

Executive Summary:

Sector Life Cycle Assessment of representative European truck RETREAD and REGROOVED tyres.

Introduction

Tyres play a significant role in daily life, crucial for moving people and goods and essential for economic activities, aviation, and rail transport. In order to get an understanding of the environmental impacts of tyres namely passenger car, Truck & Bus as well as retreaded tyres, Tyres Europe commissioned Sphera to conduct a full life-cycle study covering raw material extraction, manufacturing transport, use, and end-of-life stages.

The full reports can be requested via info@tyreseurope.org.

Goal

This study compares the environmental impacts of retreaded and regrooved truck tyres with new tyres of the same size (315/70 R22.5 LI 154). It evaluates how a High-Performance (HP) tyre that is retreaded compares to using only new Medium-Low Performance (MLP) tyres to cover the same total mileage. While it is clear that retreading offers environmental benefits by reusing the existing casing, it can also have drawbacks often due to higher rolling resistance of the retreaded tyre. Therefore, the goal of the study is to understand how much worse a retreaded tyre can perform in terms of rolling resistance to still have an overall positive environmental benefit.

Scope

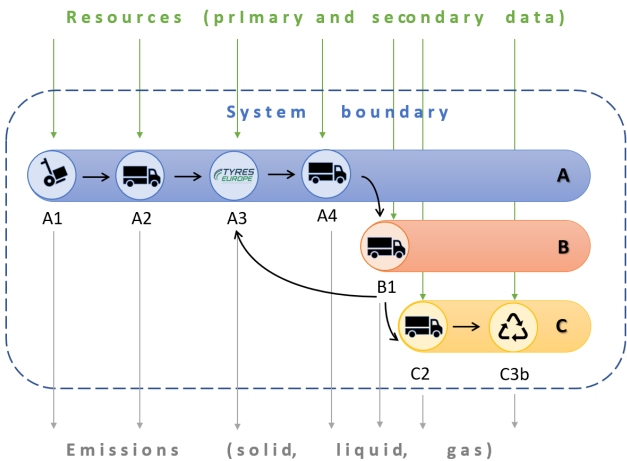
The study is based on the following assumptions and conditions:

- **What:** This study evaluates the potential environmental impacts of truck tyres when comparing virgin products to those undergoing retreading or regrooving, across both HP and MLP performance levels. Each treatment cycle alters tyre performance, influencing overall lifecycle impacts. Using these performance changes, the study assesses the number of virgin MLP tyres required over the same service life. The associated environmental burdens of producing these additional tyres are then analysed. Please note that the assumptions taken, and scenario analysis conducted were chosen to increase the understanding of the environmental impacts of retreaded tyres in comparison to virgin tyres. **They do not necessarily reflect the reality of retreaded tyres in the market.**
- **Standards:** The work is aligned with the requirements of the Product Category Rules (PCR) “UL 10006 Tyres Version 3.05,” which define modelling rules, system boundaries, and mandatory methodological choices for tyre LCA. Impact assessment followed the Environmental Footprint (EF) 3.0 method, as indicated by the reference PCR. A Monte Carlo and sensitivity analysis was performed to evaluate uncertainty and variability in key inputs, including bill of materials, RRC, tyre mass, mileage and end of life scenarios.
- **Data Collection:** The present study started in 2022. The reference time for the present study is 2021, the most recent calendar year for which primary data were available through the involved companies when the study was

launched. Data were collected from multiple European manufacturing plants. In the case of raw materials, they are indicative of the specific production country (where available). No cut-off has been applied for this study.

- **Functional Unit:** The functional unit is “1 tyre driven for 1.000 km”. Table below shows average key performances parameters (collected during the present study) that are considered (see table xx for the relevant data adjusted to the functional unit).
- **Boundary Systems:** The study, following the UL Tyre PCR, applies a cradle-to-grave system boundary covering modules A1–A4, B1, and C2–C3, as shown in the picture below.
- **Data Base:** The LCA model was developed using LCA for Experts (Sphera LCA FE), and background data were sourced from the Sphera Managed LCA Content (MLC) Database 2024.1. Where gaps existed, they were filled conservatively using technologically representative proxy datasets.

Schematic representation of the tyre life cycle system boundaries



Technical Specifications of Tyres Europe's Virgin, Retread, and Regrooved Truck Tyre (Size 315/70x22.5 li 154)

Product Information	Use	Average Mileage [km]	Average Rolling Resistance coef- ficient [kg/t]	Tyre weight [kg]	Number of Re- treading Process	Number of Re- grooving Process
HP Tyre	Truck tyre	245.920	5,38	63,4	0	0
MLP Tyre	Truck tyre	138.858	5,92	58,9	0	0
Retread Tyre	Truck tyre	245.920 ²	5,38 ²	66,25	1-2	0
Regrooved Tyre	Truck tyre	55.000	3,59	55,45	0	1

²Note: The RRc and Mileage for retreaded tyres are not measured values but assumed, set equal to the RRc of virgin HP tyres. Also tread depth retread tyre has been assumed equal to the virgin HP tyre tread depth.

Impact category list

Impact Category	Unit	Reference
Climate change (GWP)	kg CO ₂ eq.	(IPCC, 2013)
Climate change, land use and land use change (GWP-luluc)	kg CO ₂ eq.	(IPCC, 2013)
Acidification Potential, terrestrial (AP)	moles H ⁺ eq.	(Seppälä J., 2006; Posch, 2008)
Eutrophication (freshwater) (EP)	kg P eq.	(Seppälä J., 2006; Posch, 2008; Struijs, 2009)
Ozone Depletion (ODP)	kg CFC-11 eq.	(Guinée, et al., 2002)
Photochemical Ozone Formation (POFP)	kg NMVOC eq.	(Van Zelm R., 441-453)
Resource use, minerals and metals (ADPe)	kg Sb eq.	(Guinée, et al., 2002)
Resource use, energy carriers (ADPf)	MJ	(Guinée, et al., 2002; van Oers, de Koning, Guinée, & Huppes, 2002)
Particulate matters (Respiratory inorganics) (PM)	Disease incidence	(Fantke, 2016)

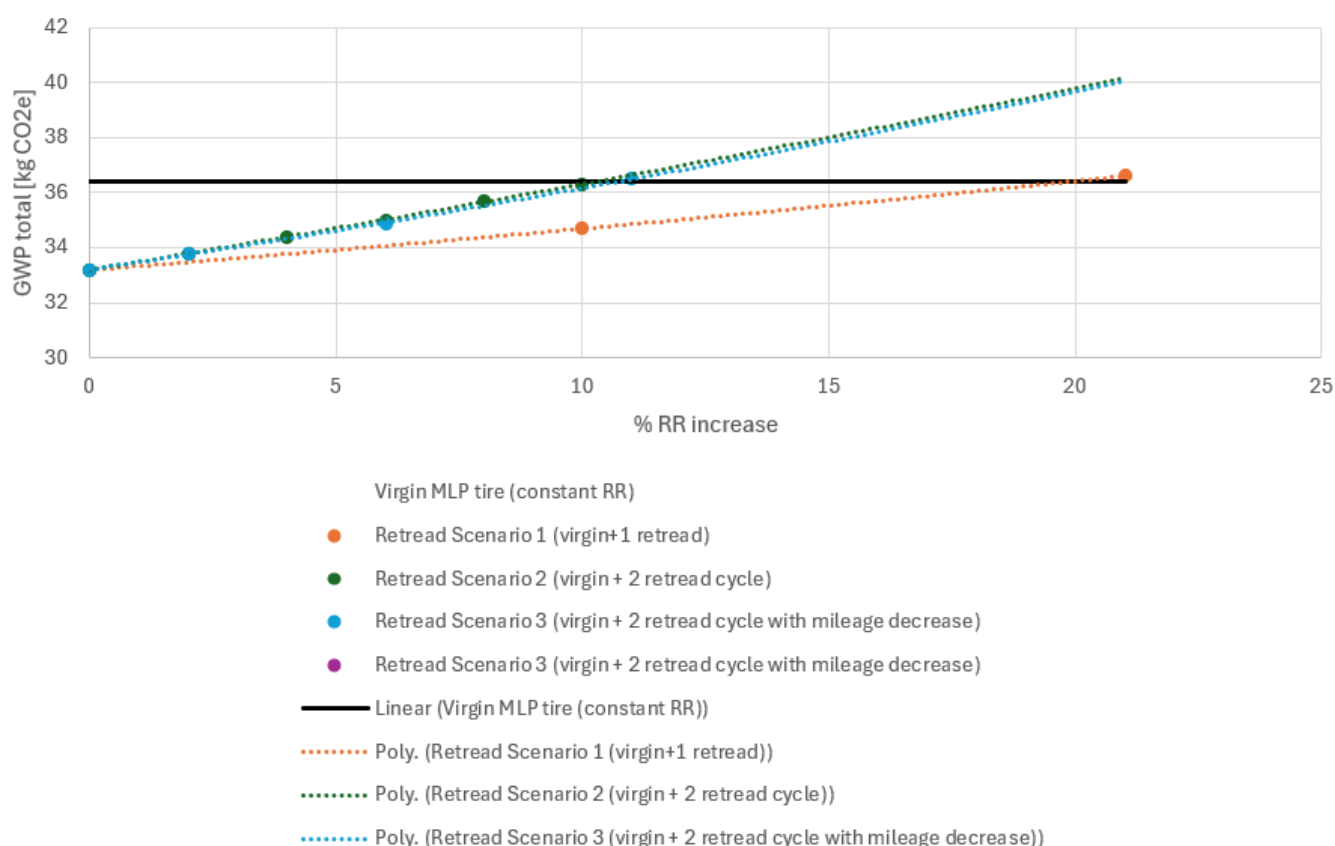
Results

Retreaded Tyre

The study showed that the overall retreading process significantly reduces the cradle-to-gate environmental impacts because it preserves the original tyre casing. Overall, the full retreading process results in **52% lower cradle-to-gate greenhouse gas emissions (GWP)** compared to using new MLP tyres. Due to a lack of reliable rolling resistance data for retreaded tyres a breakeven analysis was conducted. The study looked at different scenarios calculating the break-even point where both retread and virgin MLP truck tyres perform similarly based on GWP contributions and to understand the correlation between the change in rolling resistance, mileage, and number of retreads. The following results were obtained: :

- When the tyre is only retread once, the break-even point for the increase in rolling resistance was found to be 21% with the rolling resistance coefficient being 6,51 kg/t.
- When the tyre is retreaded two times, but no mileage decrease is assumed with the second retread, the break-even point for the increase in rolling resistance was found to be 10% with the rolling resistance coefficient being 5,92 kg/t for the first retread and 6,51 kg/t for the second retread.
- When the tyre is retreaded two times and a 15% decrease in mileage is assumed with the second retread, the break-even point for the increase in rolling resistance was found to be 11% with the rolling resistance coefficient being 5.97 kg/t for the first retread and 6,63 kg/t for the second retread.

Breakeven analysis Retread



Regrooved Tyre

For regrooved tyres, the difference between premium regrooved truck tyres and virgin MLP truck tyres using overall GWP contributions was found to be 14% illustrating regrooved tyres having lower potential impacts. The results also showed that the regrooving process has a positive impact on tyre production due to the preservation of raw materials.

Conclusions

The main takeaways from this study are as follows:

- Retread tyres perform better as a virgin tyres for cradle-to-gate, however, rolling resistance is an important parameter in the use phase of the retreaded tyre that determines the overall environmental impact of the tyre.
- Rolling resistance coefficient is an important parameter that has a significant impact on the GWP impact category. From a Life Cycle Assessment perspective, the use phase is responsible for over 90% of the GWP contribution. Therefore, any specifications that affect rolling resistance, especially of the retreaded tyre should be investigated in more detail.
- Environmental impacts related to the production of tyres are mainly affected by one of the reference flow parameters, the mileage. The amount of tyre consumed depends on the different mileage values, therefore, extended mileage values result in lower impacts in A1 through A3 information modules for retread and regrooved tyres.
- The number of retreading processes has a direct influence on the mileage parameter, in line with the extended mileage approach. When comparing one retread to two retreads, lower environmental impacts were observed in the A1-A3 information modules for both retread. This highlights the potential environmental benefits of increasing the number of retreading cycles, as it proportionally reduces the production phase impacts relative to the use phase.
- Tread height and rolling resistance loss are other important parameters that significantly influence the rolling resistance coefficient and energy consumption over the lifetime of a tyre. The decrease in tread height with the same treadwear indicator height, led to a reduction in rolling resistance loss by 18% which resulted in an approximately 4% increase in energy consumption in the use phase. It is important to note that this difference in tread height, for retread tyre, is not an inherent assumption but rather a result of the data collected during the analysis.
- Regrooved tyres have lower potential impacts for environment, due to the preservation of raw materials.