EPD®

ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14025 for:

PLASTIC WASTE AND SCRAP RECYCLING
from **DENTIS RECYCLING ITALY S.R.L.**

DENTIS Recycling ITALY

PETALO
PET RECYCLING

Programme	**The International EPD® System** *www.environdec.com*
Programme operator	**EPD International AB**
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PROGRAMME INFORMATION

Programme
The International EPD® System

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Product category rules (PCR)
Plastic waste and scrap recovery (recycling) services, 2013:08, v. 2:12, UN CPC 8942

PCR review was conducted by
International EPD® System Technical Committee

Chair: Lars-Gunnar Lindfors

Contact at info@environdec.com

Independent third-party verification of the declaration and data, according to ISO 14025:2006:

- ☐ EPD process certification
- ◉ EPD verification

Third party verifier
Ugo Pretato, Studio Fieschi & soci s.r.l.

Approved by
The International EPD® System

Procedure for follow-up of data during EPD validity involves third party verifier:

- ☐ Yes
- ◉ No

An EPD should provide current information, and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com

The EPD owner has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programmes may not be comparable.

COMPANY AND SERVICE INFORMATION

Owner of the EPD
Dentis Recycling Italy S.r.l.
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DESCRIPTION OF THE ORGANISATION

Founded in 1987 as a small company operating in the field of the mechanical recycling of plastic industrial scrapes in Fossano (CN), **Dentis Recycling Italy is nowadays a multinational family-run business**, specialized in the **recovery and mechanical recycling of post-consumer PET packaging** coming from the Italian or European selected plastic waste collection circuits.

In 1994, Dentis started up its first recycling line with a PET bottles input capacity of 10,000 ton/y. In the end of 2001, the construction of a new plant in Sant'Albano Stura (CN), today the Group's headquarter, allowed to fourfold the input capacity up to the current one of 40,000 ton/y of PET bottles, equal to 1.4 billion PET bottles recycled in a year. In this way, Dentis is able to valorize an initial waste by transforming it into a new Secondary Raw Material as recycled PET flakes suitable for new PET based materials.

Focused on new challenges, in 2010s, Dentis expanded during a season of PET market growth through the acquisition of a recycling plant in Spain in 2013 (Pet Compania para su reciclado S.a.u.) and a second one in France in 2018 (Nord Pal Plast S.a.s.). Thanks to this innovation policy, since 2019 it has been possible to catch the ambitious goal of more than 150,000 tons of bottles recycled in the Group.

Dentis Recycling plant and process is certified according to ISO 14001:2015, ISO 9001:2015 and ISO 28000:2007 standards in order to ensure that the recovery process is carried out under proper environmental, health and safety management control as well as under an implemented quality management system and controlled supply chain. This system can guarantee a full traceability and quality control along the whole process, ranging from the PET plastic waste input to the **R-PET PETALO®** final products.

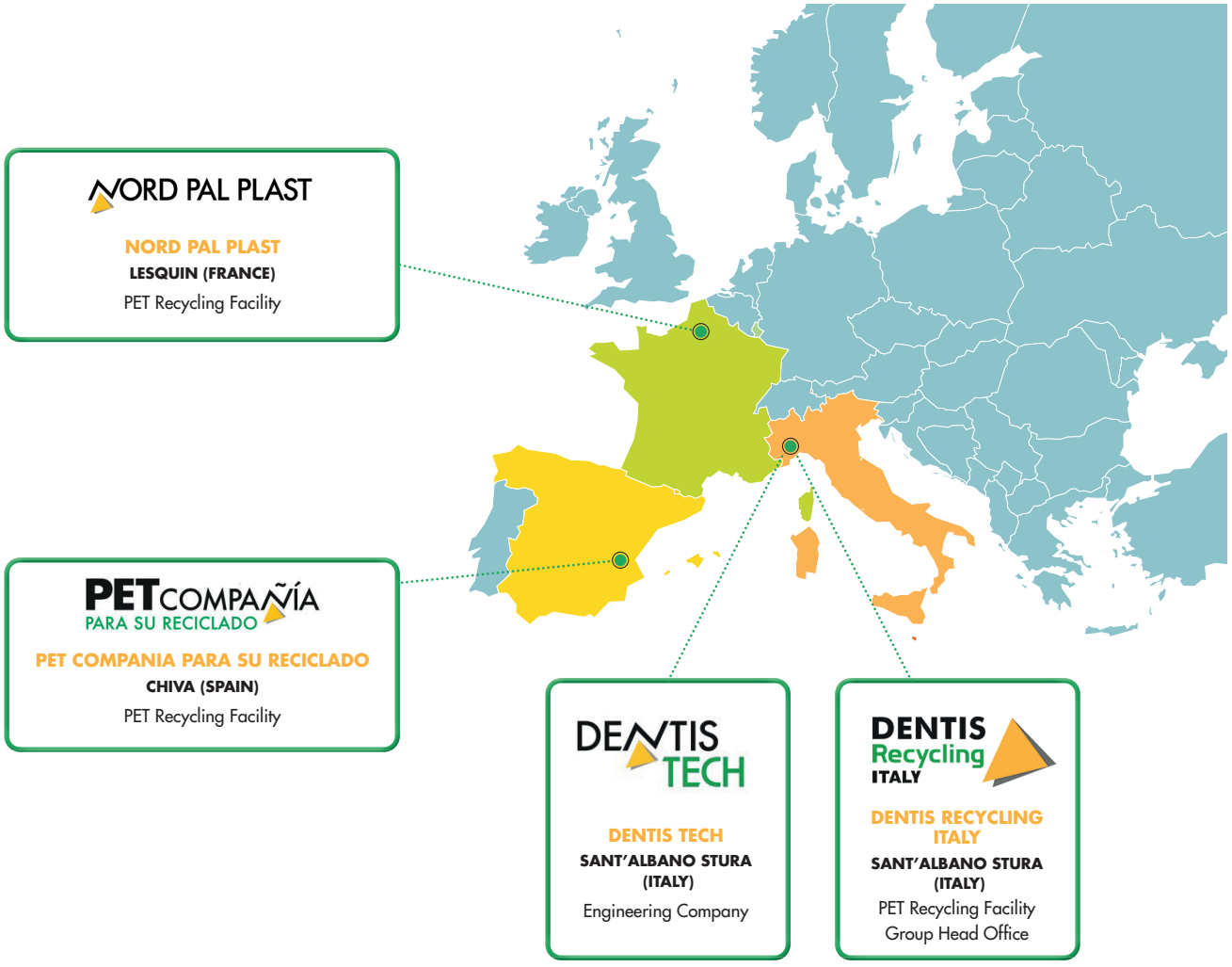
PRODUCTION SITES

Dentis Group has production sites in:

- ITALY DENTIS RECYCLING ITALY S.R.L. (Sant'Albano Stura – Cuneo)
- SPAIN PET COMPANIA PARA SU RECICLADO S.A.U. (Chiva - Valencia)
- FRANCE NORD PAL PLAST S.A.S. (Lesquin – Lille)

Dentis Group has also a specialized engineering company:

- ITALY DENTIS TECH S.R.L. (Sant'Albano Stura – Cuneo)



The system under study is the activity of plastic waste recycling by Dentis Recycling Italy S.r.l., in Sant'Albano Stura (CN), in Italy. The activity of the plant consists of mechanical recycling of post-consumer PET waste (ISIC-CPC classification: group 894, class 8942, ISIC code 3830 "Non-metal waste and scrap recovery (recycling) services, on a fee or contract basis").

The recycling process yield is 77.2% (calculated considering PETALO® and co-products).

PRODUCT INFORMATION

PETALO PET RECYCLING

PRODUCT NAME: PETALO®

Dentis R-PET product is known as PETALO®, available in five color shades as flakes (clear T100, light blue A200, multicolor MC300 and AV500, clear-light blue AT400) or as pellets (mainly by RPET clear flakes PETALO® T100), spread into the European market as a high-quality brand thanks to its homogenous crystallization and minimum contaminant content, i.e. a total maximum contamination of 60 ppm for first choice products and up to a maximum of 20 ppm for high quality products.

Today, PETALO® is widely used in a variety of applications, fully alternative to virgin PET or in mixture with it, such as fruit and ham/cheese trays or other general thermoforming applications, yarn for textiles and car interiors, fiber, injection-moulded compounds for furniture and packaging strapping.

Plastic waste input comes to Dentis Recycling Italy from sorting plants in Italy, and from other European countries, which process plastic waste collected through municipal waste collection services (98.98% of plastic waste input), and from selective collection of PET bottles, through Reverse Vending Machines (RVM) collection systems (1.02% of total waste input).

Due to the partially mixed composition of plastic waste input, the recycling process at Dentis Recycling Italy produces different outputs, according to their quality. The main products of the process are PETALO® flakes and pellets (top-quality R-PET) and R-PET by-products, such as unsorted R-PET flakes with impurity content higher than 60 ppm and with possible presence of metal scraps (classified as R-PET "MD"). The recycling process delivers also the following co-products that are sold on Italian and European markets: mixed milled polyolefin caps (called "TA") and R-PET fines (R-PET with very small particle size < 0.6 mm, called "PO").

The Quality management system fully ensures the quality control on the final products in order to evaluate the compliance to the internal Technical Data Sheet (Table 1) and to UNI 10667 standard about secondary raw material production. Indeed, the R-PET product is automatically and constantly sampled to have a statistical representativeness of each production lot and submitted to a full characterization according to the above mentioned UNI protocols.

Table 1 – PETALO® technical data sheet

Parameters	PETALO® HIGH QUALITY	PETALO® FIRST CHOICE
Origin of the material	100% Post consumer PET bottles	
Moisture Content (%)	≤ **0.6**	≤ **0.6**
Bulk Density (kg/m^3)	≥ **300**	≥ **300**
Intrinsic Viscosity (dl/g)	**0.72 ± 0.02**	**0.72 ± 0.02**
Flakes distribution (min - max) (mm)	**0.6 – 8.0**	**0.6 – 8.0**
CONTAMINANTS (PPM)		
PVC content	-	≤ **30**
Polyolefin content	-	≤ **10**
Metal content	≤ **5**	≤ **10**
Paper/Cellulose content	**Absent**	**Absent**
Other contaminants	-	≤ **10**
Inert (glass, wood..) content	**Absent**	**Absent**
Max Total Contaminants	≤ **20**	≤ **60**
PACKAGING		
PETALO® is packed in big-bags (material: PP, weight: 3 kg)		

In the mechanical recycling process carried out in the DENTIS RECYCLING ITALY S.r.l. plant of Sant'Albano Stura (CN), no Substances of Very High Concern (SVHC) included in the candidate list of ECHA are intentionally added and none of the "Candidate List substances" is contained in the final product in a concentration exceeding the 0.1 % w/w.

LCA INFORMATION

Functional unit / declared unit
Recycling of 1000 kg of plastic waste and scrap

Reference service life
Not applicable

Geographical scope
Europe

Time representativeness
The study is based on year 2019 data.

Database(s) and LCA software used
The study has been conducted using Simapro 9.1 software and the ecoinvent 3.6 LCI library.

System boundaries
Product environmental performance was assessed using Life Cycle Assessment (LCA), from the extraction of raw materials to the distribution of the finished products. The study was conducted in compliance with the ISO 14040 standard and the product category rules set forth in PCR 2013:08 v.2,01 PLASTIC WASTE AND SCRAP RECOVERY (RECYCLING) SERVICES, approved by the International EPD® System technical committee. Use phase of the recycled material is not included in the system boundaries.

Activities included in Upstream, Core and Downstream phases of Dentis Recycling Italy S.r.l. recovery process are illustrated in *Figure 1*.

Upstream activities include:

- The collection of post-consumer PET plastic waste in Italy and other European countries;
- Sorting of PET plastic waste from the plastic waste stream resulting from municipal collection systems (this step is not needed in case of PET bottle waste collected by RVM machines);
- The extraction of raw materials and the production of auxiliary materials used in the core module as follows: diesel for internal handling of PET bales and final R-PET products; chemicals used as additives to the mechanical recycling process and to the wastewater treatment; packaging materials used for the transport of R-PET and co/by-products;
- Transportation and waste treatment related to the activities mentioned before.

Core activities include:

- Activities at Dentis Recycling Italy production site:
  - Unloading and unpacking of PET plastic waste bales
  - Preliminary selection of PET materials through sieving of materials from unpacked bales
  - PET containers pre-washing with hot water
  - PET containers sorting (automatic and manual)
  - Wet grinding (to transform PET containers into flakes)
  - Flakes hot washing in alkali water solution
  - Separation of polyolefin caps by flotation
  - Flakes drying
  - Flakes automatic sorting (based on their quality) and metal detection
  - Flakes homogenization
  - Dust extraction
  - Packing in big-bags
- Transport of a fraction of flakes to extrusion plants (external suppliers)
- Pelletization of a fraction of flakes
- Transport of pellets back to Dentis

Downstream activities include:

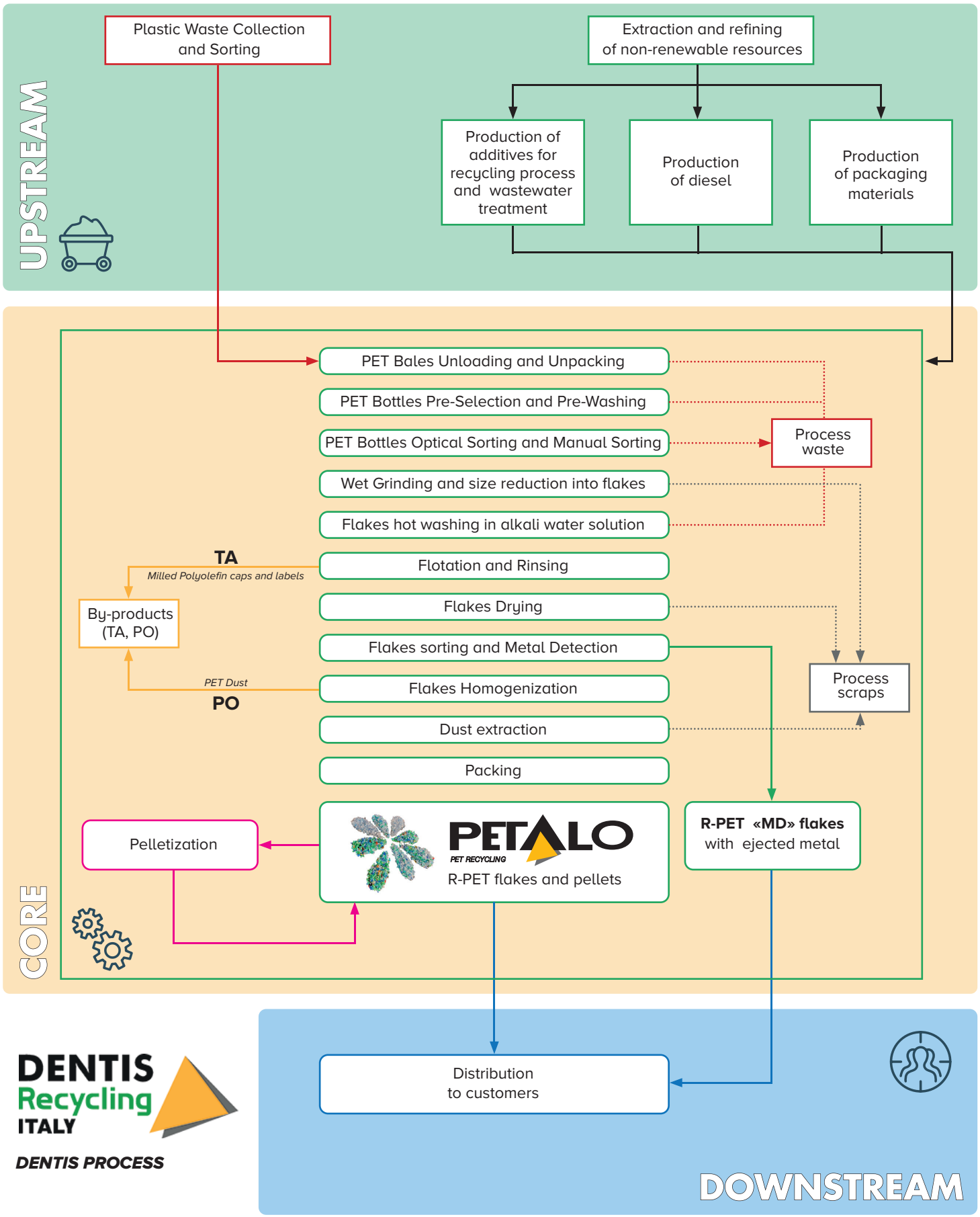
- Transportation of recycled plastic material to Dentis customers

Recycled material use phase is not included in the study.

No cut-off is applied to the inventory of the system studied.
No allocation has been applied to data of the foreground system, because the system boundaries include all the processes carried out at Dentis Recycling Italy production plant and includes all the products generated at its premises.

The study has been conducted by Valentina Castellani for Dentis Recycling Italy S.r.l.

Figure 1 - Life cycle of post-consumer PET plastic waste recycling by Dentis Recycling Italy



SERVICE ENVIRONMENTAL PROFILE

ENVIRONMENTAL PERFORMANCE

Potential environmental impact generated by recycling of 1.000 kg of plastic waste and scrap by Dentis Recycling Italy

PARAMETER		UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Global warming potential (GWP)	Fossil	kg CO_2 eq.	3.74E+02	4.11E+02	5.01E+01	**8.35E+02**
	Biogenic	kg CO_2 eq.	3.35E+01	2.07E+01	1.53E-02	**5.42E+01**
	Land use and land transformation	kg CO_2 eq.	3.16E-01	5.30E-02	1.77E-02	**3.86E-01**
	TOTAL	kg CO_2 eq.	4.08E+02	4.32E+02	5.01E+01	**8.90E+02**
Acidification potential (AP)		kg SO_2 eq.	1.62E+00	9.48E-01	2.28E-01	**2.79E+00**
Eutrophication potential (EP)		kg PO_4^{3-} eq.	2.55E-01	1.86E-01	3.45E-02	**4.75E-01**
Photochemical ozone formation potential (POFP)		kg NMVOC eq	1.92E+00	1.17E+00	2.76E-01	**3.37E+00**
Abiotic depletion potential Elements		kg Sb eq.	6.93E-03	3.17E-03	1.38E-03	**1.15E-02**
Abiotic depletion potential Fossil resources		MJ, net calorific value	5.23E+03	6.03E+03	7.53E+02	**1.20E+04**
Water scarcity potential		m^3 eq.	1.25E+02	1.47E+01	2.17E+00	**1.41E+02**

Use of resources by recycling of 1.000 kg of plastic waste and scrap by Dentis Recycling Italy

PARAMETER		UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Primary energy resources Renewable	Use as energy	MJ, net calorific value	8.79E+02	5.67E+01	1.09E+01	**9.46E+02**
	Used as raw material	MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
	TOTAL	MJ, net calorific value	8.79E+02	5.67E+01	1.09E+01	**9.46E+02**
Primary energy resources Non-renewable	Use as energy	MJ, net calorific value	5.74E+03	6.17E+03	7.69E+02	**1.27E+04**
	Used as raw material	MJ, net calorific value	2.20E+04*	0.00E+00	0.00E+00	**2.20E+04***
	TOTAL	MJ, net calorific value	2.77E+04	6.17E+03	7.69E+02	**3.47E+04**
Secondary material		kg	1.00E+03**	0.00E+00	0.00E+00	**1.00E+03****
Renewable secondary fuels		MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Non-renewable secondary fuels		MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Net use of fresh water		m^3	3.84E+00	5.31E+00	9.00E-02	**9.24E+00**

**energy content of the plastic waste input* ***main input of the recycling process*

WASTE PRODUCTION AND OUTPUT FLOWS

Waste generated by recycling of 1.000 kg of plastic waste and scrap by Dentis Recycling Italy

PARAMETER	UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Non-hazardous waste disposed	kg	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Radioactive waste disposed	kg	3.00E-02	1.00E-02	1.00E-02	**4.00E-02**

(The amount of wastes declared in the present table includes only the waste for which the treatment process is not included within the system boundaries)

Output flows generated by recycling of 1.000 kg of plastic waste and scrap by Dentis Recycling Italy

PARAMETER	UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Components for reuse	kg	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Materials for recycling	kg	0.00E+00	4.94E+01	0.00E+00	**4.94E+01**
Materials for energy recovery	kg	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Exported energy, electricity	MJ	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**
Exported energy, thermal	MJ	0.00E+00	0.00E+00	0.00E+00	**0.00E+00**

ENVIRONMENTAL IMPACT PER KG OF PETALO® R-PET

PARAMETER		UNIT	UPSTREAM	CORE	DOWNSTREAM	TOTAL
Global warming potential (GWP)	Fossil	kg CO_2 eq.	4.85E-01	5.32E-01	6.49E-02	**1.08E+00**
	Biogenic	kg CO_2 eq.	4.34E-02	2.68E-02	1.98E-05	**7.03E-02**
	Land use and land transformation	kg CO_2 eq.	4.09E-04	6.86E-05	2.29E-05	**5.00E-04**
	TOTAL	kg CO_2 eq.	5.29E-01	5.59E-01	6.49E-02	**1.15E+00**
Acidification potential (AP)		kg SO_2 eq.	2.09E-03	1.23E-03	2.95E-04	**3.62E-03**
Eutrophication potential (EP)		kg PO_4^{3-} eq.	3.30E-04	2.41E-04	4.47E-05	**6.16E-04**
Photochemical ozone formation potential (POFP)		kg NMVOC eq	2.49E-03	1.52E-03	3.57E-04	**4.37E-03**
Abiotic depletion potential Elements		kg Sb eq.	8.97E-06	4.11E-06	1.79E-06	**1.49E-05**
Abiotic depletion potential Fossil resources		MJ, net calorific value	6.77E+00	7.82E+00	9.75E-01	**1.56E+01**
Water scarcity potential		m^3 eq.	1.61E-01	1.90E-02	2.81E-03	**1.83E-01**

(Impacts are calculated applying allocation by mass)

REFERENCES

- General Programme Instructions of the International EPD® System. Version 3.01, 2019-09-18.
- PCR 2013:08. Plastic waste and scrap recovery (recycling) services. Version 2:12.
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- Castellani V., Life cycle Assessment (LCA) of plastic waste and scrap recycling by Dentis Recycling Italy, 2021.