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## END-OF-LIFE VEHICLES MANAGEMENT IN ROMANIA: AN OVERVIEW

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**Abstract:** Vehicles, which people are so dependent on, are produced all over the world in quite large number. Therefore, when they become obsolete or can no longer be repaired from various reasons, are called end-of-life vehicles (ELVs). Considering the high number resulting annually, the legislation in force, in each EU member country, obliges the insurance of treatment activities for all end-of-life vehicles, and so in this way the concept of sustainable development is supported. The main purpose of this paper is to provide an overview on end-of-life vehicles treatment operations, and also an analysis regarding the quantity of ELVs generated and then reused (REU), recycled (RCY) respectively recovered (RCV). The analyzed data were obtained from Statistical office of the European Union. The study makes a comparison between Romania, the Member States of UE and the quantitative targets that are set out in the End-of-life vehicle Directive. In Romania the REU-RCV and REU-RCY percent for year 2020 was 91.60% respectively 85.40%. Therefore, Romania fulfilled the conditions related to the imposed targets only for reuse-recycling rate.

**Keywords:** End-of-life vehicles (ELVs), Recovery, Recycling, Reuse, Eurostat

### INTRODUCTION

Considering the large number, the end of life vehicles (ELVs) can represent a major problem of the contemporary world, as an incorrect treatment can have a negative impact on the environment.

So, in 2000, the European Union issued the Directive 2000/53/EC of the European Parliament and of the Council on end-of-life vehicles [1] and thereby has introduced means to promote and increase recycling [2]. At the same time, it established the minimum technical requirements for the treatment of ELVs. The EU policy on ELVs emphasizes the importance of a correct management approach as related to treatment operations of all components and materials that can be found in a vehicle. Therefore, the targets imposed by the European Commission according to Article 7 (2b) of Directive 2000/53/CE are: by "1 January 2015, for all end-of-life vehicles, the reuse and recovery shall be increased to a minimum of 95 % by an average weight per vehicle and year. Within the same time limit, the reuse and recycling shall be increased to a minimum of 85 % by an average weight per vehicle and year". This directive is transposed into Romanian legislation by Law 212 of July 21, 2015, regarding the management of end-of-life vehicles. All economic agents that deal with ELVs management must comply with all the specifications of the law mentioned above.

According to the literature [3], the European Union member states apply the diagram shown in Figure 1 in the process of ELVs managing.

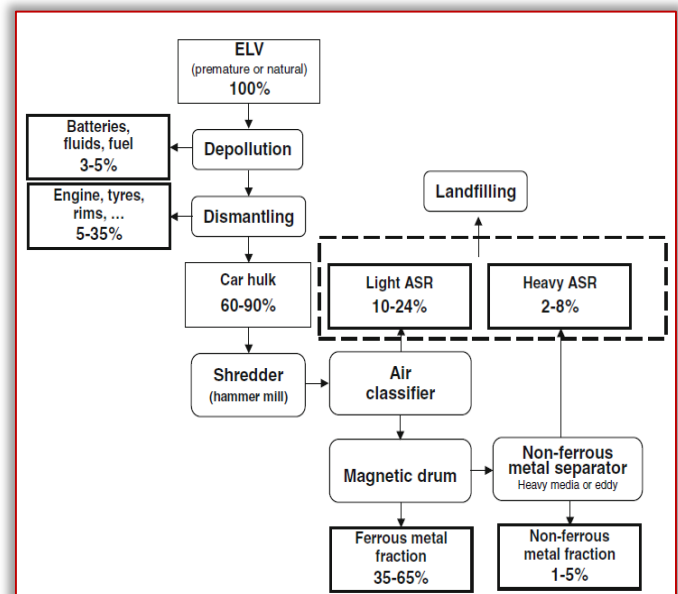


Figure 1. The treatment flow of end-of-life vehicles in the European Union [3]

Usually, in the treatment of end-of-life vehicles are followed three main stages [4,5,6]:

- *depollution*, an essential stage in which all hazardous substance, materials and components are selectively removed such as batteries, fuels, pyrotechnic components, cooling fluids, components containing mercury, oils, glass;
- *the dismantling* stage involving the removal of components that can be reused as such or can be reconditioned and then reused such as wheels, engines, plastic parts, radiators and
- *the shredding* stage where the car hulks are fed into a hammer mill. The resulting fragments are sorted into ferrous and non-ferrous metals and a residues named automotive shredder residue (ASR).

In Article 6 (3c) of Directive 2000/53/CE is specified that the dismantling stage must be carried out in such a way as to allow the reuse, recovery and, in particular, the recycling of vehicle components. *Ferrous fraction* (steel) and *non-ferrous metals* (aluminum, copper, zinc, lead, etc.) represent about 70–75%, respectively 5% of the mass of an end-of-life vehicle [6] and can be reused or recycled in proportion to about 100%. The rest of 20–25% waste that remains after shredding called automotive shredder residue (ASR) [6] is divided in two categories: *heavy fraction* which contains glass and metal fines and *light fraction* that contain plastic, rubber, textiles, etc. [7]. So, in order to reach the target of 95% for reuse–recovery must be found efficient and clean methods to improve the ASR recovery.

Economic operators involved in ELVs treatment activities can be guided by the International Dismantling Information System (IDIS). IDIS is a platform that contains information on the preliminary treatment and dismantling of end-of-life vehicles. Moreover, it provides instructions for airbag deployment and handling of high voltage batteries respectively information on parts and components with recycling potential, mentioned in the EU directive on end-of-life vehicles [8]. The platform covers over 72 vehicle brands and is available in 43 countries including Romania, and 31 languages [8].

The paper emphasize the obligatory main stages in ELVs treatment, analyze the trend concerning the rate of reuse, recovery, recycling for Romania (in period 2012–2021), and then compare the data with those of the EU member states and with the target imposed by the EU. The data used for graphical dependencies presented regarding ELVs generation, reuse (REU), recovery (RCV) and recycling (RCY) were obtained from the Statistical Office of the European Union (Eurostat) website [9].

### END-OF-LIFE VEHICLES MANAGEMENT IN ROMANIA

In 2023, approximately 94 million motor vehicles [10] were produced worldwide, 10% more than the previous year, as can be seen in figure 2. Considering the large number generated, it is predictable that the number of vehicles removed from use is also high. The studies [7] indicate that every year 50 million vehicles become waste or ELVs to be treated.

Based on statistical data, in 2021 [9], only in European Union member countries

approximately 5.68 million ELVs were subjected to treatment operations (Figure 3).

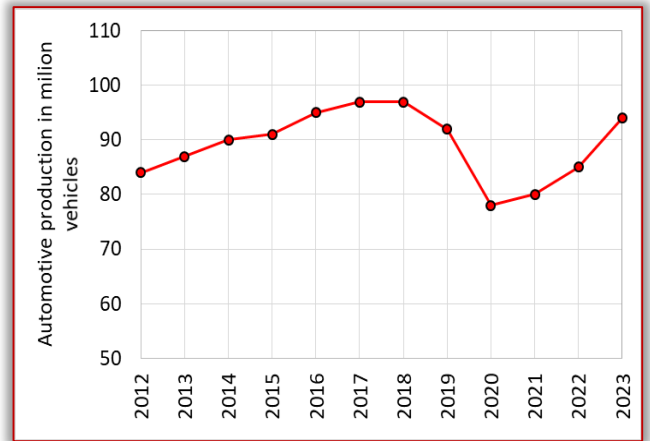


Figure 2. Estimated global motor vehicle production (reproduced from Statista 2024 [10])

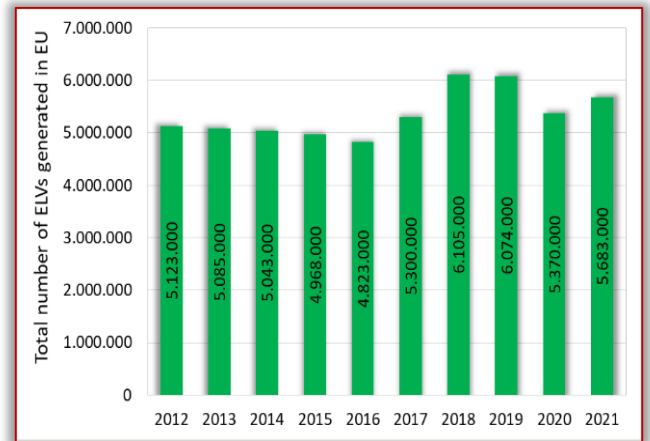


Figure 3. Total number of ELVs generated by current EU member states, in period 2012–2021

Figure 4 shows the number of ELVs generated by current EU member states over a 10-year period (2012–2021).

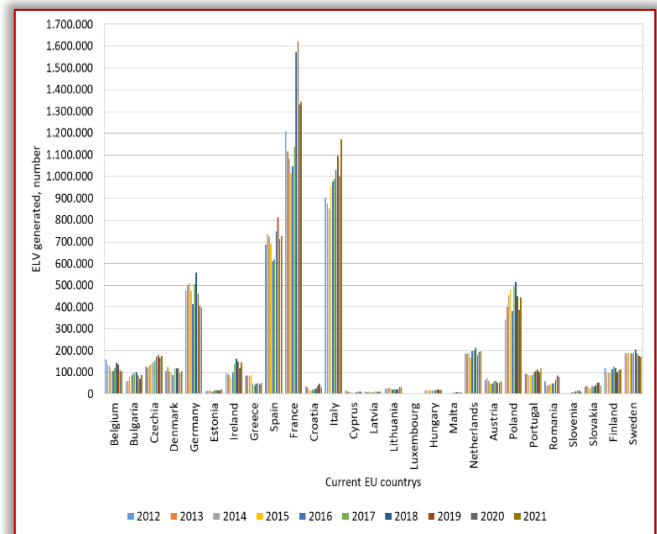


Figure 4. ELVs generated by current EU member states in period 2012–2021

Analyzing the number of ELVs for year 2021, was found that the countries that removed from use the largest and the smaller number of vehicles

more precisely 1.345.831 and 2.497, are France respectively Luxembourg.

By calculating the arithmetic mean of the ELVs number generated for each country for the last decade, it turned out that France is in the first place with a number of 1.248.299 end-of-life vehicles, followed by Italy (986.008 ELVs) and Spain (707.143 ELVs). Romania did not exceed the value of 100.000 ELVs annually, the highest number of end-of-life vehicles being 84.621 in 2019 (Figure 5).

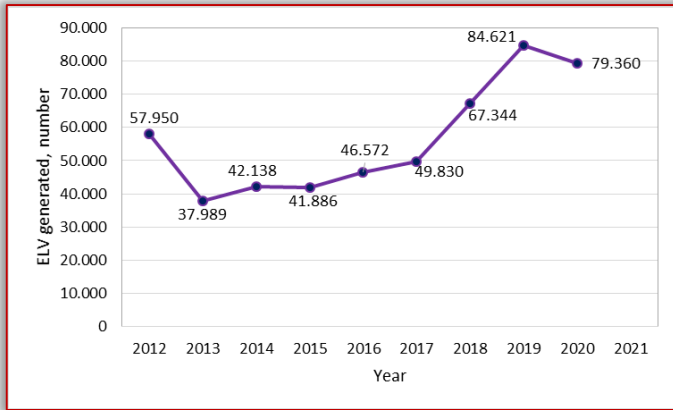


Figure 5. ELVs generated in Romania in period 2012–2020

As specified above, economic operators treating end-of-life vehicles are required to reuse (REU) and recover (RCV) at least 95% of the average mass per vehicle per year. The graph in figure 6 shows the percentage quantities obtained in Romania compared to the European Union average and the impose target. Studying the chart, we notice that Romania managed to obtain percentage values slightly below the average results obtained for EU. During the period 2016–2020 our country succeeded to exceed the reuse and recycling rate of 90%, but the target imposed was not reached.

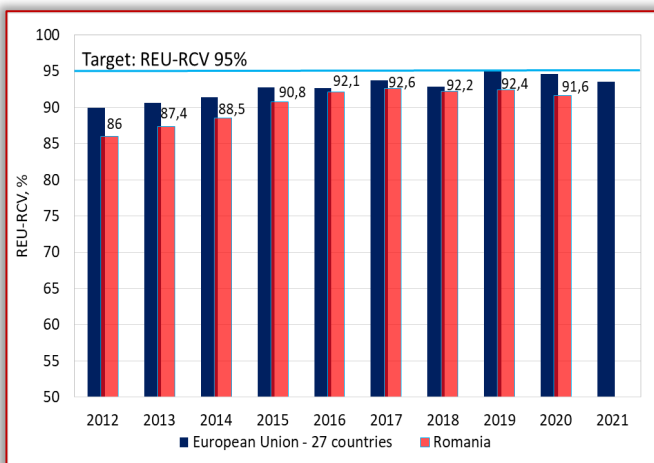


Figure 6. ELVs reused and recovered (REU–RCV) [%] in Romania compared with EU average and EU target

If we refer to the reuse and recycling rate, we can see in figure 7 that the target imposed of 85% is achieved from year 2015 until 2020.

From the data provided by EUROSTAT, it is found that that in 2020, twenty-four member states achieved the reuse–recycling target of 85%, and twenty achieved the reuse–recovery target of 95%.

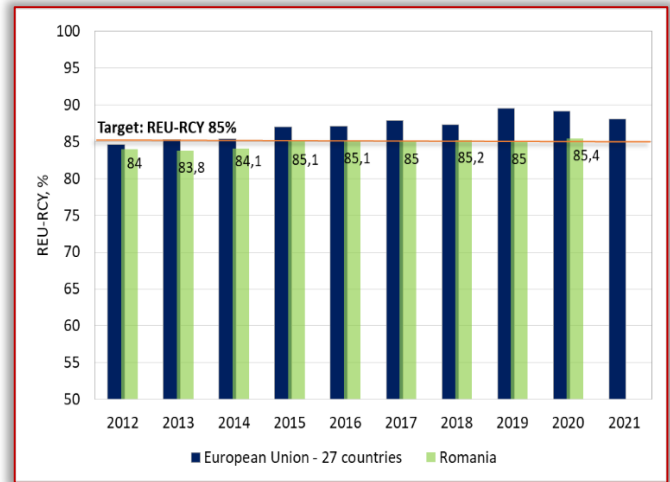


Figure 7. ELVs reused and recycled (REU–RCY) [%] in Romania compared with EU average and EU target

In Romania, the monitoring of the objectives regarding the reuse, recycling and recovery of ELVs is done according to Annex 2 of H.G. 2406/2004 [11]. The REU–RCV rate is calculated by dividing the total amount reused and recovered to the total mass of end-of-life vehicles, and the REU–RCY rate is the ratio of the total amount reused and recycled to the total mass of end-of-life vehicles. The values are reported as percentage.

Increasing the reuse and recovery rate at 95% could be achieved by finding efficient and environmentally friendly treatment methods of waste that remains after shredding called automotive shredder residue. Must be mentioned that ASR is a complicated solid waste, if we refer to its composition, since it contains different plastics, elastomers, foams, metals, glass, textiles, etc. [12] and so is hard to recycle. But, for example Santini A., et al. [13] showed that recycling of light, organic fraction of ASR through mechanical separation and pyrolysis could be a suitable recycling method if the resulted oil can be refined and used as chemical.

Another low cost, green recycling strategy elaborated Yang S. [14] called solid state shear milling technology (S<sup>3</sup>M), applied on ultrafine fraction of ASR, is used to obtain polypropylene composites that can be used in the production of container for waste, plastic garbage bags

etc. Thus must find more efficient recovery solutions for ASR, knowing that the most unfavorable option in waste treatment is disposal.

## CONCLUSIONS

End-of-life vehicles can have a negative impact on the environment if they are not treated properly by the economic agents involved in this process. Therefore, Romania, together with the rest of the EU member states, meet or trying to reach and exceed the reutilization, recycling and recovery targets set in the Directive 2000/53/CE.

For Romania, the next conclusions can be drawn:

- In year 2020 achieved the reuse – recycling target of 85% along with twenty-four other member states;
- The highest reuse – recovery rate of 92.4% was achieved in 2017, while in 2020 the obtained percentage was slightly lower (91.6%);
- In order to achieve and exceed the 95% reuse-recovery target, attention must be directed to more effective utilization of the automotive shredder residue.

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ISSN: 2067-3809

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