RadiciGroup
High Performance Polymers' approach to sustainability: strategy and new products

HIGH PERFORMANCE POLYMERS

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RADICI GROUP

Agenda

- **Corporate carbon footprint and emission reduction targets**
  (20 min, Elisa Gelmi)

- **Latest new mechanically recycled and bio materials**
  (25 min, Riccardo Galeazzi, Erico Spini)

- **Q&A**

A Roadmap to Decarbonization

Index

- RadiciGroup **environmental sustainability milestones** so far
- **Drivers** to ambitious climate action
- Corporate Carbon Footprint - Setting a **baseline** for climate action
- Emissions Reduction Targets - Taking a science-based **commitment**
- CDP Disclosure - Public **reporting** on climate action
- **Scope 1 and 2** emissions reduction initiatives
- **Scope 3** emissions reduction initiatives
- Additional **resources** on climate action

RadiciGroup environmental sustainability milestones so far

RadiciGroup **commitment to environmental sustainability** is a longstanding one.

Several initiatives have contributed to **reduce RadiciGroup GHG emissions** over the years, across all emissions scopes.

These initiatives have been developed in the context of **certified environmental management systems** and they have been consistently subject to **transparent reporting**.

Learn more about RadiciGroup environmental achievements so far from our Sustainability Reports.

RadiciGroup environmental sustainability milestones so far

Emissions reduction initiatives over the years

RadiciGroup **Direct (scope 1) emissions** have been reduced by more than 70% between 2011 and 2020, thanks to significant investments on abatement systems in its chemical plants.

Electricity generated from renewables makes up more than 50% of the electricity mix of RadiciGroup and it keeps growing, also thanks to the partnership with Geogreen.

RadiciGroup has been developing its know-how for **polymer recycling** since 1981 and it offers today a wide portfolio of high performance recycled, bio-based and low carbon products.

Management systems and reporting

RadiciGroup obtained its first **ISO14001** environmental management system certification in 2003.

RadiciGroup released its first **Sustainability Report** in 2004. Since 2018, the Report has been certified according to GRI Standards.

After contributing to the establishment of the first Product category Rules (**PCRs**) for fibers and engineering polymers in 2013, RadiciGroup achieved the first **EPD** certifications for its products in 2015. Today RadiciGroup can offer the expertise of an in-house team of **LCA** experts.

Drivers to ambitious climate action

In the context of a growing focus on **climate change** as a material topic and top global risk, corporate and regulatory requirements, as well as customers' and consumers' expectations are now calling for **systematic climate action.**

In a context where…

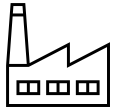
Climate change is defined as one of the "structural forces that will shape the materialization and **management of global risks** over the next decade" by the WEF Global Risks Report 2024[1].

Climate change and related extreme weather events are ranked as **top threats**, both in the short term (2 years) and long-term (10 years) time frames.

Drivers

Net Zero 2050 Goal by European Union

The EU law on climate established a legally binding objective to **net zero emissions of GHG by 2050**. This objective is leading to increasingly demanding regulations across all sectors.



Corporate Requirements

As part of its latest **materiality analysis** (2022), **RadiciGroup** identified «Climate Change & CO2 Emissions» as the material aspect with the highest financial impact.

Requests from Strategic Customers

Customers are interested in reducing emissions along their value chains. Companies are starting to include emissions performance among the criteria considered for supplier selection and purchasing decision-making.

https://www.weforum.org/publications/global-risks-report-2024/

Corporate Carbon Footprint - Setting a baseline for climate action

In 2023, **RadiciGroup High Performance Polymers Business Area** established a baseline for action by calculating its **Corporate Carbon Footprint** for year 2022 according with the **GHG Protocol**, including **for the first time Scope 3 emissions**. The scope of this CCF assessment includes **all the production sites, offices and warehouses** under the operational control of RadiciGroup High Performance Polymers.

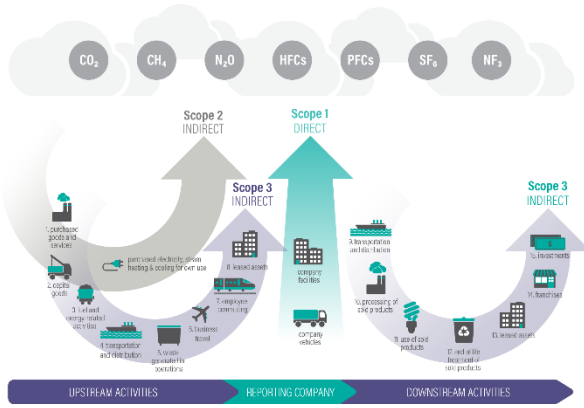
2022 GHG Emissions (tCO_2e)	
Scope 1	3.011
Scope 2 (Market- Based)	11.839
Scope 3	948.111
Total	**962.961**

RadiciGroup High Performance Polymers

- Radici Plastics Ibérica SL
- Radici Plastics (Suzhou) Co., Ltd.
- Radici Plastics India PVT. LTD.
- Radici Novacips SpA
- Radici Plastics GmbH
- Radici Plastics USA Inc.
- Radici Plastics Mexico S. de R.L. de C.V.
- Radici Plastics France SA
- Radici Plastics Ltda
- Radici Plastics UK LTD

The following Scope 3 categories have been included in the CCF assessment:

- Cat. 1 – Purchased goods and services
- Cat. 2 – Capital goods
- Cat. 3 – Fuel and energy related activities
- Cat. 4 – Upstream transportation and distribution
- Cat. 5 – Waste generated in operations
- Cat. 6 – Business travel
- Cat. 7 – Employee commuting
- Cat. 8 – Upstream leased assets
- Cat. 9 – Downstream transportation and distribution
- Cat. 12 – End of life treatment of sold products
- Cat. 15 – Investments



Emissions reduction targets | Taking a science-based commitment

As a tangible sign of its commitment to accelerate its decarbonization efforts, RadiciGroup High Performance Polymers Business Area has established **near-term emissions reduction targets**, which have been validated by the **Science Based Targets initiative (SBTi).**

Key Insight

- **Targets organizational boundary**

Targets have been set for Radici Novacips Spa, as parent company of the RG HPP Business Area. All the production sites, offices and warehouses under the operational control of RadiciGroup High Performance Polymers are included in the reporting perimeter.

- **Targets scope & ambition**

Near term targets have been set for all 3 scopes. Scope 1 and 2 target ambition has been classified as in line with a 1.5°C scenario.

- **SBTi Target Dashboard**

RG HPP emissions reduction targets are publicly available online on the SBTi target dashboard: [Companies taking action - Science Based Targets]

CDP Disclosure - Public reporting on climate action

Since 2022 RadiciGroup High Performance Polymers Business Area has been disclosing its progress towards environmental stewardship by responding to the **CDP Climate Change questionnaire**.

Key Insight

- **About CDP**

The CDP (formerly the Carbon Disclosure Project) is an international non-profit organization that helps companies and cities disclose their environmental impact. It aims to make environmental reporting and risk management a business norm, driving disclosure, insight, and action towards a sustainable economy.

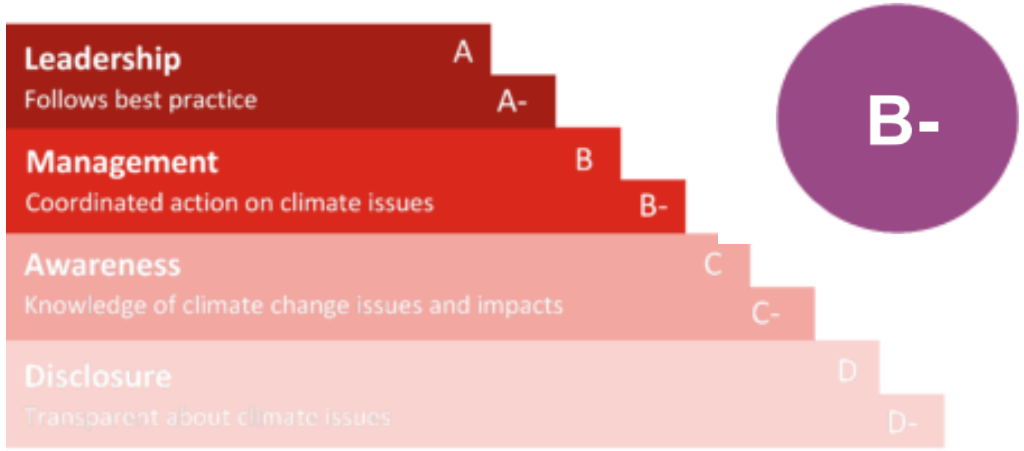
- **Why we disclose**

We value **transparency** as proof that our commitment to sustainability is serious. Furthermore, annual CDP disclosure helps us identify **continual improvement** opportunities for our sustainability strategy.

- **Our latest CDP score**

For its response to the to the Climate Change questionnaire in 2023, RadiciGroup High Performance Polymers received a **B-**, which is in the management band - demonstrating "***coordinated action on climate issues***".

Our CDP Score – Climate Change 2023



Leadership (A/A-): *Implementing current best practices*
Management (B/B-): *Taking coordinated action on climate issues*
Awareness (C/C-): *Knowledge of impacts on, and of, climate issues*
Disclosure (D/D-): *Transparent about climate issues*

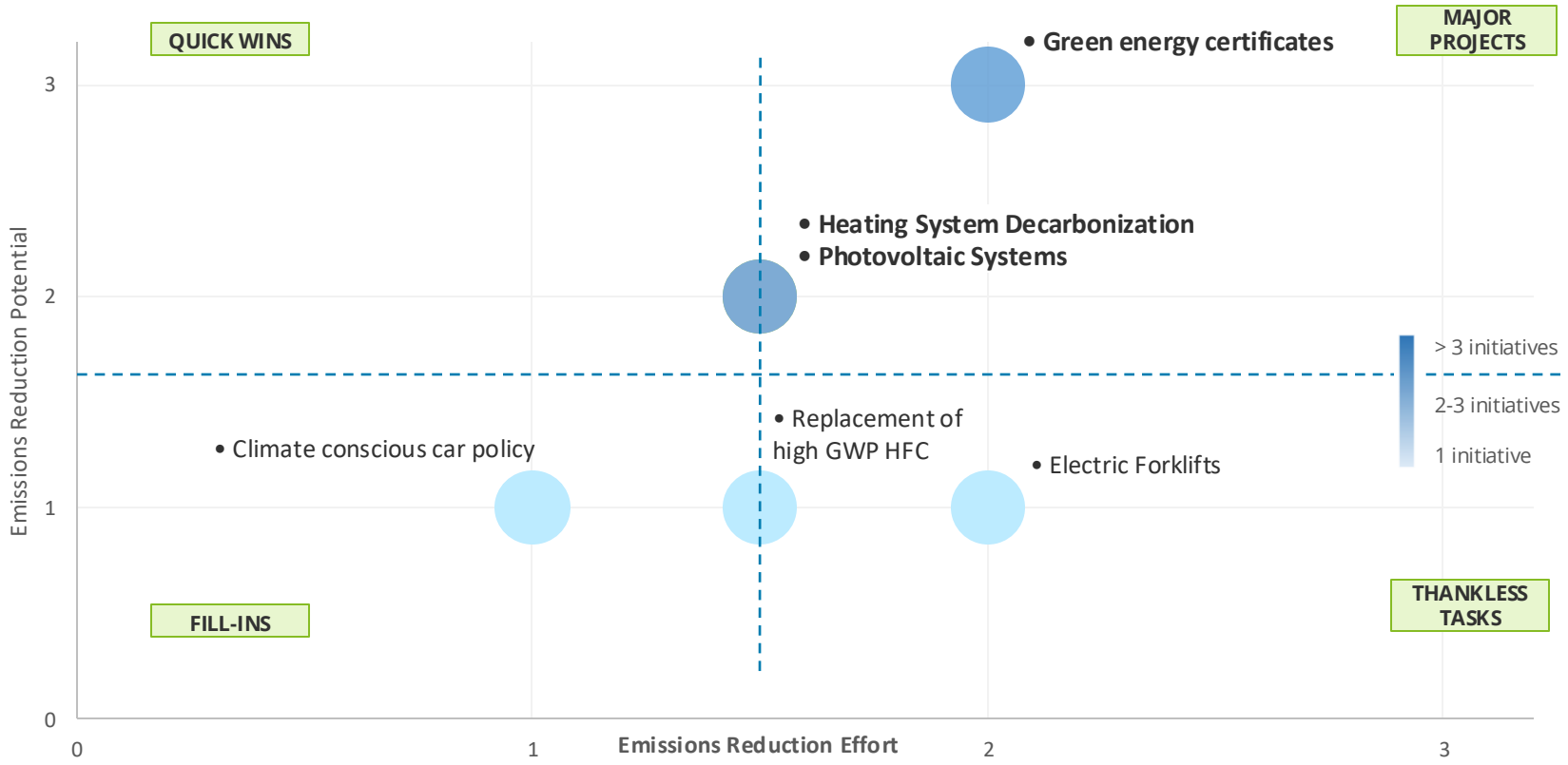
Scope 1 and 2 emissions reduction initiatives

A priority matrix of scope 1 & 2 emissions reduction initiatives has been established, to prioritize action with the highest emissions reduction potential.

Definitions

- **Scope 1 emissions:** the GHG emissions that are directly produced by an organization, for instance due to fuel combustion by running its boilers or vehicles.
- **Scope 2 emissions:** the GHG emissions that are indirectly produced by an organization, related to purchased and used energy (electricity, heat or steam).
- Scope 1 and 2 emissions accounted for **1,5%** of RG HPP total emissions in 2022.

Prioritarization Matrix - Scope 1 & 2



Scope 1 and 2 emissions reduction initiatives

Work is in progress and some important milestones have already been reached.

S1

62% of RadiciGroup High Performance Polymers production sites run **fully electric heating systems and forklift fleets**.

S2

In 2023 RadiciGroup High Performance Polymers production sites used **54% electricity from renewables**, either self-generated or covered by green energy certificates.

S2

The first **photovoltaic system** of RadiciGroup High Performance Polymers has been switched on in **June 2023**.

Case Study - Suzhou Green Building Project

In 2023 Radici Plastics (Suzhou) Co., Ltd. inaugurated a new production plant in Suzhou, China. The new plant has been awarded the certification of **LEED GOLD** – the most popular sustainability certification for buildings issued by U.S. Green Building Council.

Among other state-of-the-art features, the new factory is equipped with a **rooftop distributed PV system with a capacity of 1.4MW**, which is now supplying part of the electricity required by the factory.

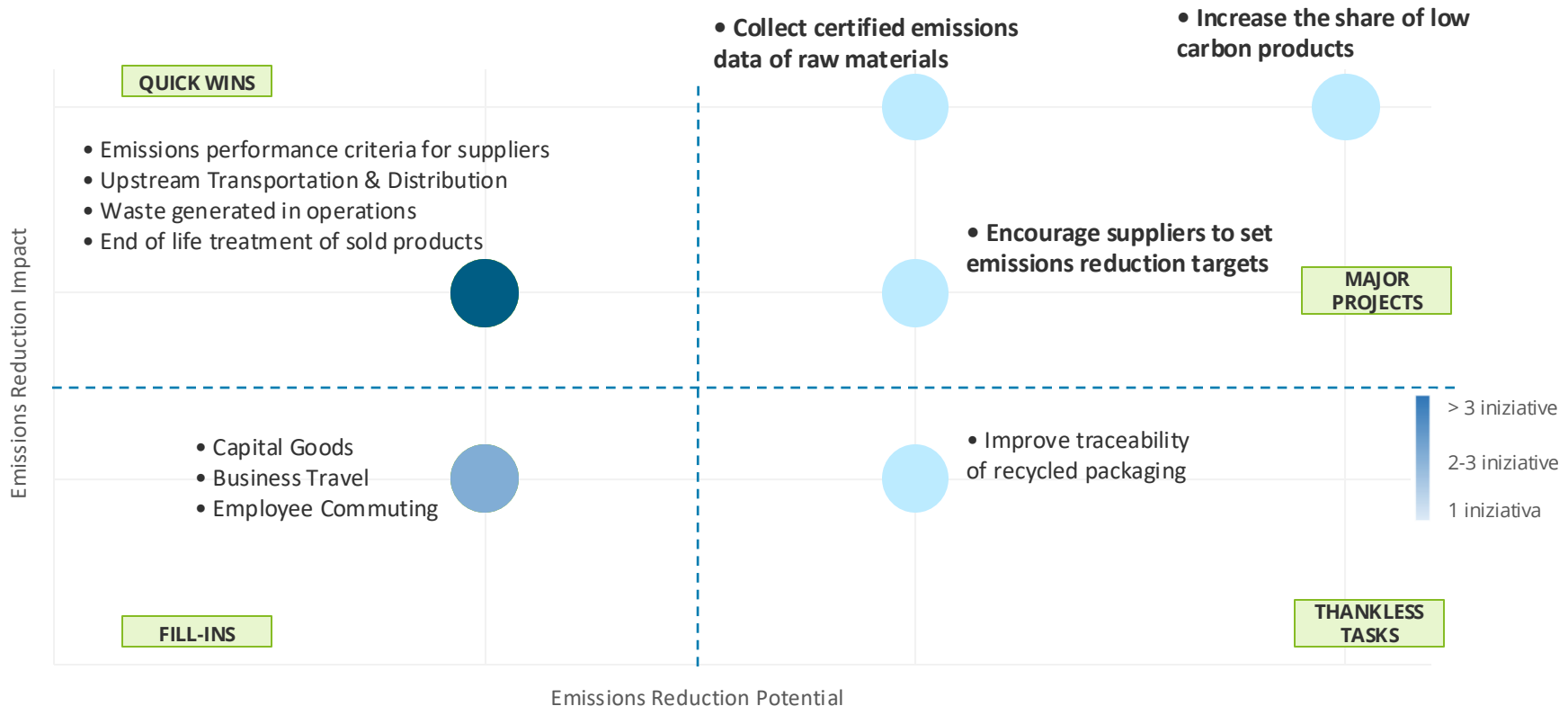
Scope 3 emissions reduction initiatives

A priority matrix of scope 3 emissions reduction initiatives has been established, to prioritize actions with the highest emissions reduction potential.

Definitions

- **Scope 3 emissions:** the GHG emissions for which the organization is indirectly responsible, upstream and downstream its value chain. For example, those related to products purchased from supplier or to own products when used by customers.
- Scope 3 emissions accounted for **98,5%** of total emissions in 2022.

Prioritarization Matrix - Scope 3



Emissions reduction initiative - Scope 3 milestones so far

Work is in progress and some important milestones have already been reached, with particular regard to Scope 3 – Category 1 “Purchased goods & Service”, which alone represents 93% of RG HPP Scope 3 emissions in 2022.

S3 Cat. 1

A value chain approach

We have integrated emissions reduction requirements in our **supplier qualification and monitoring** process. We collect certified primary data about the product emissions of our raw materials and we encourage our suppliers to set emissions reduction targets.

S3 Cat. 1

Our low carbon product portfolio

We have developed a significant offer of low carbon products for a wide range of applications, including **post-industrial** and **post-consumer recycled** products as well as **bio-based** products.

RENYCLE®
nylon after nylon

radilon® D

Learn more about our Renycle® brand of low environmental impact and high performance products.

Additional resources on climate action

Consult the following resources to learn more about RadiciGroup High Performance Polymers climate action.

Corporate emissions performance

Consult **Radici Novacips Spa near-term emissions reduction targets** on the SBTi target dashboad *to* learn more about our decarbonization ambition.

Consult **RadiciGroup - Climate Change annual responses** to monitor our progress towards climate stewardship on the CDP website. In 2023 RadiciGroup received a **B-score** which is in the Management band: *Taking coordinated action on climate issues.*

Request **Radici Novacips Spa Ecovadis Sustainability and/or Carbon scorecards** for an assessment of our sustainability and/or carbon management systems.

Product emissions performance

Consult the available **Environmental Product Declarations** on the RadiciGroup website or on The International EPD System website for the full environmental profile of our products.

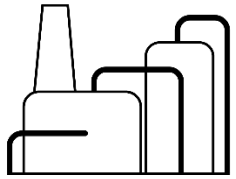
Request an **LCA short study** to learn about the environmental impacts of a specific product from a specific geography.

RADICI GROUP

RENYCLE®

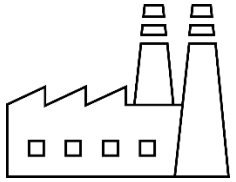
nylon after nylon

Product definition by raw material sources



Virgin

This material is produced starting from the chemical precursors of the base polymers.



Post-industrial

Material diverted from the waste stream during a manufacturing process.

Post-consumer

Material generated by households or by commercial, industrial and institutional facilities as end-users of products which can no longer be used for their intended purpose.

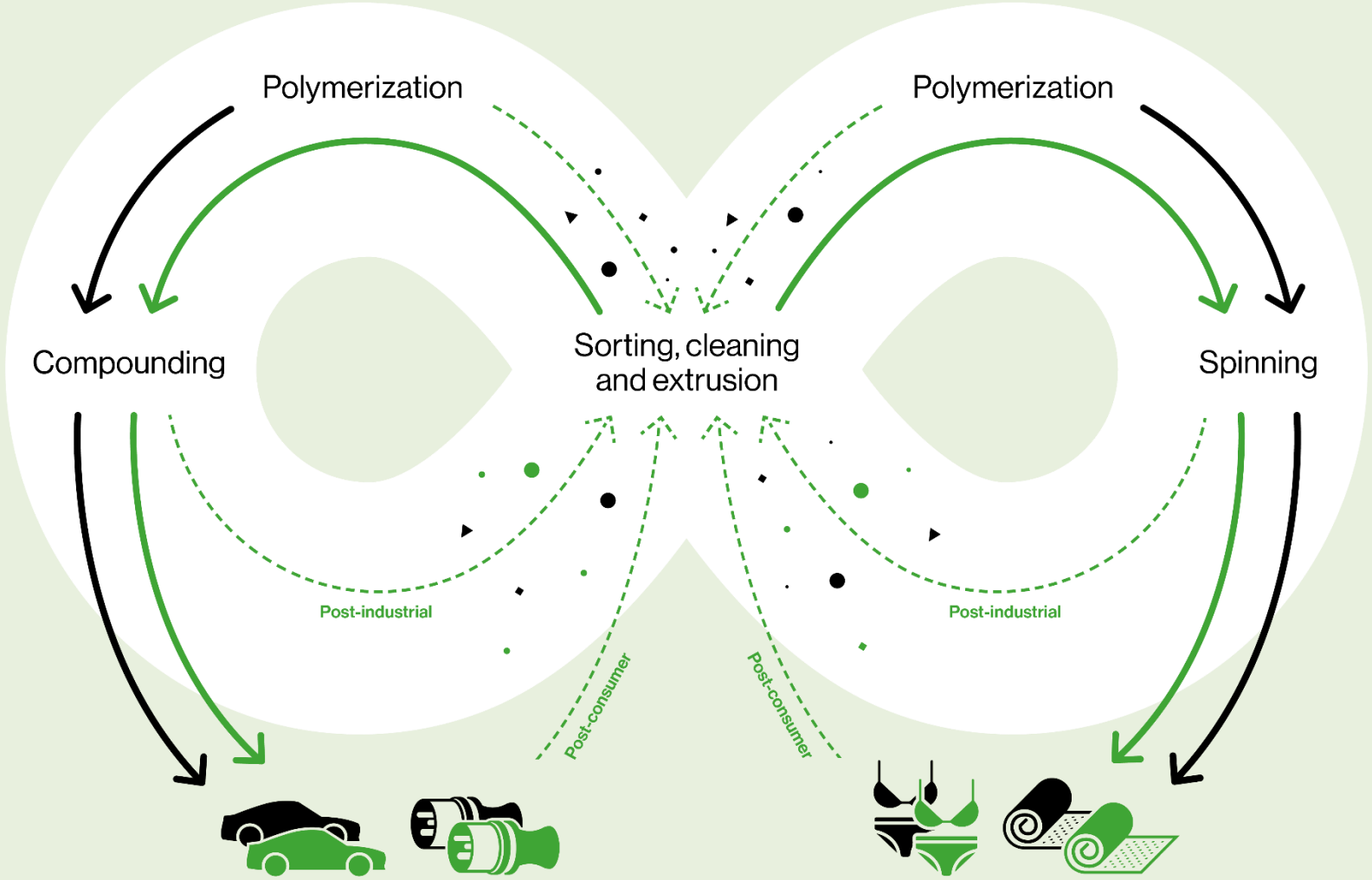
RadiciGroup - Nylon recycling system for circularity

RENYCLE®

nylon after nylon

RadiciGroup is able to **convey scraps either in the same industry which originated them or in a different one**.

It is possible to obtain low environmental impact polyamides, based on **post-industrial** and **post-consumer** sources characterized by **lower and measurable environmental impact**.



Legend

- Virgin raw materials
- Recycled raw materials
- Recycling process
- Scraps

RENYCLE® a certified offer

Renycle® has no compromises on safety, reliability, traceability, and quality.

CERTIQUALITY

ATTESTATO DI CONVALIDA
DICHIARAZIONE AMBIENTALE DI PRODOTTO
ENVIRONMENTAL PRODUCT DECLARATION
P4419

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO

DAP n. 003 H
Membro degli Accordi di Mutuo Riconoscimento EA,IAF e ILAC.
Signatory of EA, IAF and ILAC Mutual Recognition Agreements.

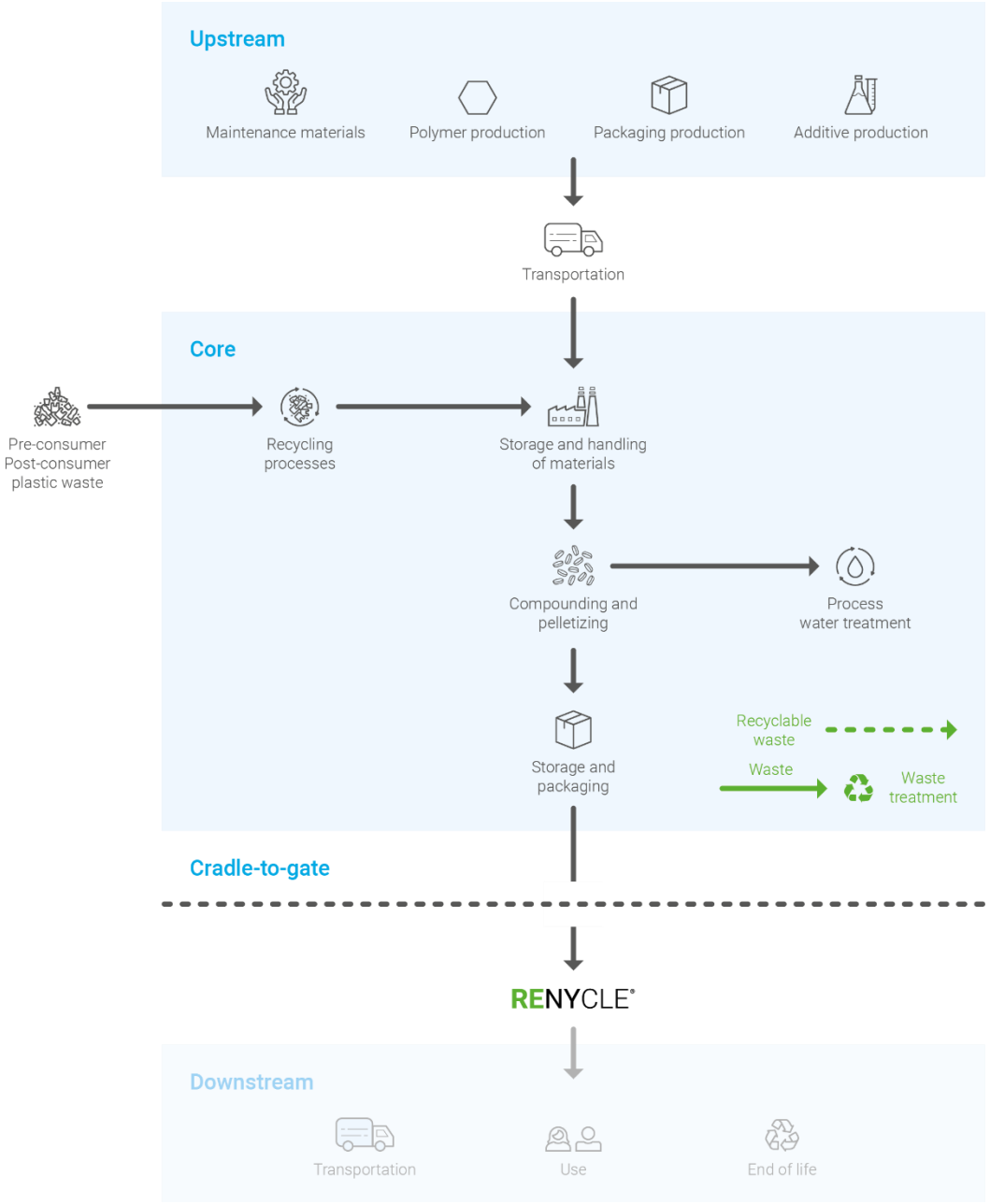
EPD®
THE INTERNATIONAL EPD® SYSTEM

RENYCLE®

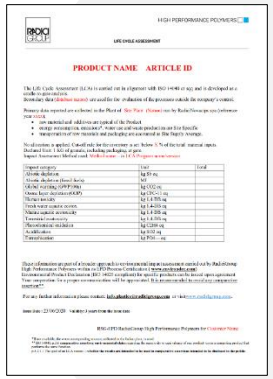
Environmental impact evaluation. What is LCA?

Life Cycle Assessment, knowing the system boundaries, **is the compilation and evaluation of the input, output, and potential environmental impacts of a product system throughout its life cycle (ISO14040).**

The system boundaries here in RadiciGroup include the production phase of the primary raw materials (**upstream**) and the production phase of the compound (**core process**).



RENYCLE® Sustainability available documents: LCA & EPD



LCA Short Study

Confidential.

Faster.

For almost all RadiciGroup products.

Boundaries: **Cradle-to-gate.**

Common Characteristics

Specific data.

Certified management system.

LCA and Calculation methodology.

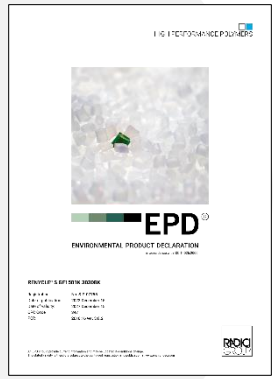
EPD

Public.

To be evaluated grade by grade.

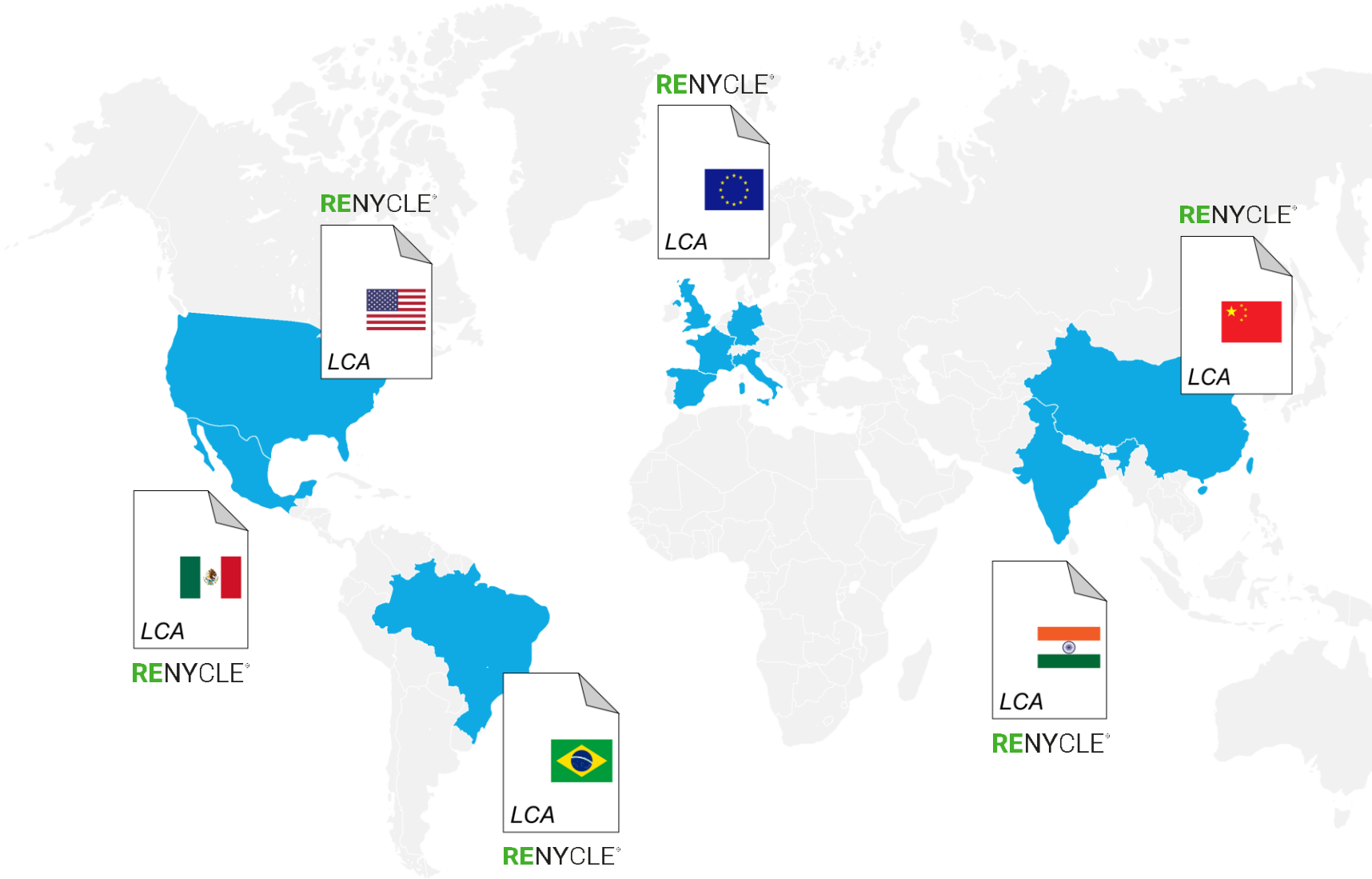
Third-party verified.

Boundaries: **Cradle-to-distribution.**

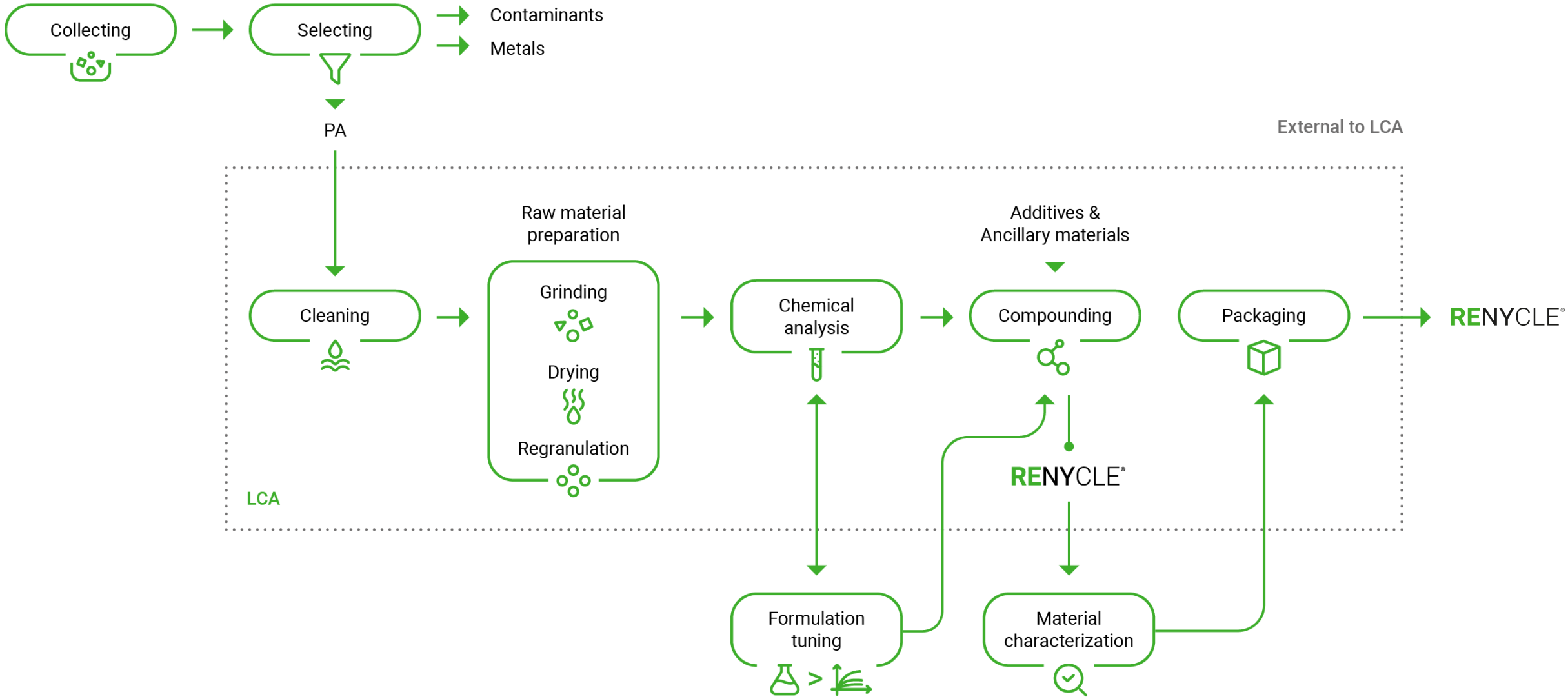


RENYCLE® is a “Glocal” brand

- **Renycle®** is a **global brand**.
- **The feedstocks** and **production processes** are supplied and performed **locally**.
- **Also the LCA** characterizations **is performed locally**.
- For this reason, **the same Renycle® material** produced in different geographical areas, presents **equivalent performances but different environmental footprint**.

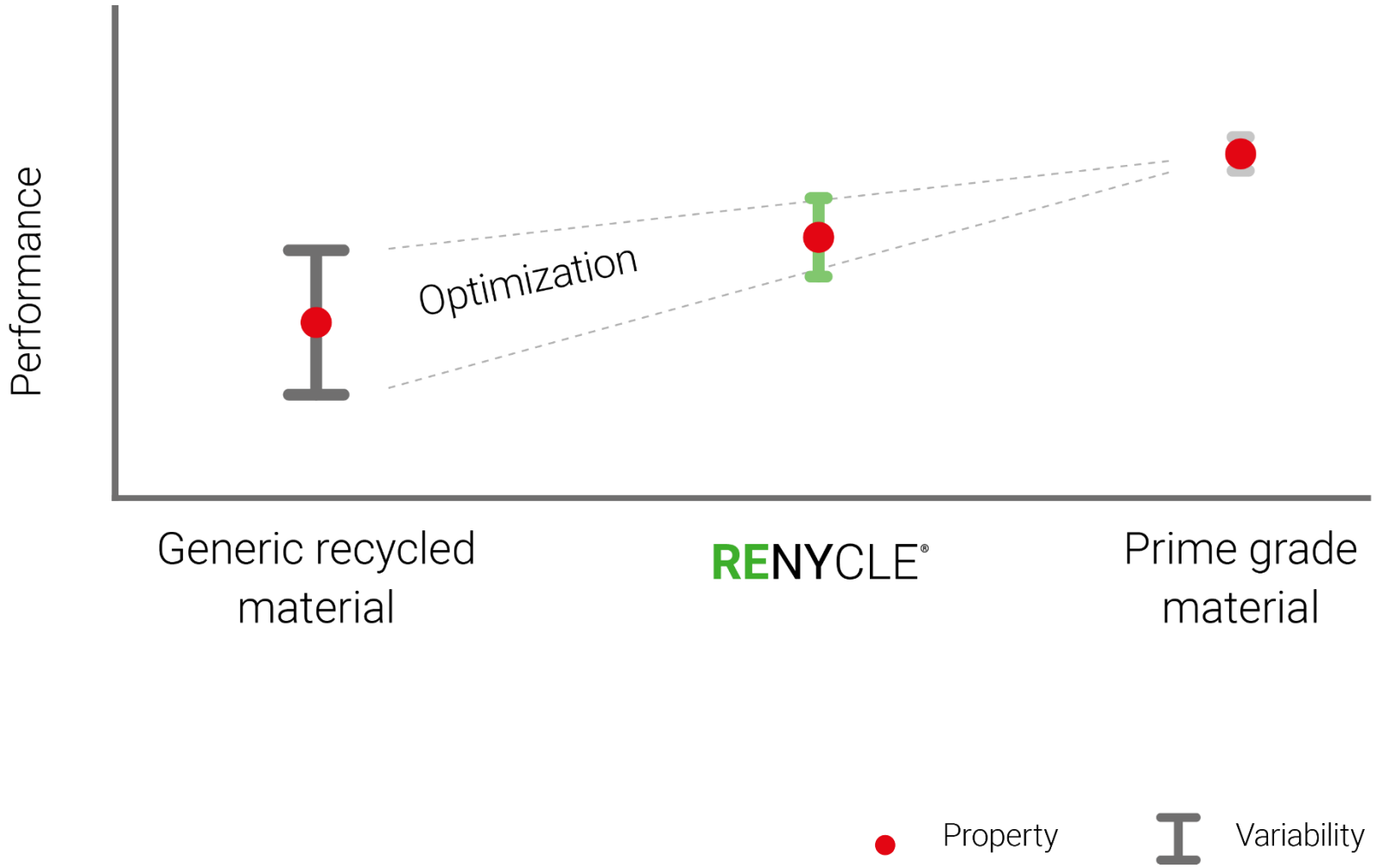


RENYCLE® Production process stages



RENYCLE® Goal

The experience gained in post-industrial materials production and the opportunity to participate in circular economy projects has allowed us to develop a production process that **thoroughly monitors raw material selection and treatment** in order to optimize material characteristics and variability.



RENYCLE® is a safe solution

The raw material used for the production of Renycle® **is carefully selected and checked**, in order to ensure its traceability and origin.

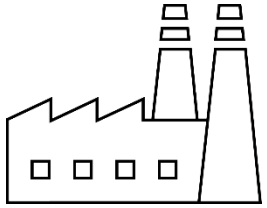
Renycle® materials are subjected to strict controls to guarantee the absence of dangerous substances according to the **GADSL*** (Global Automotive Declarable Substance List) and the reference regulations, including:

- **REACH**** (CE) n.1907/2006
- **RoHS III***** (2011/65/CE)

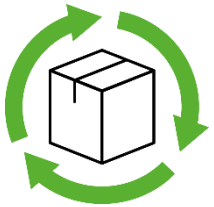
* http://www.gadsl.org
** https://www.echa.europa.eu/
*** https://eur-lex.europa.eu/legal-content

RENYCLE®
nylon after nylon

RENYCLE® Current product offering



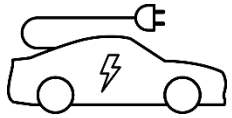
Post-industrial based



Post-consumer based

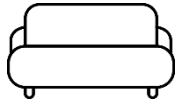
General purpose

Automotive

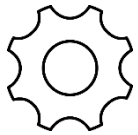


E-mobility

Electrical & Eletronic



Furniture



Industrial

Sport

Hydrolysis resistance and flame retardancy (red phosphorus-free, and halogen-free) are just some achievable properties for this new materials family.

RENYCLE® Grades targeted at different solutions

Renycle® S GF1501K 3030BK	Partially recycled PA6 15% glass fibre-reinforced injection moulding grade. Heat stabilized.
Renycle® S GF2501 HF0 3033BK	Partially recycled PA6 flame retardant injection moulding grade, halogen and red phosphorus free. 25% glass-fibre-reinforced. Laser markable.
Renycle® S GF3001K 3030BK	Partially recycled PA6 30% glass fibre-reinforced injection moulding grade. Heat stabilized.
Renycle® S GF3003 3033BK	Partially recycled PA6 30% glass fibre-reinforced injection moulding grade.
Renycle® S N101 3030BK	Partially recycled PA6 injection moulding grade. Black colour.
Renycle® S T203K 3030BK	Partially recycled PA6 injection moulding grade. Toughened. Heat stabilized.
Renycle® S T204K 3930BK	Partially recycled PA6 injection moulding grade. Toughened. Heat stabilized.
Renycle® S GF3004K 3033BK	Recycled PA6 30% glass fibre injection moulding grade. Heat stabilized.
Renycle® A GF3002HR 3039BK	Partially recycled PA66 30% glass fibre injection moulding grade. Heat stabilized, hydrolysis resistant.
Renycle® A GF3502K 3033BK	Partially recycled PA66 35% glass fibre injection moulding grade. Heat stabilized.
Renycle® A GF3504K 3033BK	Recycled PA66 35% glass fibre injection moulding grade. Heat stabilized.

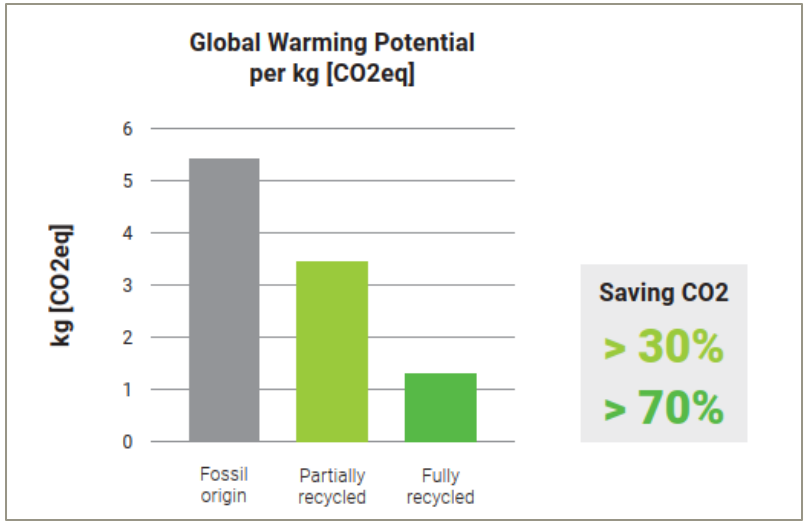
The material's availability must be checked project by project considering:

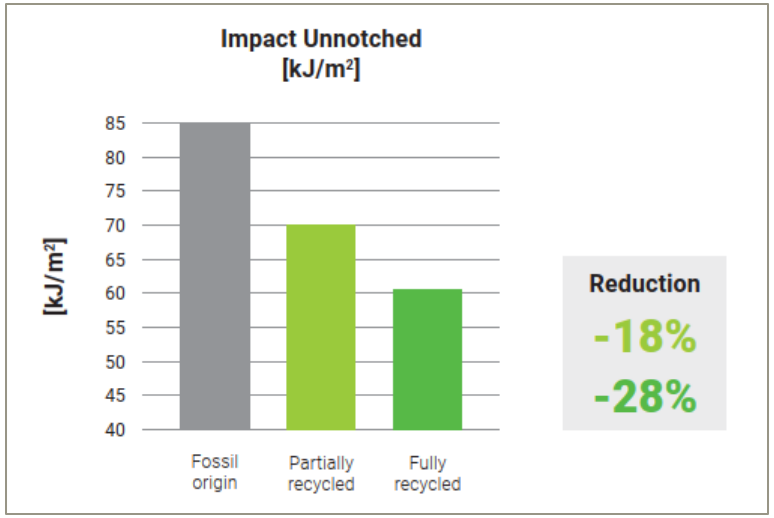
- potential volume
- geographic area
- material
- start of production
- supply duration

RENYCLE® Grades: Mechanical vs Environmental performance

PA6 recycled, 30% glass fibre-reinforced injection moulding grade. Heat stabilized, black colour.

Finished Product	Recycled content range [%]	Stress at Break [MPa]	Strain at Break [%]	Impact Unnotched [kJ/m^2]
PA6 - GF30 (Prime grade reference)	-	165	3.2	85
RENYCLE S GF3001K 3033BK	>30%	150	3.0	70
RENYCLE S GF3003K 3033BK	>65%	150	3.0	61





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RENYCLE® Automotive Application example

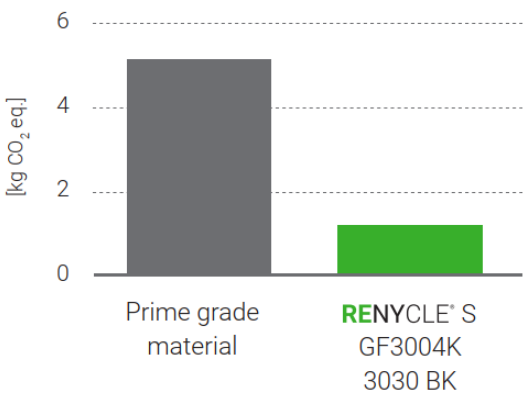
Air Intake manifold for gasoline engines

RENYCLE® S GF3004K 3033BK

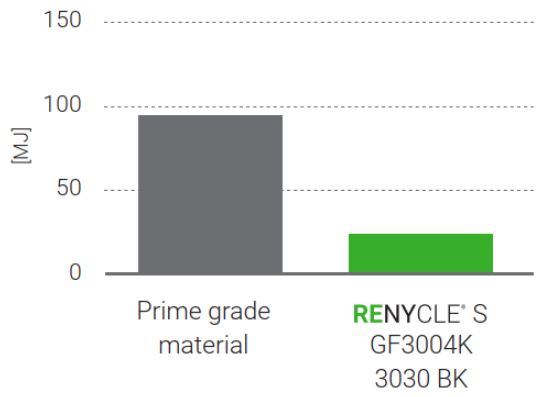
- 120°C continues use temperature
- High strength to pass burst pressure test
- Laser markable
- Good weldability (vibration)
- “In-series” application

Property	Dried-As-Molded	23°C - RH50
Tensile modulus [MPa]	9,300	5,400
Tensile stress at break [MPa]	135	85
Tensile strain at break [%]	2.6	3.6
Impact strength [kJ/m²]	55	70
Notched Impact Strength [kJ/m²]	8	12

Global warming potential per kg [kg CO_2 eq.]



Cumulative Energy Demand per kg [MJ]



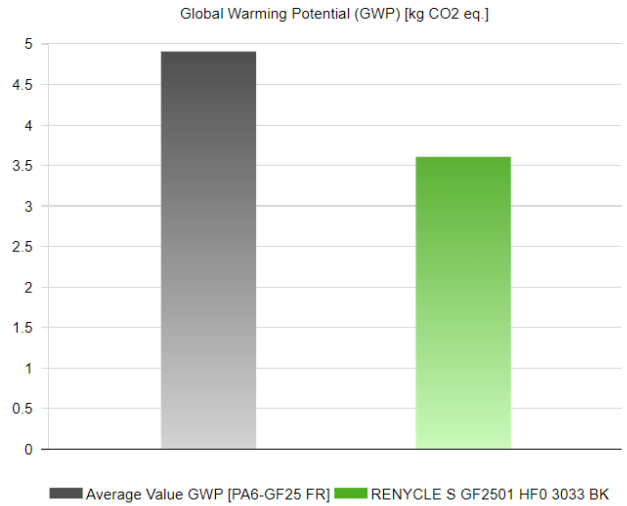
RENYCLE® E/E Application example

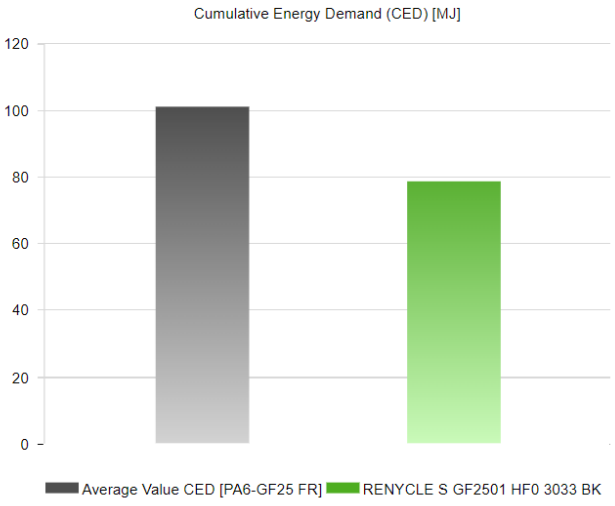
E-mobility plug and socket components

RENYCLE® S GF2501 HF0 3033BK

- Self-extinguishing properties (V0 @ 0.8mm – UL94)
- Excellent stiffness
- Laser markable
- Very good dimensional stability
- Good aesthetics

Property	Dry-As-Molded
Tensile modulus [MPa]	9,400
Tensile stress at break [MPa]	120
Tensile strain at break [%]	2.9
Impact strength [kJ/m²]	50
Notched Impact Strength [kJ/m²]	7
Flammability UL-94	V0 - 0.8 mm
Glow Wire Flammability Index (GWFI)	960°C - 1 mm
Glow Wire Ignition Temperature (GWIT)	750°C - 0.8 mm





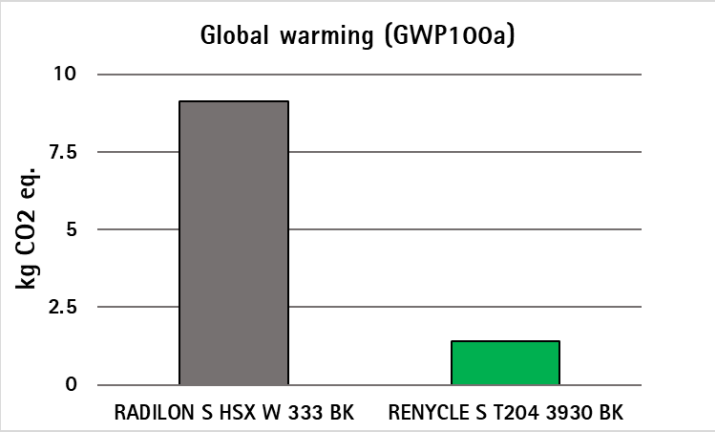
RENYCLE® Consumer goods applications examples

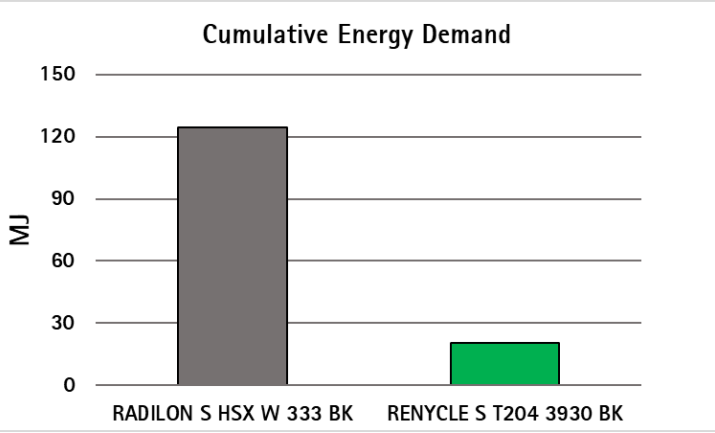
Stroller handle

RENYCLE® S T204 3930BK

- Very good impact resistance
- Excellent surface finishing and aesthetics
- Good dimensional stability

Property	Dry-As-Molded
Tensile Modulus [MPa]	1400
Tensile stress at yield [MPa]	46
Tensile strain at yield [%]	120
Notched impact strength [kJ/m^2]	20
Flammability UL-94	HB – 0.8mm





Environmental impact saving > 80%*

*Cumulative Energy Demand+ipcc2021 V1.11 / Cumulative energy demand

RENYCLE® is the answer to:

- **Customers** who want to reduce the environmental impact of their finished products and are committed to make environmentally conscious choices.
- **The evolving legislative context**, which is shifting more and more towards the reuse and recycling of materials now considered waste (so-called End-of-Life materials).
- **The need for stricter controls and standards** to guarantee the safety and traceability of the raw materials used.
- **Society** in general, which is asking industry to make a greater and more tangible commitment to sustainability.
- **Ensuring the right selection, treatment and characterization** of post-consumer and post-industrial materials.

Why RENYCLE® ?

- **Climate action**
- **Low-carbon footprint**
- **Transparency, traceability** and **safety.**
- **Waste reduction**
- **Reuse and recycling culture**
- **Environmentally conscious choices**

Bio-content (renewable) grades

Bio-based renewable polymers are seen as an alternative to fossil-based polymers for their lower environmental impact, including CO_2 emission.

Products with a lower environmental impact that contain bio-based feedstock

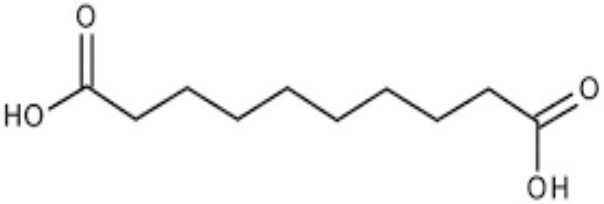
BRAND	CHEMICAL FORMULA	BIO CONTENT (BASIC POLYMER)	CHARACTERISTICS
RADILON® D Commercial	**PA610**	**64%**	• Excellent thermal properties vs PA12 and PA11 • Easy processing by injection molding and extrusion • Good chemical resistance vs PA6 & PA66 • Low moisture absorption
RADILON® P Development	**PA56**	**41%**	• Easy flow • Melting point close to PA66 • High moisture absorption
RADILON® PX RADISTRONG® PX Development	**PA510**	**100%**	• Easy flow • Excellent surface aspect
RADILON® TT Development	**PA1012**	**43%**	• Easy flow • Transparency • High flexibility • Excellent chemical resistance • Very low moisture absorption

Radilon® D PA610 (commercial grades)

PA610 with **64%** of bio-content

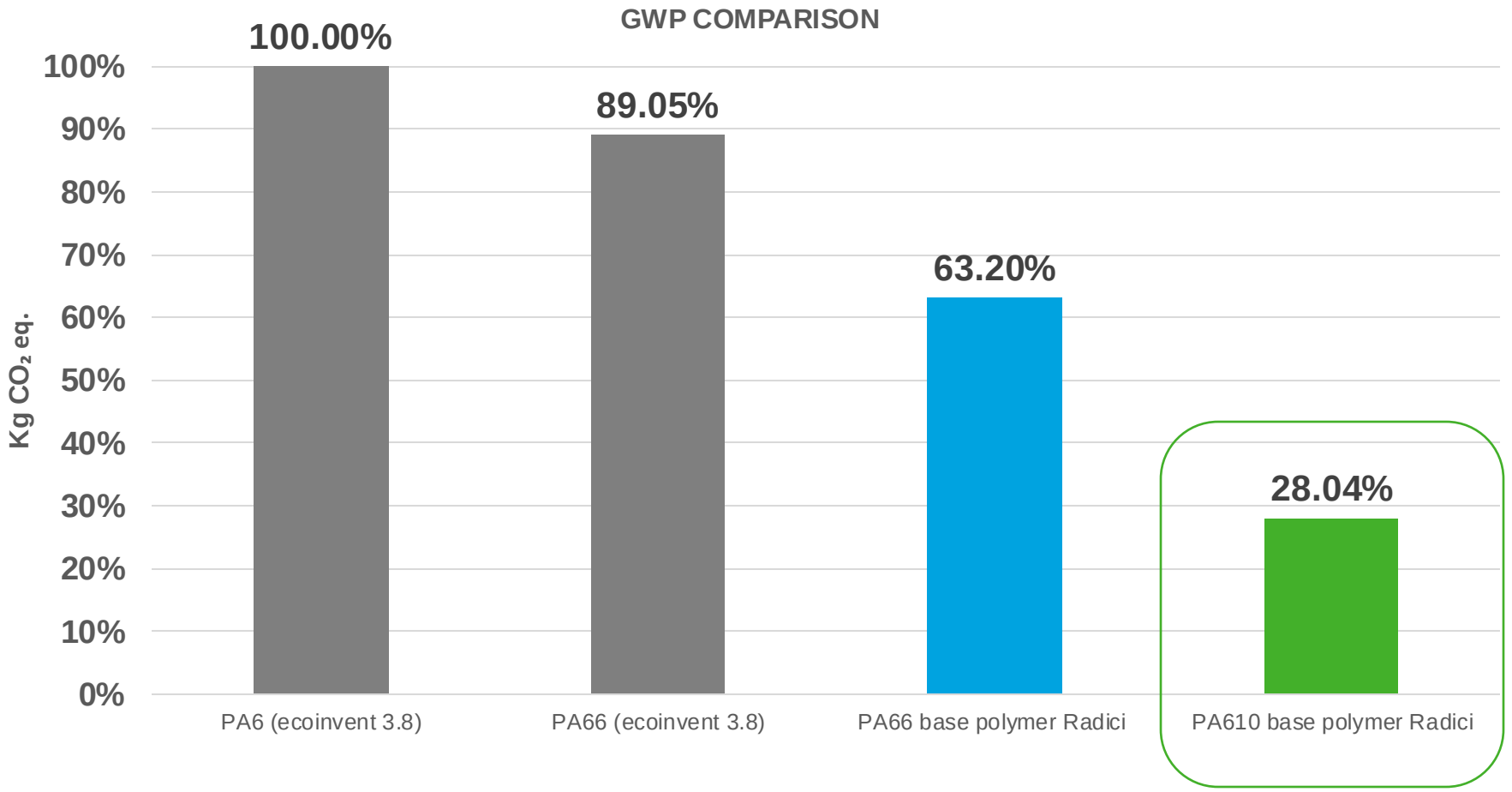
Castor oil seeds

- Enhanced Chemical resistance
- Stress cracking resistance
- Dimensional stability
- Low fuel permeation
- Limited moisture sensitivity
- Hydrolysis resistance



Sebacic acid

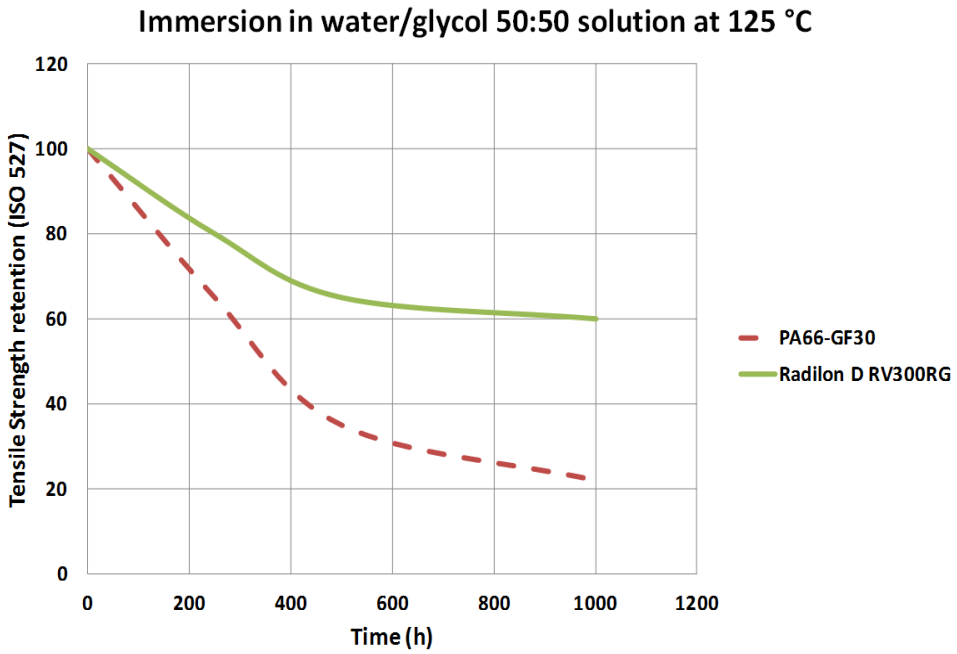
Radilon® D PA610 environmental impact



Radici grades: calculation done with SimPro (V.9.3.0.3). Database Ecoinvent 3.5. Method is based on IPCC 2021 (including CO_2 uptake). Cradle to gate study certified by certiquality. Data are regularly updated.

PA610 Applications Selection

Cooling lines connectors



Material:
Radilon® D RV300RG (PA610-GF30, hydrolysis resistant)

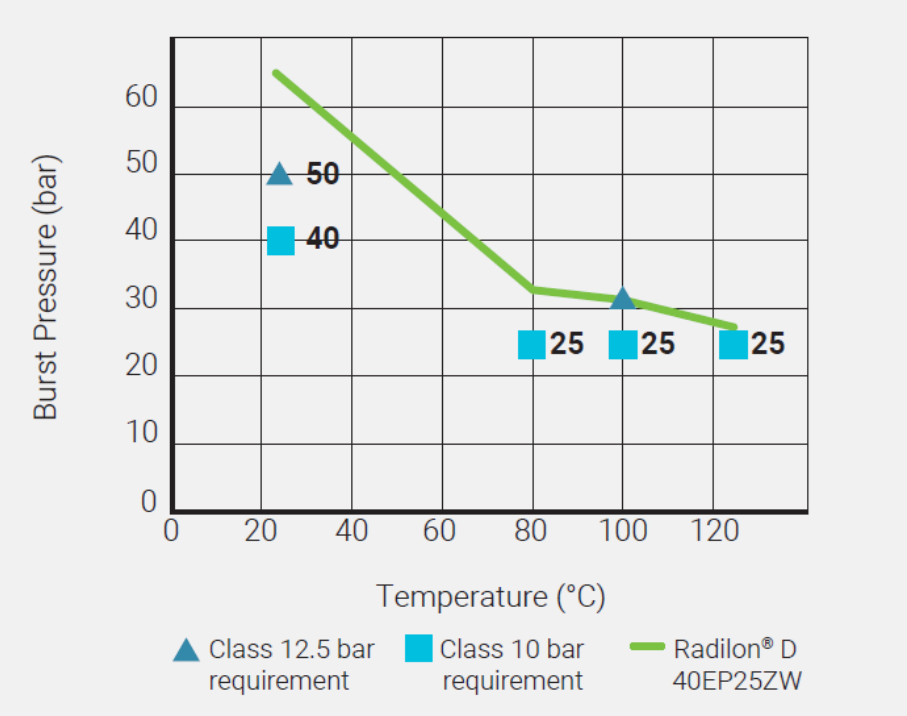
Main requirements:

- Resistance to cooling liquid
- Resistance to road salts solutions contact
- Dimensional stability

- 60 % retention with Radilon® D RV300RG (PA610-GF30-hydrolysis resistant)
- 22% retention with standard PA66-GF30

PA610 Applications Selection

Vacuum brake booster hose



Material:
Radilon® D 40EP25ZW (PA610, flexible)

Main requirements:

- Stress cracking resistance
- UV resistance
- Respect norms requirements: ISO 7628, DIN 74324, SAE J844, FMVSS106
- Excellent processability by extrusion

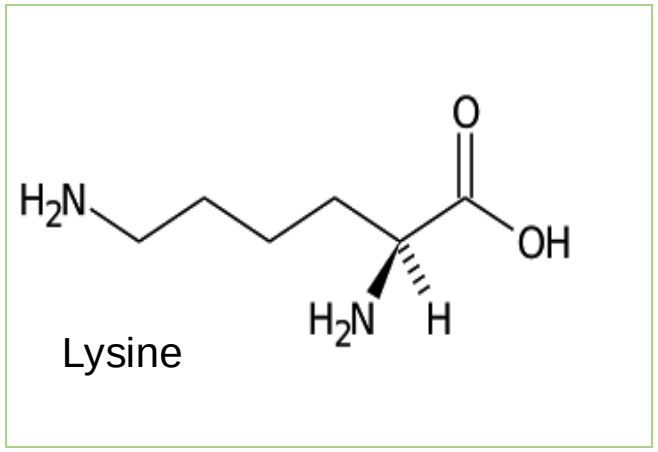
Radilon® D PA610:
a viable option to reduce environmental impact

- **Wide range of products** for both extrusion and injection molding
- **LCA data** available
- **Ideal material** (also in blend eventually) to increase components chemical resistance, dimensional stability and **to reduce environmental impact**

Radilon® P PA56 (experimental grades)

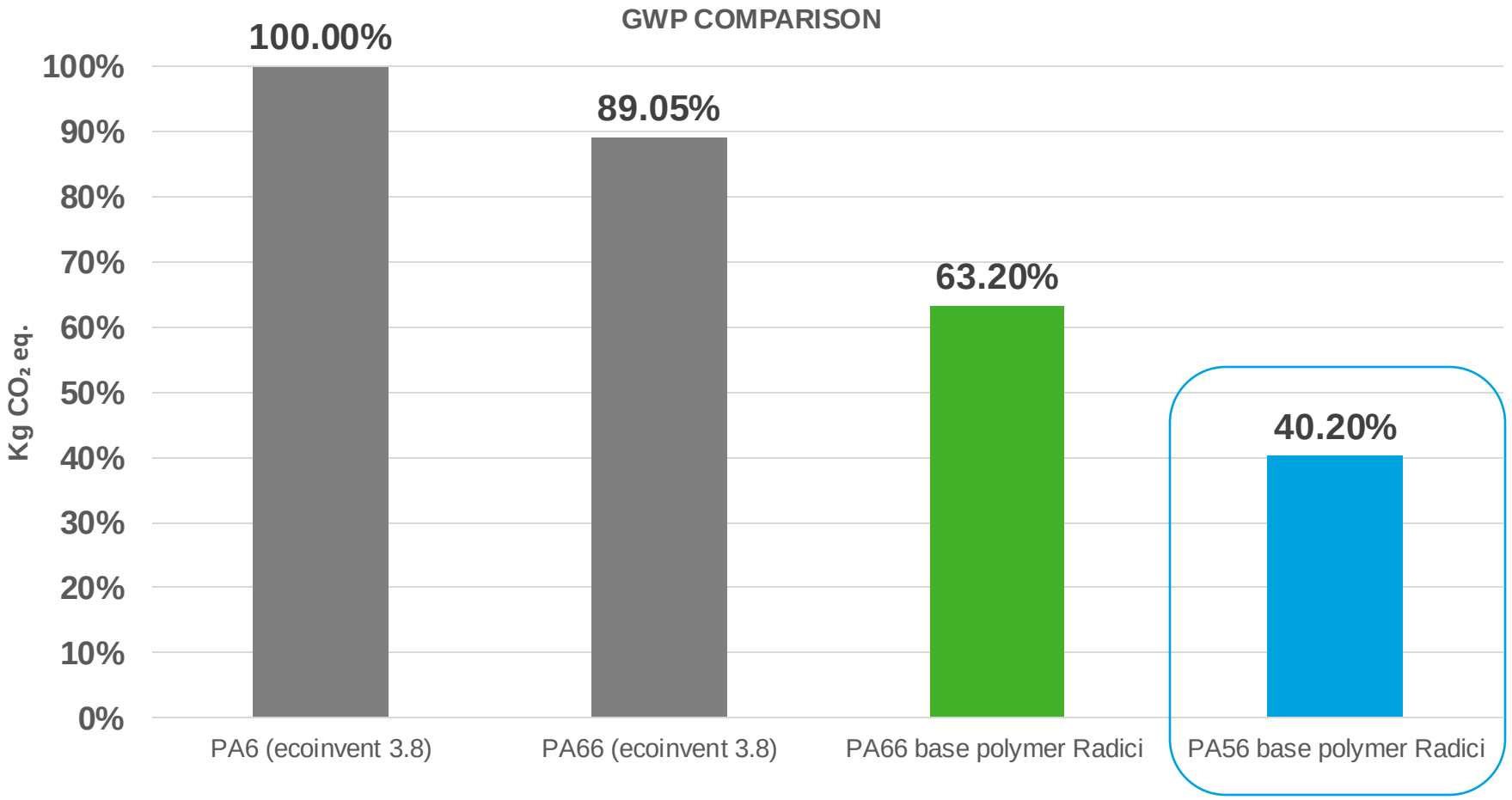
41% of bio-content

- Easy processing
- High melting temperature (252 °C)
- High cristallinity
- High LOI
- High moisture absorption



Lysine

Radilon® P PA56 environmental impact

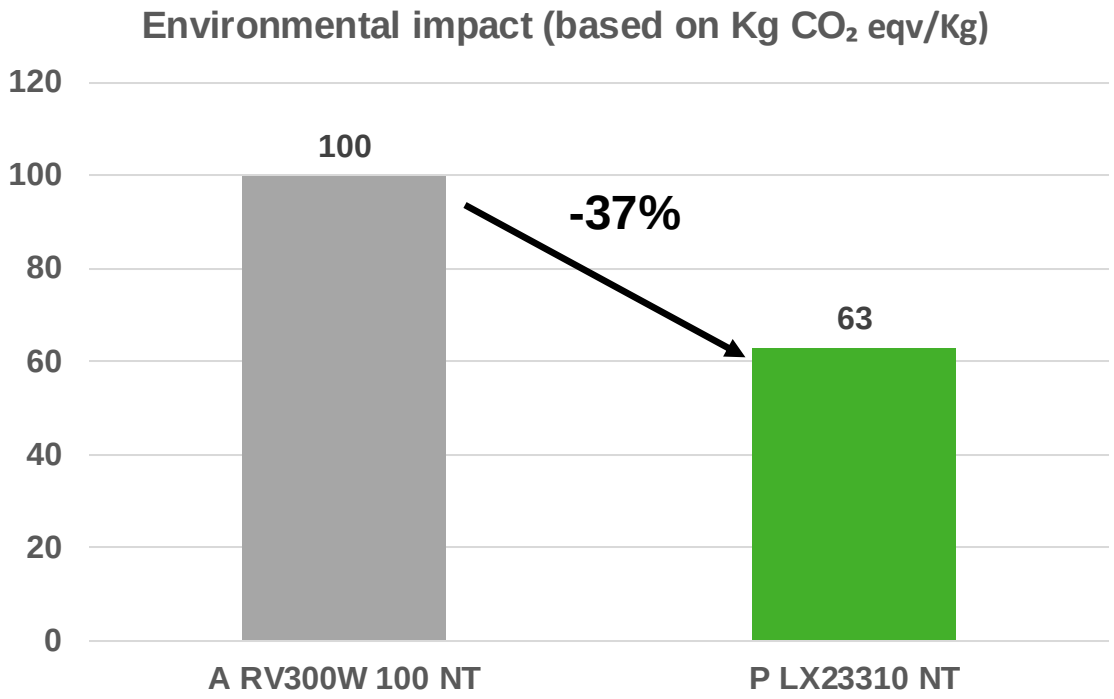


- **PA56** can be considered as a potential **PA66 alternative**
- **PA56** suitable to produce **flame retardant** grades

Radici grades: calculation done with SimPro (V.9.3.0.3). Database Ecoinvent 3.5. Method is based on IPCC 2021 (including CO_2 uptake). Cradle to gate study certified by certiquality. Data are regularly updated.

Radilon® P PA56 development grades

Radilon® P LX23310 NT (PA56-30%GF-HS)



Other grades in development phase as low environmental impact alternatives

Q&A

RADICI GROUP

HIGH PERFORMANCE POLYMERS