewable primary energy** parameters refer to the use of energy from renewable resources (e.g., wind, solar, hydro) and non-renewable resources (e.g., natural gas, coal, petroleum). The quantity of primary energy used is expressed in megajoules, on the basis of the net calorific value of the resources **(MJ, net calorific value).**

The **secondary material** parameter represents the quantity of recycled material used to produce a product **(kg)**.

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