



AIEE Symposium:
Current and future Challenges to Energy Security

**Sustainable mobility challenges for the
transition targets: regenerated products
as agents of decarbonization**

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Regeneration is a key enabler to reduce global emissions

Regeneration refers to the processing of a waste stream and turn it into a product resource with equivalent characteristics to those of the corresponding virgin product generating the relevant waste

- Raw material extraction and processing activities account for approximately 18% of total greenhouse gas emissions: Energy transition alone is not enough¹
- Circular Economy is grounded on efficient material flows and waste management practices



Why regeneration matters

- Lower energy requirements
- Lower carbon footprint
- Lower overall lifecycle impact

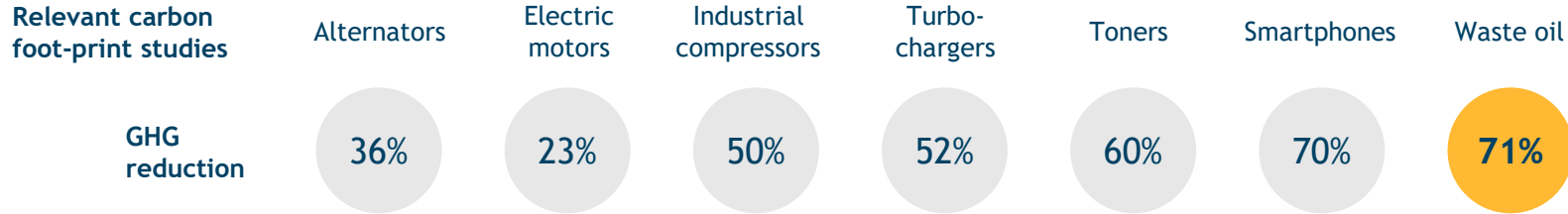
Sources: 1. EEA - https://www.eea.europa.eu/en/topics/in-depth/resource-use-and-materials?utm_source; 2. European Grouping of the Regenerative Industry (GEIR) Institut für Energie - Updated Life Cycle Assessment (LCA) for Regeneration of Waste Oil to Base Oil

How regenerated products reduce emissions

- 1 Lower use of raw materials
- 2 Energy required for regeneration lower than for production of virgin sourcing and production
- 3 Number of Regenerated cycles

- 4 CO₂ avoided
- 5 Design for remanufacturing
- 6 Take-back & reverse logistics

Regeneration is a key enabler to reduce global emissions



Example applied to sustainable mobility:

GEIR-IFEU definition: “*regeneration is the processing of waste oil to produce recycled lubricants, accounting for 62% of treated waste oil in Europe*”²

- 71% CO2 Emissions
(vs processing of virgin crude oil)

- 87% Resource depletion
(vs processing of virgin crude oil)



Regeneration is significantly better for the environment than the processing of virgin crude oil

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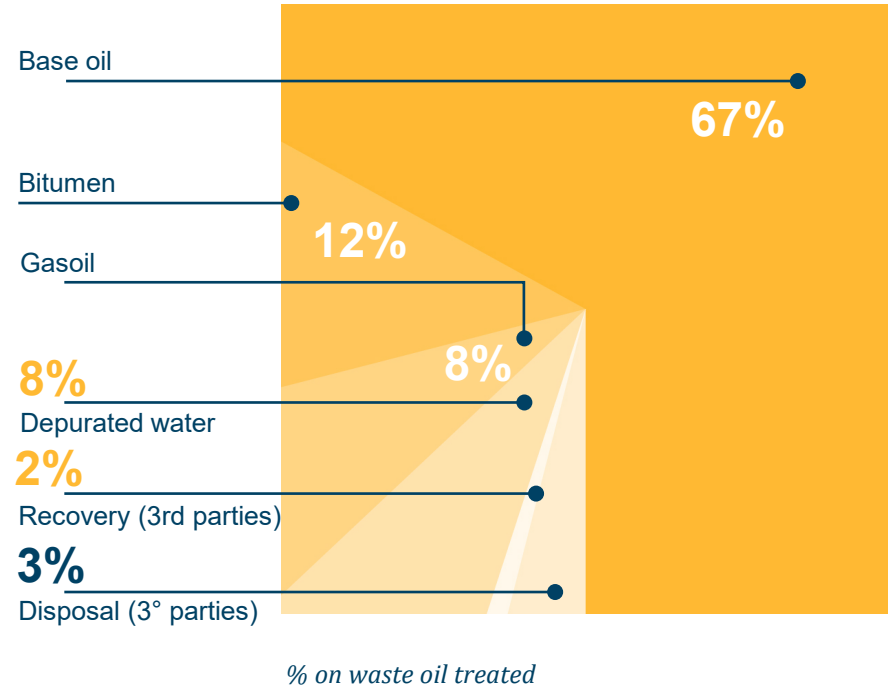
Regeneration of lubricants

Circularity excellence

Compared to primary production (virgin material stream), re-refined base oil generate:

- **71 % lower** CO₂ emissions
- **90 % less** fine particulate matter
- **Il 90 % less** acidifying emissions (NO_x, SO₂ e NH₃)

Circularity: moreover, at least **97%** The treated lubricating oil is transformed into products, returned to the environment as purified water, or recovered by third parties



Re-refining of lubricants

GP I+ & II+

- The regenerated Itelyum Group I+ and II+ base oils, produced through a high-pressure catalytic hydrogenation process, feature chemical-physical and compositional properties that make them **ideal for use in various lubrication applications**, both in the automotive sector and in industrial settings
- Their **very low sulfur and aromatic content, combined with a high viscosity index**, supports **formulation choices across a wide viscosity range**, enabling performance under the most demanding conditions and meeting the environmental requirements of modern lubricants, while also reducing the need for additives in formulations.
- The properties of Itelyum's regenerated base oils make them suitable for **numerous industrial applications**, such as rubber and compound manufacturing, and, more generally, they can be effectively used as process oils.



Re-refining of lubricants

New Gp II+, a new step forward

Thanks to its advanced **re-refining technology and further enhancements to the hydro-finishing process**, Itelyum has developed the new **HG Series Group II+ product line** — a step forward in meeting the future needs of its customers.

Perchè le basi Itelyum HG Series Group II+:

- ✓ **More stringent engine tests** and new OEM specifications require HG Group II+ base oils
- ✓ **A blend of base oils** can outperform a Group I/III base-oil blend
- ✓ **Over 75%** of engine-oil demand can be met using HG Group II+ base oils
- ✓ **Over 95%** of industrial-oil demand can be met using Itelyum HG Group II+ base oils
- ✓ **Ideal for Low/Mid SAPS** (Sulfated Ash Phosphorous and Sulfur) additive packages
- ✓ **Reduce formulation complexity**
- ✓ **Lower overall formulation cost**



Challenges and opportunities of regenerated products

1

Brand differentiation - Signals circular innovation leadership and boosts competitive positioning

2

Quality perception - Industrial-grade regeneration ensures performance comparable to new products

3

Traceability & performance standards - Robust tracking and certification enhance trust and warranty capability

4

Reduced use of raw materials - Regenerated products preserve resources and lowers exposure to critical raw-material volatility

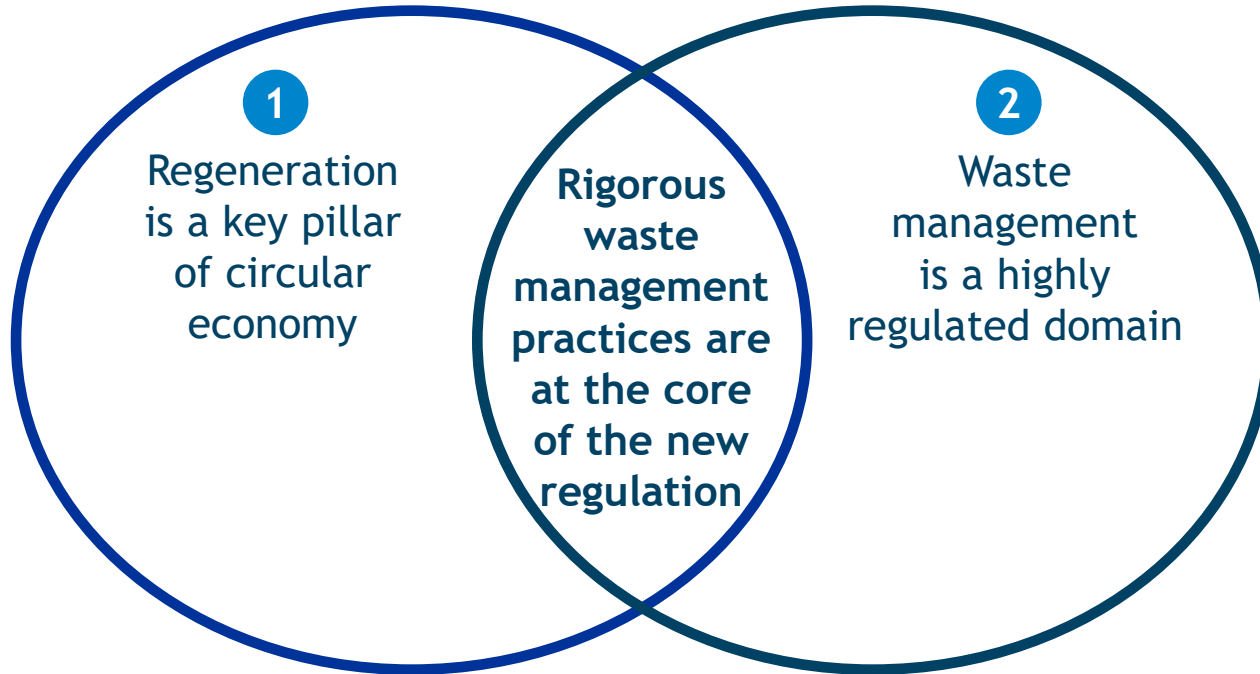
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Supports SBTi targets (Scope 3 Cat. 1) - regenerated inputs cut emissions from purchased goods

6

Decouple growth from carbon intensity - allow business expansion while lowering per-unit emissions

Regeneration and Regulation go hand-in-hand



Regulatory Framework of regeneration (1/2)

Strong political support for circular economy

Clean Industrial Deal places circularity at the core of EU's decarbonization strategy

- Goal to increase overall circularity rate in the economy from 12% today to 24% by 2030
- **Regeneration** plays an important role to ensure **energy independence**: an EU's strategic objective
- Proposal for a **2040 Climate Target** of ~90% net GHG reduction (ongoing process): impact assessment shows that circular economy can translate into a significant boost to reach the **2040 target**

Nevertheless, current regulatory challenges and inconsistencies among member states are still there

Regulatory Framework of regeneration (2/2)

EU Waste Framework Directive (WFD) gives priority to regeneration

- The new WFD will be part of Circular Economy Act, which will be a package of measures modifying different waste legislation (Waste shipment regulation, Waste Framework directive, Landfill Regulation)
- Ongoing public consultation, with Circular Economy Act to be adopted by the end of 2026



**AIEE could participate in the ongoing consultations
also to support regeneration**

The image shows an industrial plant at night, with various structures, pipes, and lights visible against a dark blue sky. A large, semi-transparent dark blue rectangle is overlaid on the left and center of the image. Inside this rectangle, the text "ITELYUM.COM" is displayed in a bold, sans-serif font. The "ITELYUM" part is white, and the ".COM" part is a light blue color that matches the background's color scheme.

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