

EUROPEAN CONSUMER PROTECTION REGARDING RECYCLING PRODUCTS MADE FROM END-OF-LIFE TIRES IN THE CONTEXT OF THE CIRCULAR ECONOMY

Philipp Seuser, Katarína Gubíniová

Comenius University Bratislava, Faculty of Management, Department of Marketing and Commerce, Slovakia

Recycling has become one of the most important topics to saving valuable resources for future generations. Not only the industry, but also governments through legislation, are focusing on producing reusable goods and reusing materials by recycling its components to give them a second, third or in any way a new life. This so-called circular economy is a key component of sustainable development. The aim of this paper is to analyze the conflict between consumer protection and ecological sustainability in order to outline elements of a strategy that will allow both: effective usage of consumer products and sustainable tire recycling.

Keywords: sustainability, recycling, consumer protection, end-of-life cycle, circular economy

Introduction

Sustainability is a topic more relevant today than ever before. All around the world, society and industries are striving to make their operations more sustainable. In recent years, humanity has become aware of the need to improve its way of life. The industry has also recognized that reducing wastefulness is essential to making our planet a safe and livable place for future generations. Given this fundamental development in society and the economy, there are countless efforts to achieve these goals.

The process of recycling tires is complex and fraught with challenges. However, the result is useful rubber granules, pure steel wire, and textile fibers. While the second life of steel and textiles presents no significant hurdles, the reuse of rubber granules poses increasing challenges for the industry. Considering that almost 80% of a tire is rubber, and therefore ends up as rubber granules or powder after recycling, the reuse of this material is crucial. For over 30 years, the industry has developed various products made from rubber granules. A significant portion of rubber granules is used in the production of molded components such as flooring tiles, shock-absorbing pads, and multi-use rubber mats, which are well-known in daily use.

Material and Methods

The aim of this paper is to analyze the conflict between consumer protection and ecological sustainability in order to outline elements of a strategy that will enable both effective usage of consumer products and sustainable tire recycling. This conflict can also be viewed as a tension between the recycling and production industries on one side and governments and consumer advocates on the other. A detailed examination of their conflicting interests will reveal the high risk of escalation and increasing tension within this conflict.

To address the research questions posed in this paper, a comprehensive and multifaceted approach will be utilized. This approach involves a combination of examining scientific literature, conducting analyses and studies, and possessing both scientific and legal expertise. This methodological framework is designed to ensure a robust and thorough understanding of the subject matter from both theoretical and practical perspectives.

Results and Discussion

Resources are inherently limited, leading to the question of how to manage materials and products that have reached the end of their life cycle (Formela, 2021). Tires, whether used for cars, buses, trucks, or other machinery, have limited usability and lifespan. Since the material is not biodegradable, it is crucial to determine what to do with them when they can no longer be used (Shulman, 2019). Reusing the high-quality materials processed from tires is one of the best approaches.

Tire recycling has been a common practice for many years. Different products, which are also well-known in daily use, such as shock-absorbing flooring for playgrounds, running track surfaces, flooring for animal husbandry, and noise isolation systems, are made from rubber derived from recycled tires. In this way, a second life can be given to rubber, while the other materials, such as steel and textiles, can also be utilized in various ways. However, due to the tightening of consumer protection regulations (Brandsma et al., 2019), the recycling business is not only under threat but is on the brink of collapse. Governmental regulations, such as the REACH regulation, continuously pose new challenges to the industry, and negative portrayals of recycling products made from old tires in media contribute to this issue (Celeiro, 2021). A combination of strict regulations based on outdated research and a negative public image could soon force the industry to cease its recycling operations.

Without significant initiatives to analyze the hazardous risks (Llompарт, 2013) of recycling products made from tires in light of new scientific findings, there will soon be no viable way to economically recycle tires. Therefore, it is essential to examine both the legal and chemical contexts surrounding tire recycling and find a path forward for this important and sustainable business model. If tire recycling is not possible, the alternative would be to dispose of tires globally or burn them as an alternative fuel for processes like concrete production (Fazli and Rodrigue, 2020). Such alternatives would cause severe environmental damage and cannot be considered sustainable solutions.

Globally, approximately 19 million tons of tires, rich in raw material, are produced every year, while over 25 million tons of tires reach their end-of-life status when they can no longer be used due to their age or less profile (EuRIC MTR, 2023). In Europe, more than five million tons of tires are produced

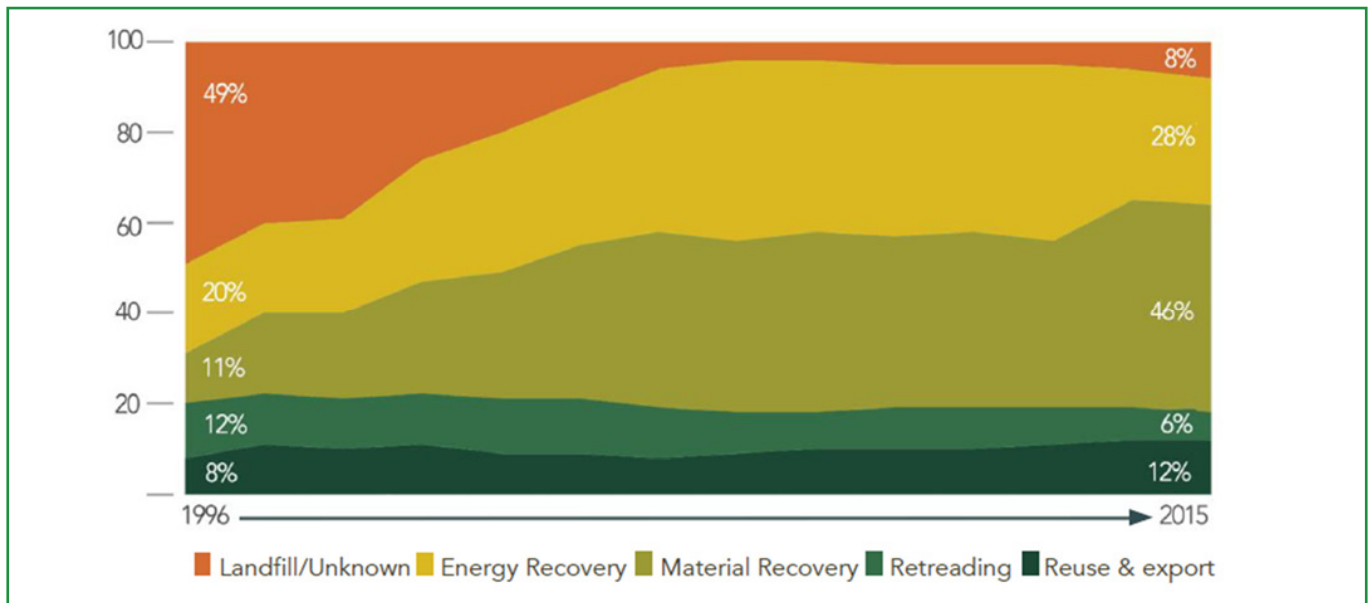


Figure 1 ELT Management Trends in Europe

Source: EuRIC MTR, 2023

annually, and over three million tons of end-of-life tires are generated (EuRIC MTR, 2023). This illustrates that we are discussing not just a small, isolated sector but an industry of considerable importance to our circular economy. For each ton of tires that undergoes recycling, the environment is spared from 700 kg of CO₂ emissions (Navazas, 2021). As previously mentioned, awareness of sustainability has increased significantly in recent years. In 1996, almost 50% of end-of-life tires (ELTs) ended up in landfills or other unknown locations; today, only 8% are landfilled. Conversely, in 1996, only 11% of old tires were recycled, while today, over 46% are recycled as material recovery.

The resources saved by recycling a tire are substantial: by recycling one truck tire, 70% of resources are saved, land use is reduced by 29%, CO₂ emissions are decreased by 24%, air pollution is reduced by 21%, and water consumption is decreased by 19% (Mugnier, 2016). Dividing a tire into its components reveals the following composition:

Almost half of a tire consists of rubber, meaning that up to 47% of a tire can be reused as rubber material while retaining its excellent characteristics, such as shock absorption, elasticity, and weather resistance. Carbon black makes up about 20% of the tire's composition but is not separated during mechanical recycling; it remains within the rubber material. The metal included in a tire, in the form of metal wires, can be fully separated during the granulation process and subsequently melted down to produce new steel products. Textiles, which are also fully separated in the recycling process, can be utilized as fuel in various production processes that require significant heating energy.

In total, 300 million tires accumulate in Europe each year (Navazas, 2021). Today, tire recyclers face a major waste challenge by transforming tires into sustainable resources. Enabling tire recycling in the future will be a critical component of achieving the goals outlined in the European Green Deal. Furthermore, banning tire recycling would have significant socio-economic impacts for both tire recyclers and communities that benefit from using tire recycling material in leisure applications (Navazas, 2021).

The concept of a circular economy is not new; it has been present in today's society for many years and can be viewed as a collection of scientific and semi-scientific approaches, including ecological economics, eco-efficiency, resilience science, natural capitalism, and cleaner production (Corvellec, Stowell and Johansson, 2022). However, there is still no consistent definition of a circular economy.

Different definitions, such as that of Sauvé et al. (2016), state that the circular economy refers to the "production and consumption of goods through closed-loop material flows that internalize environmental externalities linked to virgin resource extraction and the generation of waste" (Sauvé et al., 2016). Peston (2012) defined the circular economy as "an approach that would transform the function of resources in the economy. Waste from factories would become a valuable input to another process – and products could be repaired, reused, or upgraded instead of thrown away" (Preston, 2012). The European Union has described a circular economy as one "where the value of products, materials, and resources is maintained in the economy for as long as possible, and the generation of waste is minimized" (Rizos, Tuokko

Table 1 Materials Tires are made of

Material (wt.%)	Car Tire	Truck Tire	Off-the-Road Tire
Rubber/Elastomers	47	45	47
Carbon Black, Silica	22.5	21	22
Metals	14	23.5	12
Textiles	5.5	1	10
Vulcanization Agents	2.5	3	3
Additives	8.5	6.5	6

Source: Fazil and Rodrigue, 2020

and Behrens, 2017). This model can be divided into many process parts, such as using fewer primary resources, maintaining the highest level of materials and products, and changing utilization patterns; it is, of course, very complex in its structure (Rizos, Tuokko and Behrens, 2017). Given this complexity, it is mandatory to redesign industrial systems. To achieve a higher level of resource productivity, the idea of recycling needs to be implemented through systemic and structural changes. Since this should not just be a voluntary option, the European government implemented the Extended Producer Responsibility (EPR). This was defined in 2008 in the European Directive 2008/98/CE and involves all producers of products that become waste in their lifecycle (Avilés-Palacios and Rodríguez-Olalla, 2021). This regulation is expected to place more responsibility on producers regarding investing in the development of more sustainable products that can be recycled. By investing in more sustainable product design, companies that recycle these products may face fewer problems, particularly concerning toxic ingredients. In the case of tires, this could lead to the necessity for producers to select materials used to manufacture tires more carefully in order to enable a second life for these resources (Celeiro, 2021).

Today, with a significant percentage of tires already being recycled, this may seem redundant for this specific industry. However, the circular economy and recycling of tires are facing a fundamental problem: the regulation of chemicals included in consumer products. Because toxic substances, such as polycyclic aromatic hydrocarbons (PAHs), are found in tires, the use of granules from recycled tires is nearing its end. The Regulation on the Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH) imposes serious restrictions on the production and sale of consumer products containing substances listed in this regulation. Consequently, the concept of a circular economy will falter when it comes to tire recycling. This situation presents a significant challenge to the industry and threatens to inhibit the third step of the waste hierarchy (Skoczyńska, 2021). Recycling of tires may soon no longer be feasible, and energy recovery will be the only viable option for managing old tires. In terms of a circular economy, this development negatively impacts the ecological outcomes and sustainability of the entire tire industry (Skoczyńska, 2021).

To understand the conflict between consumer protection and sustainability, it is crucial to consider the legislative background of consumer protection. Therefore, the following part of the paper will explain both the national German and the international European levels of consumer protection in terms of legislative frameworks. Additionally, an important aspect of the regulation applicable to products made from end-of-life tires (ELT) is the testing methods for PAHs present in the product or migrating from it. Within the European Union, product safety regarding consumer protection is a topic of general interest. In 1992, the European Union first published the 92/59/EEG on general product safety (Lach and Polly, 2015). The European Economic Community (EEC) decided that "it is therefore necessary to establish on a Community level a general safety requirement for any product placed on the market that is intended for consumers or likely to be used by consumers" (Official Journal of the European Communities, 2022). This led to the continuously updated European Product Safety Act, which serves as the foundation for national regulations. Member states are required to implement European directives into national law and practice.

On June 1, 2007, the new European chemicals regulation, known as REACH (Registration, Evaluation, and Authorisation of Chemicals), entered into force. From that date, all substances placed on the market "with a production or import volume of more than one ton per year must be systematically tested for their hazardous properties" (REACH, 2022). The REACH regulation published in EU regulation 1907/2006 places the responsibility directly on

the industry to manage the risks of produced substances and products and to publish safety information about them in the database of the European Chemicals Agency (ECHA) in Helsinki (REACH, 2022).

On a national level, for example in Germany, the National Products Safety Act ensures the country's compliance with European directives. This act provides additional guidance on how to handle European regulations in detail. Based on this national law, the so-called German Product Safety Act (ProdSG) establishes the Federal Institute for Occupational Safety and Health (BAuA) as the primary interface between the market surveillance authorities of the federal states, the federal government, and Europe (Product Safety Act, 2022). Viewed as an extension of the European Commission, the BAuA links the Commission to its member states. Its most important tasks include information exchange, risk assessment, participation in product safety commissions, and the publication of announcements (Product Safety Act, 2022). Additionally, national legislation is built on international regulations, such as REACH, to implement them in local markets. Furthermore, in the federal states, local inspection bodies verify products with potential risks to ensure compliance with legal regulations before and during their distribution in any European market (Product Safety Act, 2022). Consequently, there exists a close network of legal frameworks and authorities dedicated to ensuring consumer safety within the European Union and its member states. On one hand, this leads to the protection of the domestic market from any imported products outside this union, which can be viewed as protection for the domestic industry. On the other hand, especially REACH could pose challenges to the functioning of the market economy in the European Union (Petry, Knowles and Meads, 2006).

Conclusion

It is clear that the topics of sustainability and consumer protection are in conflict within the tire recycling industry. Due to the significant political and socio-ecological pressure for sustainability across all sectors of the economy, tire recycling is a highly relevant issue. Developing a solution that facilitates tire recycling and the production of products made from recycled materials will lead to a significant improvement in sustainability throughout the European economy. Tires are essential for daily life, and the sources of raw materials such as rubber and oil are limited.

The solution must address the requirements of all stakeholders: on one hand, the industry needs a framework that allows for long-term planning and investment in recycling operations and related production facilities. On the other hand, consumers need assurance that any products offered on the market are safe. Therefore, it is crucial to invest in scientific research to evaluate the risks of various diseases, particularly cancer.

The academic work in this area is of utmost importance, as discussions about this research topic have been ongoing for many years, and a revision of the REACH regulation was supposed to be completed by the end of 2017. However, to date, it appears that no political stakeholders are actively pursuing a solution to this problem. By resolving the conflict between consumer protection and sustainability, not only can the tire recycling industry in Europe survive and thrive, but playgrounds and public spaces can also become safe environments for play and training in the years to come.

References

- NAVAZAS, A. 2021 Boosting tyre recycling: Essential to the European Green Deal. EURACTIVE.
- AVILÉS-PALACIOS, C. – RODRÍGUEZ-OLALLA, A. 2021. The Sustainability of Waste Management Models in Circular Economies. In *Sustainability*, vol. 13, 2021, pp. 7105.

- BfR. Risikobewertung von Chemikalien unter REACH. https://www.bfr.bund.de/de/risikobewertung_von_chemikalien_unter_reach-223.html
- BRANDSMA, S. H. – BRITS, M. – GROENEWOUD, Q. R. – VAN VELZEN, M. J. M. – LEONARDS, P. E. G. – BOER, J. 2019. de Chlorinated Paraffins in Car Tires Recycled to Rubber Granulates and Playground Tiles. In *Environmental Science & Technology*, vol. 53, 2019, pp. 7595–603.
- CELEIRO, M. – ARMADA, D. – DAGNAC, T. – BOER, J. DE – LLOMPART, M. 2021. Hazardous compounds in recreational and urban recycled surfaces made from crumb rubber. Compliance with current regulation and future perspectives. In *The Science of the total environment*, vol. 755, 2021.
- COMMISSION OF THE EUROPEAN COMMUNITIES. 2000 Seventeenth Annual Report on Monitoring the Application of Community Law (1999). Office for Official Publications of the European Communities, 2000.
- CORVELLEC, H. – STOWELL, A. F. – JOHANSSON, N. Critiques of the circular economy. In *Journal of Industrial Ecology*, vol. 26, 2022, pp. 421–432.
- DIRECTIVE 2005/29/EC of the European Parliament and of the Council in Radley-Gardner, O. R. – G. QC, H. Beale, R. Zimmermann and R. Schulze (eds.). *Fundamental texts on European private law*, 2nd ed., Hart Publishing Limited, 2016.
- ECHA, Mission: Who we are. <https://echa.europa.eu/about-us/who-we-are/mission>
- ETRM, Circular Economy is a system to reduce – and eventually eliminate – waste and manage raw materials' scarcity through the continual use of resources. <https://www.etrma.org/key-topics/circular-economy/>
- EuRIC MTR. 2023. Mechanical Tyre Recycling Fact Sheet: Recycling: Bridging circular economy & climate policy. Brussels, 2023. <https://euric.org/resource-hub/reports-studies/mechanical-tyre-recycling-factsheet>
- FAZLI, A. – RODRIGUE, D. 2020. Recycling Waste Tires into Ground Tire Rubber (GTR)/ Rubber Compounds: A Review. In *Journal of Composites Science*, vol. 4, 2020, no. 3, pp. 103. <https://doi.org/10.3390/jcs4030103>
- FORMELA, K. 2021. Sustainable development of waste tires recycling technologies – recent advances, challenges and future trends. In *Advanced Industrial and Engineering Polymer Research*, vol. 7, 2021, no. 4, pp. 209–222. <https://doi.org/10.1016/j.aiepr.2021.06.004>
- FRANZ, R. – GRUBER, L. 2018. Determination of migration of polycyclic aromatic hydrocarbons (PAH) from a polyurethane(PU)-coated rubber slab. In *Test Report*, 2018.
- HARITASH, A. K. – KAUSHIK, C. P. 2009. Biodegradation aspects of Polycyclic Aromatic Hydrocarbons (PAHs): A review. In *Journal of Hazardous Materials*, vol. 169, 2009, pp. 1–15.
- HOFMANN, T. G. 2020. Expert opinion on the toxicological risk assessment of polyaromatic hydrocarbons in rubber products and safety salbs made of granulte from recycled used tires. 2020.
- JONGENELEN, F. J. 1997. Methods for routine biological monitoring of carcinogenic PAH-mixtures. In *Science of The Total Environment*, vol. 199, 1997, pp. 141–149.
- LACH, S. – POLLY, S. 2015. Produktsicherheitsgesetz: Leitfaden für hersteller und händler. 2nd ed., Wiesbaden (Germany) : Springer Gabler, 2015.
- LAWAL, A. T. 2017. Polycyclic aromatic hydrocarbons. A review. In *Cogent Environmental Science*, vol. 3, 2017.
- LLOMPART, M. – SANCHEZ-PRADO, L. – PABLO LAMAS, J. – GARCIA-JARES, C. – ROCA, E. – DAGNAC, T. 2013. Hazardous organic chemicals in rubber recycled tire playgrounds and pavers. In *Chemosphere*, vol. 90, 2013, pp. 423–431.
- MUGNIER, E. – FARHANGI, C. – KLEY, S. – AUREZ, V. 2016. The socio-economic impact of truck tyre retreading in Europe: The circular economy of tyres in danger. EY, Building a better working world, 2016.
- PETRY, T. – KNOWLES, R. – MEADS, R. 2006. An analysis of the proposed REACH regulation. In *Regulatory toxicology and pharmacology : RTP*, vol. 44, 2006, pp. 24–32.
- PRESTON, F. 2012. A global redesign? Shaping the circular economy: Energy, Environment and Resource Governance. 2012.
- PRODUCT SAFETY Act. https://www.baua.de/EN/Tasks/Statutory-and-sovereign-tasks/Product-safety-act/Product-safety-act_node.html [03 September 2022]
- REACH, annex XVII, restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles : ReachOnline. <https://reachonline.eu/reach/en/annex-xvii.html> [03 September 2022].
- REACH – Registration, Evaluation, Authorisation and Restriction of Chemicals. https://reachonline.eu/REACH/EN/REACH_EN/article67.html [03 September 2022]
- REACH – the new European chemicals legislation – BfR. https://www.bfr.bund.de/en/reach_the_new_european_chemicals_legislation-9749.html [03 September 2022]
- RIZOS – TUOKKO – BEHRENS. 2017. The Circular Economy: A review of definitions, processes and impacts. 2017.
- SAUVÉ, S. – BERNARD, S. – SLOAN, P. 2016. Environmental sciences, sustainable development and circular economy: Alternative concepts for trans-disciplinary research. In *Environmental Development*, vol. 17, 2016, pp. 48–56.
- SHULMAN, V. L. 2019. Tire Recycling. In *Waste*, 2019, pp. 489–515.
- SKOCZYŃSKA, E. – LEONARDS, P. E. – LLOMPART, M. – BOER, J. 2021. Analysis of recycled rubber: Development of an analytical method and determination of polycyclic aromatic hydrocarbons and heterocyclic aromatic compounds in rubber matrices. In *Chemosphere*, vol. 276, 2021.
- SUMMER TOBOGGANS RUNS – Part 2: Safety requirements for operation. 2018.
- TOXICITY OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHs). 2012. Ed. by Agency for Toxic Substances and Diseases Registry. Agency for Toxic Substances and Diseases Registry, Case Studies in Environmental Medicine:
- TRUDSØ, L. L. – NIELSEN, M. B. – HANSEN, S. F. – SYBERG, K. – KAMPMANN, K. – KHAN, F. R. – PALMQVIST, A. 2022. The need for environmental regulation of tires: Challenges and recommendations. In *Environmental Pollution*, vol. 311, 2022. <https://doi.org/10.1016/j.envpol.2022.119974>
- ZHANG, C. – HU, M. – DI MAIO, F. – SPRECHER, B. – YANG, X. – TUKKER, A. 2022. An overview of the waste hierarchy framework for analyzing the circularity in construction and demolition waste management in Europe. In *The Science of the total environment*, vol. 803, 2022.
- WORLD HEALTH ORGANIZATION. Cancer. <https://www.who.int/news-room/fact-sheets/detail/cancer>

Contact address

Philipp Seuser
Comenius University Bratislava, Faculty of Management
Department of Marketing and Commerce
Odbojárov 10, 820 05 Bratislava 25, Slovakia
✉ Seuser1@uniba.sk

Katarína Gubíniová
Comenius University Bratislava, Faculty of Management
Department of Marketing and Commerce
Odbojárov 10, 820 05 Bratislava 25, Slovakia
✉ Katarina.Gubiniova@fm.uniba.sk

