LIFE CIRC-ELV

BOOSTING CIRCULAR ECONOMY OF PLASTICS FROM END-OF-LIFE VEHICLES THROUGH RECYCLING INTO HIGH ADDED-VALUE APPLICATIONS

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PU	Public	✓
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

Table of Contents

1. Summary and Objectives

LIFE CIRC-ELV project aims to develop a new management model for End-of-Life Vehicles (ELVs). This new model is focussed on the plastics that are present in ELVs for increasing their recovery ratio and their quality in an early stage, so they are suitable for recycling. Therefore, a new business model would arise for recycled plastics coming from ELVs, which is intended to be techno-economic and environmentally sustainable.

This deliverable is an updating on the ELV management situation in the LIFE CIRC-ELV project areas (Spain, France and Portugal) and the European Union (EU). The main objectives of it are:

- To gather information on the specific situation in each project area, including information about number of ELVs managed, management models applied, recovery/recycling rates and key actors in the ELV and plastics recycling chains.
- To identify any novelty arising, from proposal submission date up to now, that can have an impact on the project, i.e., changes in legislation, novel treatment technologies, other technical developments, etc.
- To define the baseline for the project to be monitored as it is being developed
- To identify potential key actors for further actions to be conducted during the project

2. Methodology

The information updating will be carried out through literature reviewing and consultation of specialized databases, like scientific publications, in force legislation (both at EU & national level), patents, novel technological developments (by using the SoftVT Technological Watch Service from AIMPLAS) and guides/documentation from applicable sectorial forums.

Each partner will take advantage of their networks to gather additional information when necessary, and to validate the information provided here.

3. Number of ELVs managed in the EU

The European Commission issued the Decision 2005/293/EC[1] laying down detailed rules on the monitoring of the reuse/recovery and reuse/recycling targets, set out in Directive 2000/53/EC on end-of-life vehicles, for controlling the compliance with these targets. This Decision 2005/293/EC (published on April 2005) establishes that Member States had to report on an annual basis (starting on 2006) to the European Commission the specific information on key waste streams together with the information of the number of ELVs treated.

[1] 2005/293/EC: Commission Decision of 1 April 2005 laying down detailed rules on the monitoring of the reuse/recovery and reuse/recycling targets set out in Directive 2000/53/EC of the European Parliament and of the Council on end-of-life vehicles (notified under document number C(2004) 2849). ELI: http://data.europa.eu/eli/dec/2005/293/oj

This information is published by the statistical office of the European Union (Eurostat) in its website, under the specific information on key waste streams[2]. However, data is only available only up to 2016 for the number of ELVs treated for different countries across the EU.

Table 1 shows the information available in the Eurostat database for the 2006-2016 period, regarding to the number of ELVs treated. It is important to point out that there are some countries that have not reported their data for the last years (2015 and/or 2016): these are set in Table 1 as 'N/A'.

[2] European Commission > Eurostat Waste > Key Waste streams > End of life vehicles (ELVs) https://ec.europa.eu/eurostat/web/waste/key-waste-streams/elvs

Table 1. Number of ELVs treated 2006-2016 in the EU countries (in alphabetical order)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Austria	87,277	62,042	63,975	87,364	82,144	80,004	64,809	73,993	59,904	47,926	48,077
Belgium	131,043	127,949	141,521	140,993	170,562	165,016	160,615	134,506	126,835	107,425	106,458
Bulgaria	45,127	23,433	38,600	55,330	69,287	62,937	57,532	61,673	80,862	85,946	92,706
Cyprus	1,032	2,136	14,273	17,303	13,219	17,145	17,547	13,212	11,160	8,293	5,151
Czech Republic	56,582	72,941	147,259	155,425	145,447	132,452	125,587	121,838	131,987	139,440	145,928
Denmark	102,202	99,391	101,042	96,830	100,480	93,487	106,504	125,650	104,413	98,929	89,039
Estonia	11,035	12,664	13,843	7,528	7,268	11,413	12,835	14,712	14,720	12,884	11,184
Finland	14,945	15,792	103,000	96,270	119,000	136,000	119,000	99,300	94,540	99,630	114,460
France	930,000	946,497	1,109,876	1,570,593	1,583,283	1,515,432	1,209,477	1,115,280	1,084,766	1,016,326	1,046,083
Germany	499,756	456,436	417,534	1,778,593	500,193	466,160	476,601	500,322	512,163	473,386	412,801
Greece	29,689	47,414	55,201	115,670	95,162	112,454	84,456	86,205	82,863	87,050	46,573
Hungary	20,976	43,433	37,196	26,020	15,907	13,043	15,357	14,897	15,283	16,788	15,141
Ireland	N/A	112,243	127,612	152,455	158,237	134,960	102,073	92,467	86,950	74,910	98,213
Italy	1,379,000	1,692,136	1,203,184	1,610,137	1,246,546	952,461	902,611	876,052	853,584	958,245	978,960
Latvia	6,288	11,882	10,968	10,590	10,640	9,387	10,228	9,003	9,268	8,924	8,049
Liechtenstein	N/A	82	91	72	107	94	114	326	188	230	260
Lithuania	13,877	15,906	19,534	19,656	23,351	26,619	22,885	26,482	29,982	26,546	21,306
Luxembourg	4,864	3,536	2,865	6,908	6,303	2,341	2,834	2,290	2,225	1,617	1,854
Netherlands	192,224	166,004	152,175	191,980	232,448	195,052	187,143	183,451	188,487	N/A	N/A
Norway	105,324	95,128	130,018	95,000	112,537	124,563	119,905	141,452	139,920	145,098	142,280
Poland	150,987	171,258	189,871	210,218	259,576	295,152	344,809	402,416	454,737	478,202	N/A
Portugal	25,641	90,509	107,746	107,946	107,419	77,929	92,008	92,112	86,713	84,158	88,559
Romania	21,234	36,363	51,577	55,875	190,790	128,839	57,950	37,989	42,138	41,886	N/A
Slovakia	15,069	28,487	39,769	67,795	35,174	39,171	33,469	36,858	29,175	26,176	36,931
Slovenia	9,418	8,409	6,780	7,043	6,807	6,598	5,447	N/A	6,260	N/A	N/A
Spain	954,715	881,164	748,071	952,367	839,637	671,927	687,824	734,776	724,820	689,760	611,446
Sweden	283,450	228,646	150,197	133,589	170,658	184,105	185,616	189,748	186,967	188,810	186,875
United Kingdom	995,569	1,138,496	1,210,294	1,327,517	1,157,438	1,220,873	1,163,123	1,149,459	1,106,846	995,527	1,103,050
TOTAL	**6,087,324**	**6,590,377**	**6,394,072**	**9,097,067**	**7,459,620**	**6,875,614**	**6,368,359**	**6,336,469**	**6,267,756**	**5,914,112**	**5,411,384**

The total number of ELVs treated in the whole EU region is kept stable around 6-6.5 million vehicles per year, even when, for instance, for 2009 this value rises to 9 million because an increase in these numbers for Germany.

In the same line, whereas the number of annually treated ELVs values for each country is roughly stable, the population for each country has a growing trend in this period[3]. Therefore, population is not an indicator of the evolution of the numbers of ELVs annually treated. These data shall be related with other motivations, like incentives for replacing old cars[4], for instance.

Figure 1. shows the number of ELVs treated for the period 2006-2016 as in Table 1. In this, countries are now arranged by the average number of ELVs treated in this period (as they are showed on the legend of the graph).

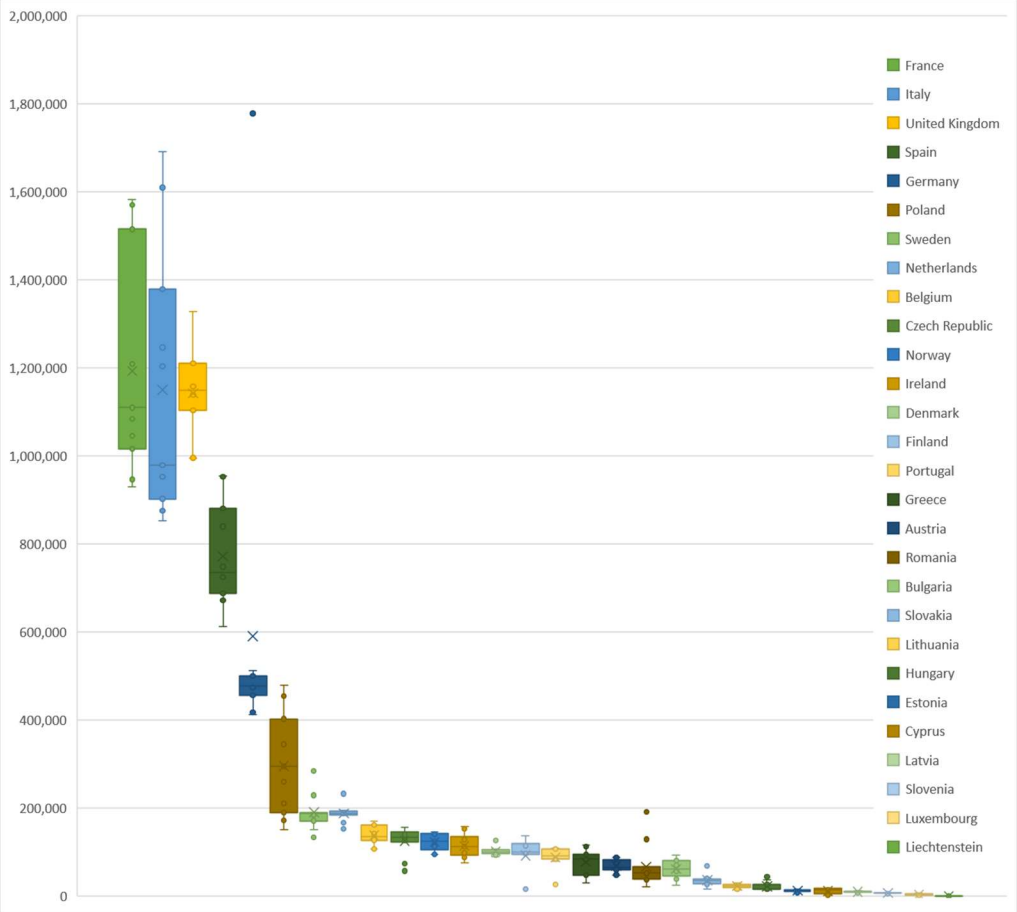

Figure 1. Box and whiskers graph for the number of ELVs managed in 2006-2016 period by EU country. For each country all available data are plot together, then showing the variation of the recorded numbers

[3] Eurostat > Population and population change statistics https://ec.europa.eu/eurostat/statistics-explained/index.php/Population_and_population_change_statistics#EU-28_population_continues_to_grow

[4] https://ihsmarkit.com/country-industry-forecasting.html?ID=106596019

As showed in Figure 1, France and Spain appear as two of the countries where more ELVs have been treated. Difference from Spain and France on the number of ELVs could arise from its population, but this assumption is not straightforward, as previously explained: on the 2016 basis Germany has almost double population than Spain but Germany treats lower quantities than Spain, for instance.

On the contrary, Portugal, with higher population than Norway, Sweden or Belgium, appears at the tail of the countries by number of treated ELVs.

In that sense, further relationships will be conducted for ELVs treatment for these countries in the following sections, where the treatment of ELVs is described.

4. Management models applied

The process for treating End-of-Life Vehicles (ELV) at the different countries across the European Union is regulated by the Directive 2000/53/EC[5] on end of life vehicles, lastly amended by Directive (EU) 2018/849[6]. Article 6 together with Annex I of this Directive establish both the treatment operations to be carried out on end of life vehicles, but also the minimum technical requirements that the facilities must fulfil for they to treat ELVs.

Nonetheless, before describing the current management models for ELVs in EU, it is important to highlight first the main obligations laid down in the Directive 2000/53/EC on end of life vehicles for the economic operators[7], out of the treatment processes, which are summarized in the following image (Figure 2) and described in the following sections.

[5] Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles - Commission Statements. ELI: http://data.europa.eu/eli/dir/2000/53/oj

[6] Directive (EU) 2018/849 of the European Parliament and of the Council of 30 May 2018 amending Directives 2000/53/EC on end-of-life vehicles, 2006/66/EC on batteries and accumulators and waste batteries and accumulators, and 2012/19/EU on waste electrical and electronic equipment (Text with EEA relevance). ELI: http://data.europa.eu/eli/dir/2018/849/oj

[7] producers, distributors, collectors, motor vehicle insurance companies, dismantlers, shredders, recoverers, recyclers and other treatment operators of end-of life vehicles, including their components and materials (as defined by Directive 2000/53/EC)

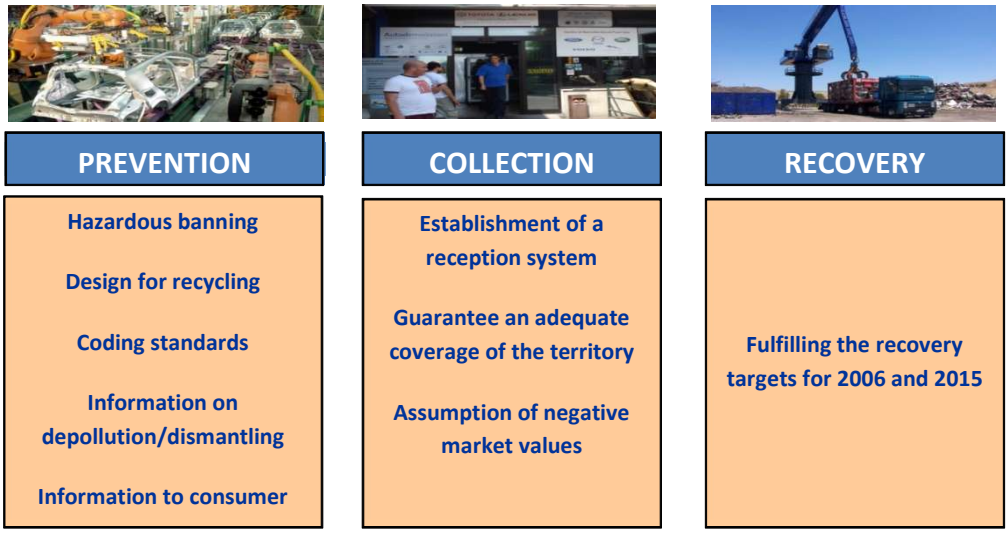

Figure 2. Economic operators' main obligations laid down in Directive 2000/53/EC

4.1. Prevention

When looking at the obligations regarding prevention, the first three bullets in Figure 2, i.e., limitation of hazardous substances, design for recycling and codification, shall be directly managed by vehicle producers and they must do so at the design phase. Vehicle producers have struggled their production process for new vehicles for avoiding using hazardous substances based on the End of Life Vehicles Directive text. However, there is still room for further optimization when designing for recycling new vehicles: plastics and other-than-metals materials are increasing in new cars and they shall be properly managed in order to comply with recovery/reusing ratios also claimed on the Directive 2000/53/EC text.

Focusing on the fourth obligation in Figure 2 for prevention, regarding information for depollution and dismantling, the International Dismantling Information System (IDIS Consortium) is the central repository[8] of manufacturers that compiles the treatment information for ELVs, proposed by manufacturers from Europe, Japan, Korea, Malaysia, India, China and the USA.

[8] https://www.idis2.com/

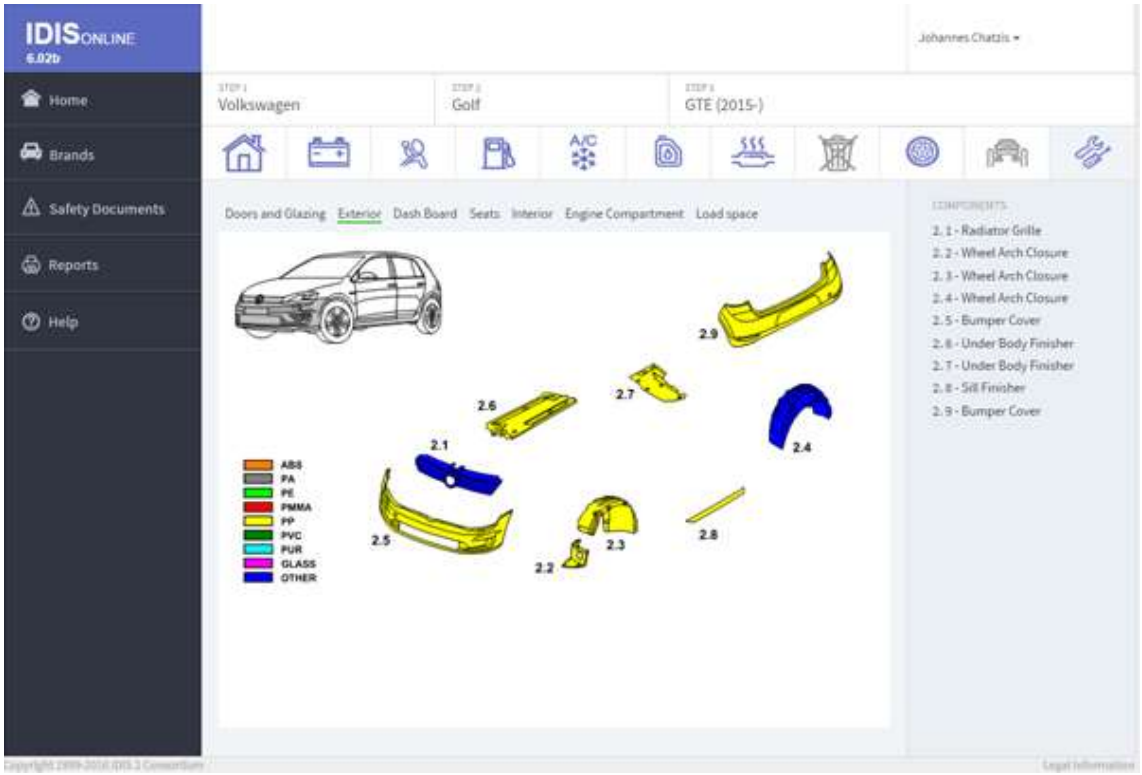

Figure 3. Scheme for the components of a car within the 'Area Dismantling' in the International Dismantling Information System online tool (Source: IDIS webpage)

As shown in the picture on Figure 3, IDIS database includes, in addition to other details, information about the polymers used in many plastic parts of a vehicle. It could be an interesting tool to be considered along the LIFE CIRC-ELV project. Beneficiaries could take the advantage of this tool as it claims is free of charge for commercial enterprises in the ELV business[9]. Interesting information could be obtained in advance for different vehicle models before they are treated. On the one hand, some indications for dismantling and for depolluting appear. On the other hand, as codification for materials is also reported, collecting tasks could be made easier: if an ELV has a broken piece and is just in that part where the codification appears, the IDIS tool could help to identify the material used for this piece.

Finally, when talking about consumer information, every producer is providing this information through their main communication tools with the users, such as their webpages or the user's manuals.

4.2. Collection

Regarding to the obligations for the economic operators for collection, two main different approaches for establishing a reception system with an adequate territorial coverage in the different countries are commonly used across EU:

[9] https://www.idis2.com/register.php

- Individual approach: where each producer sets up its network of authorized treatment facilities (ATFs). In order to do so, vehicle producers usually look for ATFs willing to become part of their network and then they sign a business contract.
- Collective approach: where a group of producers (or even all producers) decide to use an external entity to provide them with an ATF network where last owners can deliver their vehicles free of charge.

Producers are free for adopting any of these approaches, if not any regulatory at national/regional level in each country exists, but when there exists a provider network in a country, manufacturers mainly opt for the collective approach. It is uncommon in EU countries that the two approaches operate at a time: as depicted in Figure 4, countries in purple are opting for the collective approach. In this Figure 4, representant of each collective approach are presented for the countries they belong to. In green in Figure 4 appear the countries where individual approach exists.

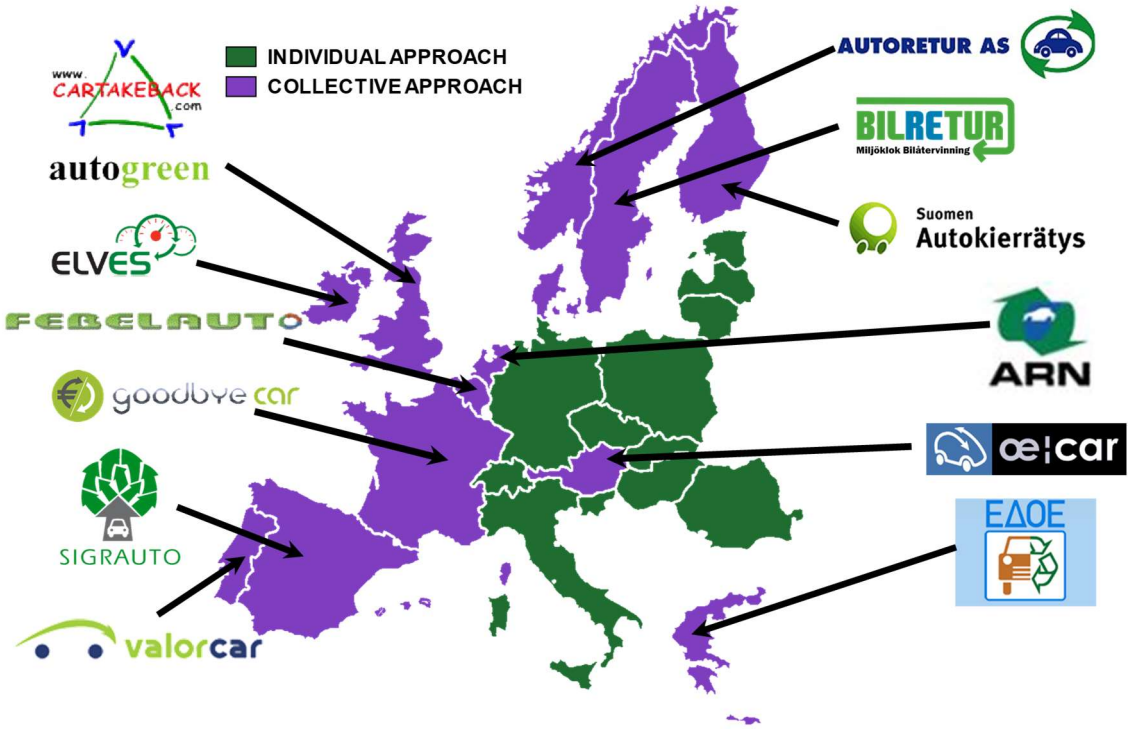

Figure 4. Individual and Collective schemes in Europe by region and representative institutions for collective schemes.

It is also important to point out that not all collective network providers have the same legal form or structure. They can also provide other services to vehicle producers, related mainly with the improvement and the monitoring of the recovery targets set in the legislation.

As showed in Figure 4, the coverage of the territory is guaranteed depending on the collective or individual approach.

Regarding to the last obligation in Figure 2, based on the assumption of the negative market impacts for the producer, it means that if a treatment for an ELV has a higher cost this shall go directly to the producer but never to the last owner.

4.3. Recovery/recycling

Article 7.2 of Directive 2000/53/EC establishes that Member States shall take the necessary measures to ensure that the following targets are attained by economic operators:

- no later than 1 January 2006, for all end-of life vehicles, the reuse and recovery shall be increased to a minimum of 85 % by an average weight per vehicle and year. Within the same time limit the reuse and recycling shall be increased to a minimum of 80 % by an average weight per vehicle and year;
- no later than 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 re-use and recycling shall be increased to a minimum of 85 % by an average weight per vehicle and year.

In this sense, a clarification among these terms is also defined on the ELV Directive:

- reuse: any operation by which components of end-of life vehicles are used for the same purpose for which they were conceived

- recovery[10]: any operation the principal result of which is waste serving a useful purpose by replacing other materials which would otherwise have been used to fulfil a particular function, or waste being prepared to fulfil that function, in the plant or in the wider economy

- recycling: reprocessing in a production process of the waste materials for the original purpose or for other purposes but excluding energy recovery

The following series of graphs in Figure 5 present the reuse-recovery/reuse-recycling annual evolution of the data reported for the period 2006-2014 for different EU countries. During this period, targets of 80% reuse/recycling and 85% reuse/recovery (total recovery) applied. In Figure 5, values for the percentage of current reuse/recycling and reuse/recovery are shown for different countries in EU. Countries in each are arranged by decreasing values of total reuse/recovery rates for this year. In the case that a country does not comply with the target, the corresponding current rate is coloured in red instead of green. On the same time, for each country the ratio of reuse/recycling, targeted to 80% for this period, is also presented (as the light green bar). In case this year a country does not comply with this target, its rate appears in yellow.

[10] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (Text with EEA relevance). ELI: http://data.europa.eu/eli/dir/2008/98/oj

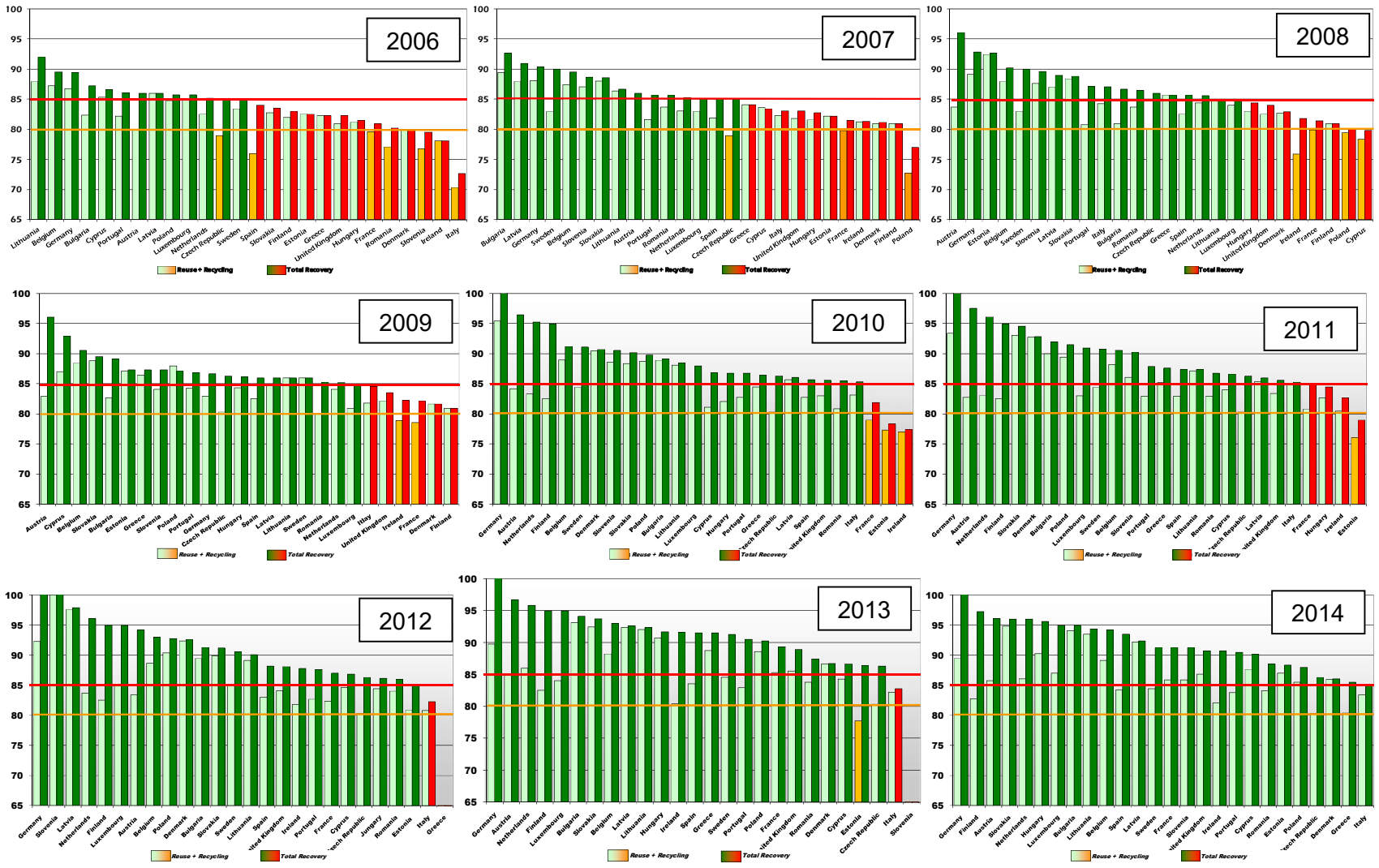

Figure 5. ELV recovery levels in EU countries in the period 2006-2014

Figure 5 shows that the number of countries with non-compliances based on the targets set for that period is decreasing every reported year. Indeed, the last year of the period in which these targets were set (2014), all countries achieved the 80% reuse/recycling and the 85% total reuse/recovery targets.

Even if the Commission has stated that there is some lack of consistency and liability in the data of some countries, it is shown that the Directive has really an effect on the recovery levels from ELVs among the different countries in EU. The targets set in this ELV Directive are the highest targets for any waste stream including the ones that are homogeneous. Since 2011 (Figure 5) all countries were complying with the 80/85% targets set for the 2006-2014 period, only with some punctual exception on a year. This could come also from the inconsistency of data claimed by the European Commission.

When looking at the reported data available for the years 2015 and 2016 (Figure 6), when the targets were higher (85% for reuse/recycling and 95% for total reuse/recovery), the trend seems to be repeated: most of the countries do not comply with the 95% total reuse/recovery target in 2015, but this number of countries start decreasing for 2016. Then, the evolution is expected to be similar and all targets will be complied by 2020. Unfortunately, these data for 2017 and 2018 are still not available

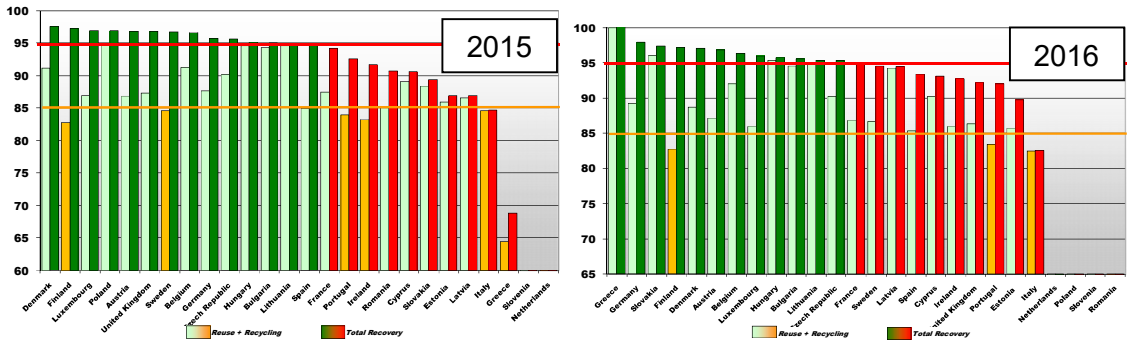

Figure 6. Recovery levels in EU countries in the period 2015-2016

According to the data recorded in Figure 5 and Figure 6, France, Portugal and Spain are not the first countries in the EU in implementing these actions. On the other hand, based on the records for the previous period (Figure 5), these countries early fulfil with the targets set. In the next years, these and the rest of the countries in the EU are forced to implement new methodologies for increasing its recovery/recycling ratios: targets are even higher for reuse and recycling (close to 100% for total recovery) and this ratio is close to the technical limit of the conventional treatment procedure.

4.4. ELV treatment processes across Europe

According to the ELV Directive, ELV treatment is focussed on depolluting and promoting recycling of the vehicle entering the ATF. However, it is not directly written anything related to the post-treatment of ELVs after they are depolluted, but some processes for shredding and reducing the volume and size of the depolluted waste are indicated to occur. In fact, shredders are also considered as economic operators within this ELV Directive. However, when moving to national regulations adapting European ones, these

shredding (and even post-shredding) processes are named to be part of the treatment process for ELVs:

- Spain: Real Decreto 20/2017[11]
- France: Article R543-156[12]
- Portugal: Decreto-Lei n.º 152-D/2017[13]

Then, there exist basically three processes for ELV treatment: depollution, size/volume reduction and dismantling/sorting for reuse/recovering/recycling. These processes are conducted at industrial scale on three types of facilities: Authorized Treatment Facilities (ATF), Shredding and Post-Shredding Facilities. Depending on their own capabilities, each site for ELV treatment can allocate two or even all the three types of processes/facilities at a time. In any case, they can be perfectly differentiated even when they are present on the same site.

A description of each type of facility and the processes occurring at them is provided below.

4.4.1. Authorized Treatment Facilities (ATF)

Although all three types of facilities listed before must have an authorization for they to conduct their activity, this 'authorized' term has been widely adopted for the facility that is focussed on receiving end of life vehicles from the last owners and on conducting the depolluting operations described on the ELV Directive. Most of these ATFs are those commonly named as 'dismantlers'. However, they have improved their facilities besides dismantling in order to comply with the new requirements established in the ELV Directive, so they are able to carry out the depollution and sorting of end of life vehicles and their parts.

The following image (Figure 7) shows the different areas that an ATF usually has, although some of them are not mandatory for obtaining the authorization, like the Part's sorting area (Figure 7E).

[11] Real Decreto 20/2017, de 20 de enero, sobre los vehículos al final de su vida útil. ELI: https://www.boe.es/eli/es/rd/2017/01/20/20

[12] https://www.legifrance.gouv.fr/affichCode.do;jsessionid=3EC87A0E4F1275F7D4E1E249452ACB5C.tplgfr29s_2?idSectionTA=LEGISCTA000034539389&cidTexte=LEGITEXT000006074220&dateTexte=20190121

[13] Decreto-Lei n.º 152-D/201. ELI: https://data.dre.pt/eli/dec-lei/152-d/2017/12/11/p/dre/pt/html

Figure 7. Illustration for a typical layout of an ATF (Source: SIGRAUTO)

This schematic procedure for the ELV treatment described in Figure 7 is similarly described by SIGRAUTO[14] in Spain, INDRA[15] in France and VALORCAR[16] in Portugal, for instance.

When an end of life vehicle enters an ATF, it is considered as a hazardous waste according to the European Waste List Code *16 01 04**. The ELV shall be stored in a reception area (Figure 7A) that must have impermeable surfaces with the provision of spillage collection, decanters and cleanser-degreasers and equipment for the treatment of water, including rainwater, in compliance with health and environmental regulations. All wastes must be stored in appropriate containers or storage tanks and must be sent to or collected by a waste management company authorized for recycling or recovering them.

The Directive 2000/53/EC indicates that treatment operations for depollution of end-of life vehicles shall be carried out as soon as possible in an area with the same requirements as the reception area. In addition, in Spain and Portugal, for instance, there is also a requirement that this depollution area must be under cover. Furthermore, in Spain, there is a 30-day limit for depolluting a vehicle after entering an ATF.

The ELV Directive establishes the following treatment operations to be conducted for depolluting an end-of-life vehicle in an ATF (Figure 7B):

- removal of batteries and liquified gas tanks
- removal or neutralisation of potential explosive components, e.g., air bags
- removal, separation, collection and storing of fuel, motor oil, transmission oil, gearbox oil, hydraulic oil, cooling liquids, antifreeze, brake fluids, air-conditioning

[14] http://www.sigrauto.com/tratamiento-vehiculo-fuera-de-uso.htm
[15] https://www.indra.fr/en/activites-france/le-recyclage
[16] http://www.valorcar.pt/en/vfv/reciclagem

system fluids and any other fluid contained in the end-of-life vehicle, unless they are necessary for the re-use of the concerned parts

- removal, as far as feasible, of all components identified as they contain mercury

After the ATF has been depolluted the End of life vehicle it is then considered as a non-hazardous waste according to the European Waste List Code *16 01 06*.

The Directive 2000/53/EC encourages the reuse of components which are suitable for doing so. Thus, stripping operations (Figure 7D) and storing (Figure 7E) shall be carried out in such a way to ensure the feasibility of vehicle components to be reused and that dismantled spare parts must be appropriately stored, including impermeable storage for oil-contaminated ones. Furthermore, this ELV Directive aims for promoting recycling of ELV parts by sorting those suitable to be recycled, if they are not segregated in the shredding next phase. Thus, there is still room for further improvement on sorting of potentially recyclable ELVs parts, as the subject of LIFE CIRC-ELV project aims to do so.

Once the vehicle is depolluted and the parts suitable to be reused have been removed (Figure 7E), the remaining vehicle hulk must be transported to a shredding facility. Depending on the distance and the number of vehicles to be transported, vehicles can be further pressed for improving the efficiency of this transport to the shredding plant (Figure 7G).

It is noticeable that bumpers are not dismantled and sorted as a standard procedure, because it is focussed on depolluting the ELV. Thus, bumpers remain fixed to the depolluted vehicle. Only if a bumper is demanded for replacing a damaged one in an operative vehicle it will be removed from the depolluted ELV. If there is not a need for this bumper, the depolluted ELV with the bumpers fixed on it is pressed and sent to a shredder facility.

On the other hand, fuel tanks from ELVS become useless for being reused because they are perforated for removing all remaining fuel, as a part of the protocol for depolluting the ELV. In addition, fuel tanks are not easily accessible for dismantling as other parts are, so all fuel tanks remain fixed to depolluted vehicles and they are sent to pressing/shredding processes.

4.4.2. Shredding Process

Shredding facilities for ELVS can receive these ELVs only after they have been depolluted and properly dismantled at an ATF. Only this type of plants allows to separate and to recover the remaining different materials or fractions that end-of-life vehicles contain. The following image (Figure 8) shows the typical layout of a shredding plant, which also needs for an authorisation to operate and receive depolluted ELVs.

Figure 8. Shredding facility typical layout (Source: SIGRAUTO)

The first step conducted in a shredding plant is the weighting and, in Spain for instance, the radiological control of the materials that are received (Figure 8A). These materials can be end-of-life depolluted hulks or pressed cubes. After that, these materials are stored in an adequate area (Figure 8B). They will undergo for a visual inspection to both verify that the content is that indicated by the supplier and to evaluate the quality of the material.

The next step for the shredding process is the feeding of the material to the shredder (Figure 8C). Usually, feeding is done by a built-in charging device, in most cases, being usually a fixed crane with a long-range articulated arm that has a hydraulic grapple at its end. The material is discharged into the shredder by hoppers, plate conveyors or tilting trays. Depending on the type of shredding facility, it can count with a pre-shredder, whose function is to make a previous disintegration of the material, mainly focussed on reducing the stiffness of pressed ELVs hulks.

The material entering to the shredding chamber is then hit by the hammers of the mill against the reinforced walls. These hammers have a double turning movement, the first is solidary to the central axis while the second is on its own axis. This process of shredding by striking, continues until the pieces of material reach the adequate dimensions and it can come out through the sieves located inside the shredding chamber.

The as-shredded material must pass at least once by an aspiration system that allows to separate the lighter non-metallic materials. Then the rest of the shredded material goes through one or several magnetic drums, where ferrous metals are separated. Next step comprises Eddie current-based separators for sorting the metallic non-ferrous part of the shredded ELVs. It is convenient that this fraction of ferrous/non-ferrous metals goes through a manual triage cabin where strange materials are taken out. Once the light and the metallic fractions have been segregated, the remaining non-metallic heavy part goes to a conveyor belt that leads to a manual triage area or directly to its

corresponding storing area. Thus, at least three fractions are obtained after the shredding process (Figure 8D):

- Metallic scrap (both ferrous and non-ferrous)
- Shredder Light Fraction (SLF or *fluff*)
- Shredder Heavy Fraction (SHF)

Shredding plants directly manage the metallic fraction by sending it to smelting/steel making industries. Then, the remaining Automotive Shredder Residue (ASR) is processed at the post-shredding facilities.

4.4.3. Post-Shredding Technologies

Post-shredding facilities process both the light and heavy fractions generated at shredding facilities, i.e., the Automotive Shredding Residue (ASR). In these facilities (Figure 9), through various segregation processes valuable materials present on the ASR are further separated.

Conventional Post-Shredding facilities are equipped with sieves, separators based on Eddie currents, densiometric tables, optical systems, dense media, etc. for recovering the metallic part of the ASR (steel, aluminium, copper…) which is sent to smelting plants or steel industries.

During this process, some other fractions are segregated and treated, depending on the Post-Shredding Technology (PST) available. They are recovered for different uses: recycling, energy valorisation, smelting aids or landfilling.

Irrespective of the sorting technology, the first operation that is carried out in these plants is the weighing of the received material and, as before indicated for the Shredding facilities for Spain, radiological tests (Figure 9A). These operations are carried out with a scale and together with a visual inspection for verifying that the content of each truck is that indicated by the provider.

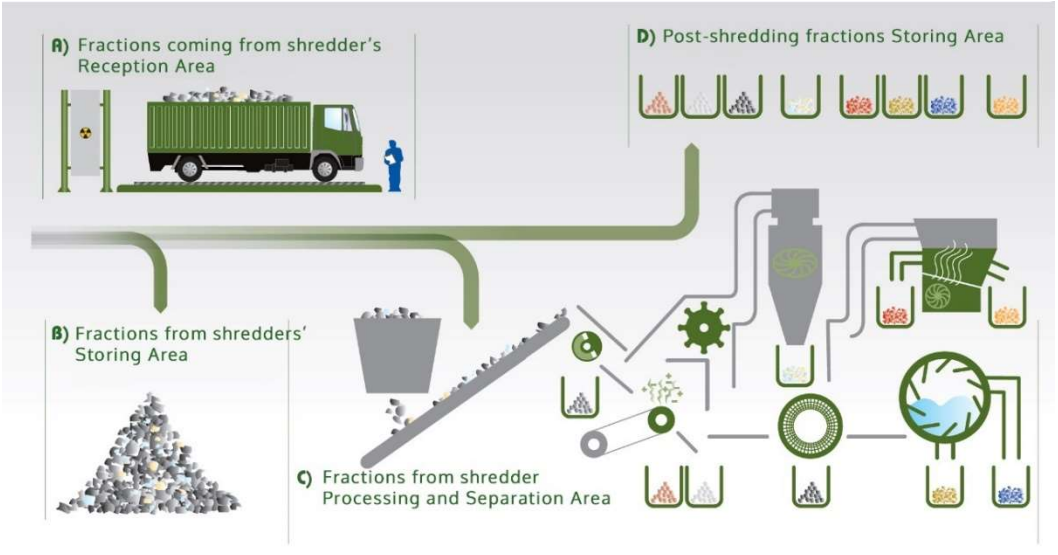

Figure 9. Post-shredding facility typical layout (Source: SIGRAUTO)

The different processes carried out in the post-shredding facilities are governed by the different Post Shredding Technologies available and used for different post-shredding companies[17].

The PST plant for the ARN Recycling company[18] is based on the Volkswagen-SiCon Process[19] and it has been funded by LIFE program[20]. In this plant, and by means of this process, it is possible to separate the ASR into four main streams by means of mechanical treatment: metals, plastics, fibres and minerals[21].

The Galloo company is working on mechanical recycling from ASR focussed on metals and plastics[22].

The process WESA-SLF also allows to separate four fractions[23] by means of a mechanical processing: a magnetic fraction (~95 % iron), a fraction containing copper granules, a mixture of minerals and some metals, and an organic fraction (mainly composed on plastics).

The previous PST are based on mechanical treatment. Thus, organic-based fractions are recovered. They are mainly composed of plastics of different nature. However, there are some other PSTs based on thermal processes. These thermal processes involve different amounts of oxygen for partial-to-total combustion of the waste they treat. As the project is focussed on the recovery for recycling the plastic fraction (both at the ATF and even with PST), these processes will not be detailed in this deliverable despite they can be consulted in literature[24].

[17] A Study to Examine the Costs and Benefits of the ELV Directive – Final Report Annexes. ANNEX 3: POST-SHREDDER TECHNOLOGIES – REVIEW OF THE TECHNOLOGIES AND COSTS; GHK / BIOIS, May 2006 http://ec.europa.eu/environment/waste/elv/study.htm

[18] https://arn.nl/en/what-do-we-do/recycling-process/

[19] The Volkswagen-SiCon Process: Eco-efficient solution for future end-of-life vehicle treatment; Stephan Krinke, Benjamin Boßdorf-Zimmer and Daniel Goldmann; 13th CIRP INTERNATIONAL CONFERENCE ON LIFE CYCLE ENGINEERING; PROCEEDINGS OF LCE2006; Leuven; May/June 2006 p. 359-364 https://www.mech.kuleuven.be/lce2006/157.pdf

[20] PST - Aim to realise 95% ELV-recycling in the Netherlands by means of post shredder technology [LIFE10 ENV/NL/000027] http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=4006

[21] PST PLANT: THE UNMISSABLE LINK; ARN 95 magazine; Yvonne van der Heijden; Number 8 – Autumn 2015; p. 17-25 http://www.arn.nl/wp-content/uploads/2015/11/2015_10_30v2-ARN-ENG-95_magazine-Raw-Material.pdf

[22] http://www.galloo.com/node/5

[23] Automotive shredder residue (ASR) and compact disc (CD) waste: options for recovery of materials and energy; Ron Zevenhoven, Loay Saeed; Final report for study funded by Ekokem Oy Ab support funding (apurahoitus) 2002; Helsinki University of Technology Energy Engineering and Environmental Protection; Espoo, April 2003; ISSN 1457 – 9944 ISBN 951 – 22 – 6508 – 7 (paper version) ISBN 951 – 22 – 6509 – 5 (PDF version) http://users.abo.fi/rzevenho/tkk-eny-14.pdf

[24] http://inpact.inp-toulouse.fr/archives/WasteEng05/FullText_D/60_NOME_05_01_26.pdf

5. ELV treatment facilities in the EU

It is difficult to find accurate and up-to-date information on the number of ATFs and shredding facilities in the EU. For that reason, the European Commission is trying to improve this information by including a specific section for it in the yearly reporting Members States must provide.

However, some documentation is available for referring the number of facilities existing for ATF[25] and Shredding[26] plants. The data are mainly from 2014.

Records for ATFs and Shredding Facilities are presented together in the map on Figure 10, where the available numbers are presented on each country.

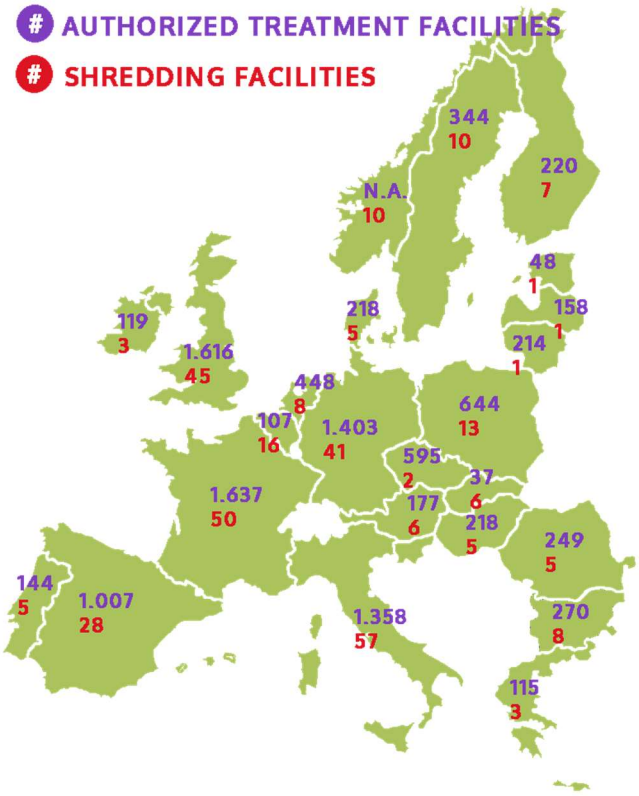

Figure 10. Number of ATFs and Shredding Facilities in the EU on 2014

Despite to the fact that data are for 2014, some increase has been detected for Spain: around 1300 ATFs and 26 Shredding facilities on 2018.

[25] Summary report on the implementation of the ELV Directive for the periods 2008-2011 and 2011-2014 made by ARGUS – Statistics and Information Systems in Environment and Public Health GmbH under the Commission Contract No. 07.0201/2015/723374/ETU/ENV.A.2

[26] European Auto Shredder List and Map; RTGE Staff; Recycling Today magacine; August 21, 2014 http://www.recyclingtoday.com/article/rtge0914-european-auto-shredders-map/

The values present in Figure 10 and those described previously for number of ELVs (Table 1) seem to be better understood when they are put together and related, as they appear in Table 2.

Table 2. Number of ELVs, ATFs and Shredding Facilities in the EU on 2014.

	ELVs	ATFs	Shredders	ELVs/ATF	ELVs/Shredder	ATFs/Shredder
Austria	59,904	177	6	338	9,984	30
Belgium	126,835	107	16	1,185	7,927	7
Bulgaria	80,862	270	8	299	10,108	34
Czech Republic	131,987	595	2	222	65,994	298
Denmark	104,413	218	5	479	20,883	44
Estonia	14,720	48	1	307	14,720	48
Finland	94,540	220	7	430	13,506	31
France	1,084,766	1,637	50	663	21,695	33
Germany	512,163	1,403	41	365	12,492	34
Greece	82,863	115	3	721	27,621	38
Hungary	15,283	218	5	70	3,057	44
Ireland	86,950	119	3	731	28,983	40
Italy	853,584	1,358	57	629	14,975	24
Latvia	9,268	158	1	59	9,268	158
Lithuania	29,982	214	1	140	29,982	214
Netherlands	188,487	448	8	421	23,561	56
Norway	139,920	N/A	10	N/A	13,992	N/A
Poland	454,737	644	13	706	34,980	50
Portugal	86,713	144	5	602	17,343	29
Romania	42,138	249	5	169	8,428	50
Slovakia	29,175	37	6	789	4,863	6
Spain	724,820	1,007	28	720	25,886	36
Sweden	186,967	344	10	544	18,697	34
United Kingdom	1,106,846	1,616	45	685	24,597	36

Once data have been related each to other, general trends arose. As previously explained, number of ELVs treated annually are not constant neither related with population in each country (Table 1). This fact also conducts to non-uniformity data when relating number of ELVs per ATF or per shredding facility (Table 2) only detailed for 2014. Indeed, assuming average numbers relating ELVs per ATF from the data in Table 2 are not representative: as described on the proposal for LIFE CIRC-ELV, those ATFs that are beneficiaries process 1,000-11,000 ELVs a year, for instance, and these value will change year after year as number of treated ELVS does. On the other hand, a ratio of 30 to 50 ATFs per shredder on each country applies and it should be similar beyond 2014 (Table 2): despite number of ATFs and shredding facilities varies, this ratio is somehow kept.

6. ELV Plastic Recovery/recycling rates

Despite to the fact that no direct targets are indicated for plastics to be recycled on the ELV Directive, some estimations have been done indicating that 30% of plastics should be recycled from ELV in order to fulfil with this ELV Directive. Indeed, in addition to this value, it is expected to be an extrapolated increase to 35% by 2025[27].

In addition to the number of ELVs treated, the information reported by Member States[1] included in the Eurostat website does not include specific plastic waste information except for the so called "Large Plastic Parts". These parts should come from the dismantling phase when bumpers, dashboards and fluid containers (as the ELV Directive defines) are sorted for direct reusing or even recycling. Note that for fuel tanks reusing is not applicable because they become perforated on the depolluting process, as previously described.

As described before, these large plastic parts are not commonly dismantled, but they are usually shredded together with the depolluted ELV hulk. Then, most of the plastics recycled or recovered by ELVs do so in the post-shredding phases, as also explicated before. In the Eurostat statistics, and under the same obligations laid down by the Decision 2005/293/EC, these plastics will fall under "Shredder Light Fraction (SLF)" or the "Other" in materials arising from shredding categories.

Another issue in order to have an estimation on how much plastic from ELVs is being recycled or recovered in the EU is that the information on "Large Plastic Parts" is reported only on a voluntary basis and not mandatory. Then, not all EU countries have reported such data.

In any case, some deep research has been done for evaluating how much plastics is being extracted and recycled at the dismantling phase; and how much is being recycled or recovered at the post-shredding phases.

The following

Table 3 shows the records for 'large plastics parts', 'SLF' and 'others' fractions reported for 2016 (in the case of Slovenia the data reported for 2014 is used instead) when referred to the total amount of ELVs treated. In

Table 3, the total amount of ELVs treated (in tonnes) is presented for each country which has reported the voluntary wastes described above. Then, for each of the fraction, the value presented is the corresponding weight percentage referred to the total amount of ELVs treated. It should be noted that for large plastic parts, the value refers to the

[27] Final Report for Plastic Recyclers Europe conducted by Deloitte (Increased EU Plastics Recycling Targets: Environmental, Economic and Social Impact Assessment)

recycling rate while for the SLF and other fractions recycling and energy recovering is presented.

Table 3. Available Information on 'Large plastic parts recycled', 'SLF' and 'Other' materials from shredding for 2016

		Large plastic parts		SLF		Other materials from shredding	
Country	**ELVs (ton)**	**Recycling (%)**	**Energy Recovery (%)**	**Recycling (%)**	**Energy Recovery (%)**	**Recycling (%)**
Austria	45,338	0.92	6.44	1.93	2.01	2.26
Belgium	119,188	0.15	2.04	4.58	0.59	2.17
Cyprus	5,094	1.10	0.00	0.00	0.00	0.00
Estonia	14,113	0.38	1.24	0.00	0.00	0.00
Finland	123,273	0.00	13.71	2.33	0.09	1.44
France	1,103,927	0.40	4.04	3.61	1.32	1.52
Germany	420,113	0.22	6.60	9.54	0.00	0.00
Greece	45,570	0.10	6.21	0.00	0.00	7.30
Hungary	12,527	0.30	0.00	0.00	0.00	0.00
Latvia	8,253	0.07	0.00	6.22	0.00	0.07
Norway	176,216	0.00	7.99	5.37	1.68	1.49
Portugal	84,473	0.69	7.80	0.00	0.00	0.00
Slovakia	34,822	2.29	0.00	2.82	0.00	0.07
*Slovenia**	5,960	1.04	3.96	1.93	0.00	0.0
Spain	642,514	0.25	5.18	1.73	1.91	1.27

This information in

Table 3 shows that Slovakia and Cyprus are the countries where large plastic parts are recycled the most of the recorded ones. The average value for recycling these large plastic parts is around 0.5%. In that sense, both France and Spain remain under the average value, but Portugal slightly overpass this value. Moving back to the general ratios of plastic content in a car, being around 9-12% of the total weight of the car, large plastic parts recycling values presented in

Table 3 are far from these and they can be improved deeply by a proper dismantling model as those to be developed under de LIFE CIRC-ELV project.

Indeed, large plastic parts fraction is not the main source of plastics that is being recycled or recovered from ELVs: nowadays plastics are mostly recycled (if any) or recovered in the shredding and post-shredding phases. However, the values for 'SLF' and 'other' fractions reported do not refer only to plastics, but to all materials potentially present in these fractions. Besides the amounts of these two fractions are not constant along time, their composition is neither constant nor uniform[23, 28]: they are composed of plastics, rubber, glass, ceramics, metals… However, main product of these 'SLF' and 'Other' fraction is plastic but with a not uniform ratio, ranging from 20 to 60% depending on the reference.

Even when no direct values could be compiled for plastics at the post-shredding stage, main values for recovery of organic fraction (where plastics are) comes for energy recovering: recycling data include also metal recycling. From the values presented in

Table 3 on 'Other' materials arising from shredding and the 'Shredder Light Fraction (SLF)', about 4.5% is being energy recovered and 3.5% is being recycled, depending on the PST available and the regulation in force for each country: Finland, Portugal and Austria move these waste to energy recovering the most.

Taking these values into account, no more than 5% plastics are currently recycled and/or recovered from ELVs stream. Then, if 9-12% of a car is made of plastic there is room for further improvements, despite to the fact that main is recovered after the shredding process: dismantling and sorting before shredding is then justified.

7. Main actors for ELV plastic recycling in Europe

As explained in the preceding points, there are two main streams for recycling or recovering plastics from ELVs: one at the ATF when the ELV is being dismantled and other at the post-shredding processing of the Shredding Residue (ASR).

Then, these two types of facilities will be considered for analysing which of them are working with recycling plastics. The following image shows the main actors identified at this early stage of the project.

[28] The best of SLF recycling; Eldan Recycling A/S https://eldan-recycling.com/sites/default/files/BR_SLF_1204_EN_r6_low.pdf

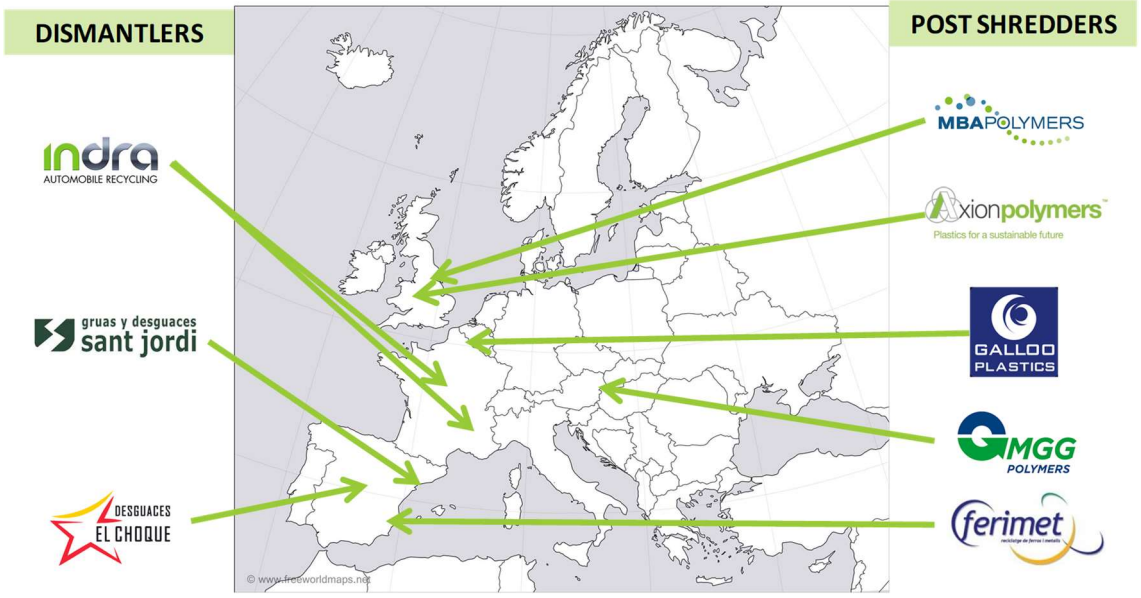

Figure 11. Main actors in plastic recycling from ELVs in the EU

Regarding the post-shredding facilities, Axion Polymers, Galloo Plastics, MBA Polymers and MGG Polymers obtain and sell their own plastic pellets from the ELV shredder waste, while Ferimet just obtains a plastic fraction with the quality needed to be sold to plastic recyclers.

8. New regulatory framework for plastics in the EU

On January 16, 2018, the European Commission published the Communication COM (2018) 028[29] final entitled "*A European Strategy for Plastics in a Circular Economy*". This strategy is already having a big impact in all the plastic related sector. The document focusses on the need for a new plastics economy based on circular economy approaches and boosting recycled plastic quality and usage. The strategy was published together with its Annexes where a detailed program of the measures to implement the strategy is included. The following table shows the measures for improving the economics and the quality of recycling plastics, that are those that would impact in the development of the LIFE CIRC-ELV project.

[29] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A European Strategy for Plastics in a Circular Economy. COM/2018/028 final https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1516265440535&uri=COM:2018:28:FIN

Measures	Timeline
Improving the economics and quality of plastics recycling	
Actions to improve product design:	
– Preparatory work for future revision of the Packaging and Packaging Waste Directive: Commission to initiate work on new harmonised rules to ensure that by 2030 all plastics packaging placed on the EU market can be reused or recycled in a cost-effective manner.	Q1 2018 onwards
– follow-up to COM (2018) 32 "*Communication on the implementation of the circular economy package: options to address the interface between chemical, product and waste legislation*": improve the traceability of chemicals and address the issue of legacy substances in recycled streams	Q1 2018 onwards
– new eco-design measures: consider requirements to support the recyclability of plastics	ongoing
Actions to boost recycled content:	
– launching an EU-wide pledging campaign targeting industry and public authorities	Q1-Q3 2018
– assessment of regulatory or economic incentives for the uptake of recycled content, in particular in the context of the:	Q1 2018 onwards
– Revision of the Packaging and Packaging Waste Directive (see above)	
– Evaluation/review of the Construction Products Regulation	
– Evaluation/review of End-of-life Vehicles Directive	
– as regards food-contact materials: swift finalisation of pending authorisation procedures for plastics recycling processes, better characterisation of contaminants and introduction of monitoring system	ongoing
– development of quality standards for sorted plastics waste and recycled plastics in cooperation with the European Standardisation Committee	2018
– Ecolabel and Green Public Procurement: Further incentivise the use of recycled plastics, including by developing adequate verification means	2018 onwards
Actions to improve separate collection of plastic waste:	
– issue new guidelines on separate collection and sorting of waste	2019
– ensure better implementation of existing obligations on separate collection, including through ongoing review of waste legislation	ongoing

Figure 12. EU measures for improving the economics and quality of plastics recycling (Source: European Commission Plastic Strategy Annexes)

Among the different above planned measures from the European Strategy for Plastics, most of them are of very high concern for the LIFE CIRC-ELV project development:

- Legacy substances in recycled streams
- Eco-design for recyclability
- Pledging campaign for industry and public authorities
- Economic incentives for the uptake of recycled content in the context of the evaluation/review of End-of-life Vehicles Directive
- Quality standards for plastics waste/recycled
- Ecolabelling for recycled plastics
- Guidelines for collecting and sorting of plastic waste

In fact, a voluntary pledge campaign was launched on January 2018 and had it is (extended) open until September 30, 2018[30]. With this voluntary pledging campaign, the Commission has the objective of boosting the uptake of recycled plastics and to ensure that by 2025, ten million tonnes of recycled plastics find their way into new products on the EU market. Among the different published names of companies providing their voluntary pledges, there is not any related with automotive sector, but they do so for raw materials and recyclers. For the moment, the Commission has not published any

[30] European Strategy for Plastics - voluntary pledges. Published on: 20/11/2018
https://ec.europa.eu/growth/content/european-strategy-plastics-voluntary-pledges_en

information on the results obtained in the voluntary pledging campaign, beyond some names of companies.

With respect to the evaluation/review of the End of Life Directive, the Commission just launched the Roadmap for the ELV Directive evaluation[31] and one of the paragraphs of this document indicates that "*In addition, the EU's Plastics Strategy of January 2018 refers to the automotive sector as a significant source of plastic waste that could be recycled and to its good potential for uptake of recycled content and includes under its actions the assessment of regulatory or economic incentives for the uptake, in particular in the context of the evaluation/review of the ELV Directive*."

This evaluation involves also the rest of the measures including eco-design for recyclability, then boosting the quality of the recycled plastics, by means of avoiding/controlling/removing legacy substances, so these recycled plastics can be used in new products which would be labelled accordingly. Once these cars are eco-designed for recyclability, guides and manuals for enhancing this recycling arise.

It should be highlighted that Directive 2000/53/EC shall be updated as indicated in Directive (EU) 2018/849 before 31/12/2020. Then it is expected that some other restrictions could appear, so all economic operators shall be ready for them to be fulfilled.

9. Novel treatment technologies

Although the LIFE CIRC-ELV project will focus on collecting large plastic parts (bumpers and fuel tanks) at the dismantling stage and on improving the pre-treatment of these plastics for boosting the quality of the recycled products made of them, it is important to be aware of any development in the separation technologies for mixed shredded plastics present in the ASR, since it will influence the sustainability of the business model proposed by the LIFE CIRC-ELV project.

In that sense, the development of novel plastic separation technologies for improving plastic sorting from a mixture of plastics coming from ELVs could come from the stages before or after shredding.

Some Post-shredding technologies have been previously described in section 4.4.3.

In addition, the project LIFE PST-SORT[32], coordinated by Calaf Industrial, will demonstrate an innovative post-shredding technology based on artificial vision for recover secondary raw materials from ASR at Post-shredding facilities.

Besides to PST, sorting of plastics can be conducted at earlies stages, as LIFE CIRC-ELV project aims to. The approach that LIFE CIRC-ELV project will propose and validate for Spain, France and Portugal and transferred to the EU, is already being particularised

[31] Evaluation and Fitness Check Roadmap - Ares(2018)5101035 https://ec.europa.eu/info/law/better-regulation/initiatives/Ares-2018-4731779

[32] http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=6755

in Catalonia (Spain) by means of the project CAR MINING[33] conducted by ZICLA in an ATF in this region. This project is the continuation of a similar project coordinated also by Zicla but then in the Basque Country region in Spain: the ROLLING PLASTIC project[34]. In both projects, bumpers and fuel tanks are collected, apart from other plastics pieces of ELV, but technoeconomic assessment and optimization is not detailed. However, and despite to the fact that these projects are only conducted in different regions of Spain, interesting results could be of interest for the LIFE CIRC-ELV project.

10. Conclusions

Conventional management models for End of Life Vehicles across different countries in the UE follow the same structure as they are regulated by the same obligations coming from the Directive 2000/53/EC known as the 'ELV Directive'. No significant differences have been found in France, Spain or Portugal, despite to the fact that some national laws in these countries impose other complementary restrictions or even extend the scope of the treatment a vehicle at its end of life.

The main processes for treating an End of Life Vehicle are removal of pollutants/hazardous substances and reusable parts, volume and/or size reduction and then sorting different materials for recycling/recovery/landfilling. These processes are conducted on different amenities: Authorised Treatment Facilities for depollution tasks and sorting parts, Shredding and Post-Shredding facilities for shredding and sorting materials in different flows.

When referring to the figures for the management of End of Life Vehicles in the countries across de European Union, main differences could arise from the gross number of vehicles treated or even the facilities those countries must do so. The amount of End of Life Vehicles to be treated in each country is not related to the population this country has. The same applies for the number of facilities authorised to treat them across these countries. However, all countries in the EU, from which data is available, seems to keep the ratio of 30-50 Authorised Treatment Facility per Shredding Facility. Even when the number of treated End of Life Vehicles is not constant neither uniform every year, France and Spain are two of the five countries in the European Union which more vehicles treat after they reach its end of life.

The preferred way to collect End of Life Vehicles from last owners by Member States lays on the Collective Approach, where all vehicle manufacturers make use of an external entity for providing a network to do so.

Directive 2000/53/EC stipulates specific targets for recovery/reuse and recycling/reuse to be attained by economic operators each year. Two periods have been stabilised: 2006-2014 and 2015-2020, with higher ratios for the second period nowadays in force. Thus, since 2006 all countries in the European Union have been progressively adapting their recover/recycling rations to those stablished on the ELV Directive. In that sense, in

[33] https://www.zicla.com/en/project/car-mining-out-of-service-vehicles/

[34] https://circulareconomy.europa.eu/platform/en/good-practices/rolling-plastics-towards-precision-sorting-plastics-components-end-life-vehicles

2014 all countries lay within the limits targeted for this period, but they did so in a progressive manner along these 9 years. Similar trend is expected to occur by 2020 for the new targets to be accomplished, as reflected by the data reported for the two first years. Member States are making great efforts to fulfil these new targets and they are doing so progressively. Directive 2000/53/EC will be reviewed in 2020.

These new targets in force make necessary to improve sorting materials from End of Life Vehicles waste streams. Conventional recovering for End of Life Vehicles is focussed on metals. Other materials are sorted in the post-shredding stage from a non-uniform mixture of wastes. Plastics are then largely collected from these mixed waste stream and they are mainly sent to energy recovery or even landfilling. New technologies are being developed for improving the materials selection in post-shredding facilities, in order to fulfil the targets, set out by the ELV Directive. However, there is room for further increase the recovery of plastics at early stages where they are easily identifiable and sorted. Collecting plastics at Authorised Treatment Facilities comprises about 0.5% of the total weight of the car. Overall plastic recovery from an End of Life Vehicle can be stated to be around 5% of the total weight of the vehicle. As the average weight of plastics in a vehicle is 9-12%, and as these values will be increased in next years for technical reasons, there exists the need for improving the ways where the plastics are collected from End of life Vehicles.

This is in line with the Directive 2000/53/EC that states to implement a design for recycling on new cars and even also with the new strategy of plastics for a Circular Economy in the European Union, in which recycling plastics shall be boosted. The easier the sorting of plastics from an End of Life Vehicle, the higher quality of the recycled plastic produced with them and the higher the demand for these plastics to be used in new products.

Combining all these figures, LIFE CIRC-ELV project will stablish a new management model for sorting and recovering plastics before they enter on the shredding stages, then increasing the ratios of recover/recycling and the quality of the recycled plastics available for the market.

ANNEX 1 – Updated data (January 2022)

The following information is collected from the last updated data available on eurostat[35] for ELVs (corresponding to the year 2019[36]).

This Annex 1 is intended for updating this deliverable as data is published.

The Figure 13 updates the data of the Figure 1 as it includes the data for 2019 extracted from the eurostat database.

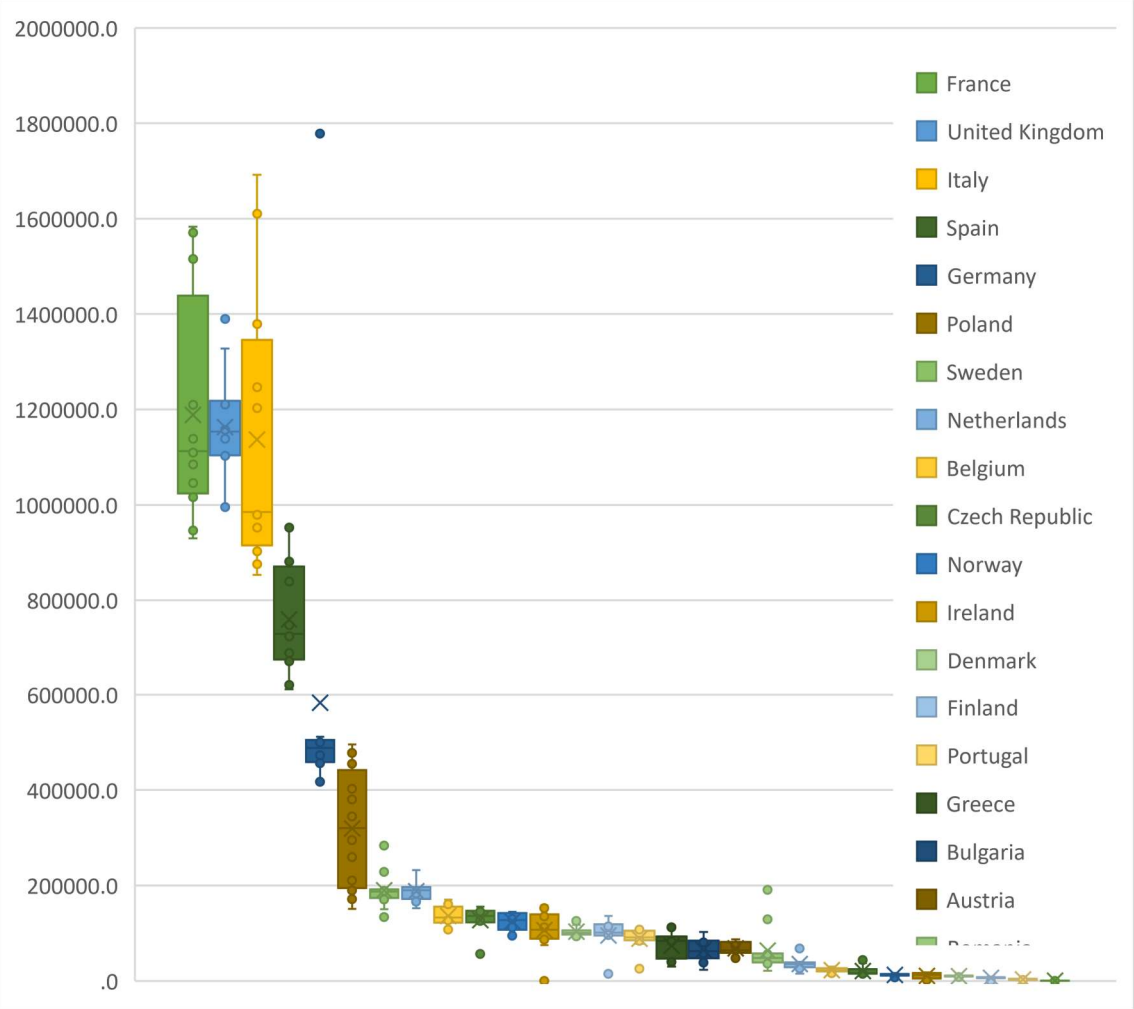

Figure 13. (UPDATED) Box and whiskers graph for the number of ELVs managed in 2006-2019 period by EU country. For each country all available data are plot together, then showing the variation of the recorded numbers

Accordingly, Table 4 shows the collected data for the years 2017, 2018 and 2019 complementing the values summarised in Table 1.

[35] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=End-of-life_vehicle_statistics

[36] The website claimed "Data extracted in November 2021"

Table 4. (UPDATED) Number of ELVs treated in 2017-2019 in the EU countries (in alphabetical order)

Year	2017	2018	2019
Austria	58.462	60.272	54.424
Belgium	120.896	142.852	134.629
Bulgaria	102.442	99.835	85.670
Cyprus	5.453	7.523	10.170
Czech Republic	154.306	169.715	178.683
Denmark	117.124	117.519	119.551
Estonia	16.236	18.147	15.293
Finland	128.280	120.040	100.922
France	1.138.742	1.571.776	1.623.522
Germany	506.531	560.455	461.266
Greece	39.761	47.141	49.533
Hungary	15.573	19.280	20.743
Ireland	140.788	162.521	149.445
Italy	990.876	1.030.318	1.094.731
Latvia	11.439	11.435	11.592
Liechtenstein	326	213	180
Lithuania	21.066	20.629	22.001
Luxembourg	1.972	3.103	2.827
Netherlands	199.506	214.013	177.404
Norway	143.664	143.767	144.933
Poland	495.805	514.210	450.066
Portugal	99.910	107.140	111.112
Romania	49.830	67.344	N/A
Slovakia	35.328	39.343	52.722
Slovenia	8.590	12.141	15.182
Spain	620.055	748.306	813.768
Sweden	192.395	204.458	186.370
United Kingdom	1.390.185	1.406.975	N/A
TOTAL	**6.805.541**	**7.620.471**	**6.086.739**

From the available data reported in eurostat database, it is also possible to update the recovery levels for the years 2017, 2018 and 2019.

Figure 14 shows the recovery ratios per country in 2017, 2018 and 2019 complementing the sequence in Figure 6.

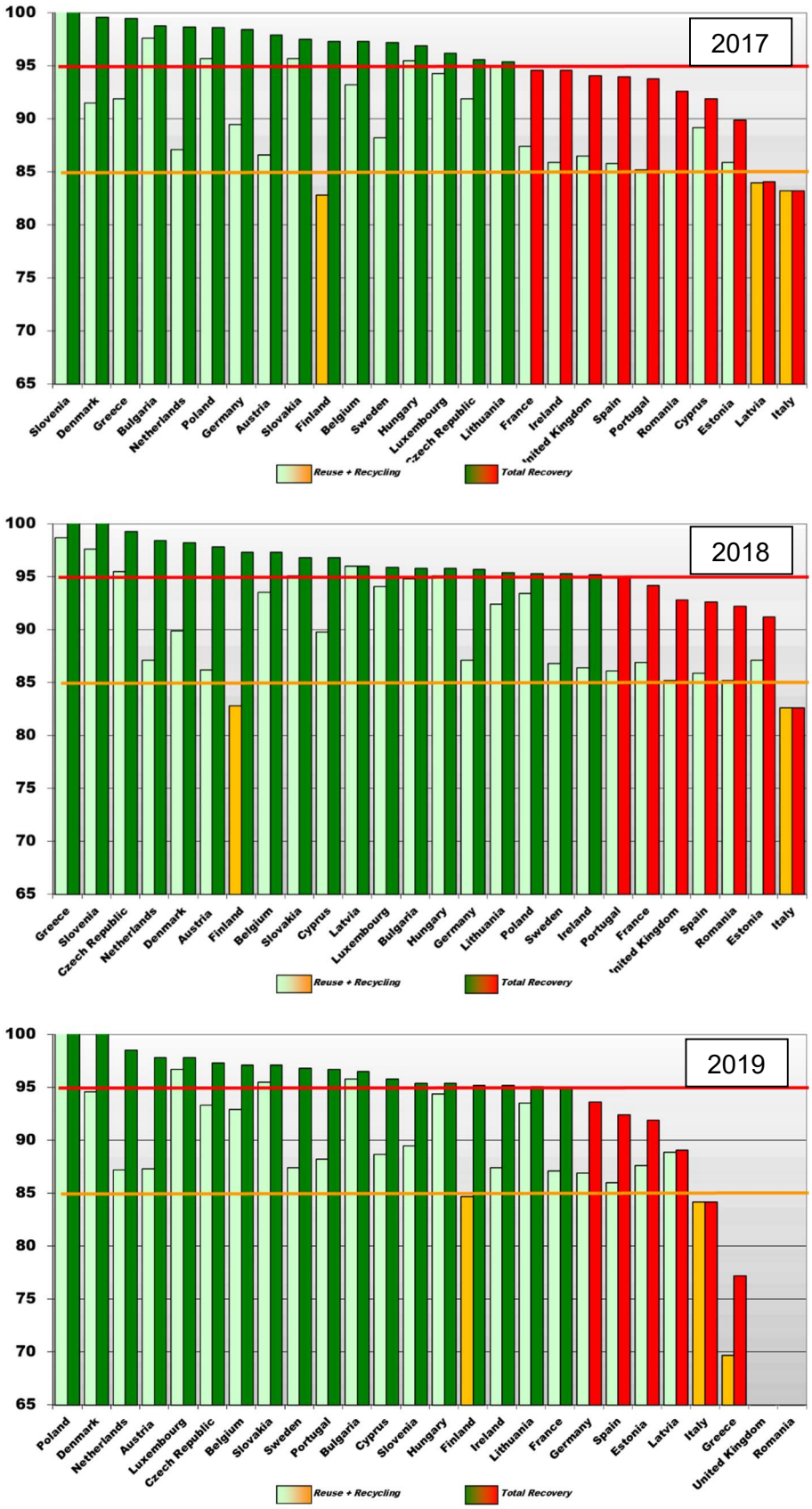

Figure 14. (UPDATED) Recovery levels in EU countries in the years 2017, 2018 and 2019

Conclusions (January 2022 update)

Based on the overall numbers, almost all countries across EU had a slight increase in the period 2017-2019 in the number of ELVs treated, as compared to the preceding years. On the other hand, this is a slight increase, so the ranking of the countries with higher number of ELVs treated is still dominated by France, United Kingdom, Italy, Spain, Germany and Poland. Portugal is still far for the values for these countries, even if it increased the number of ELVs treated in these last years to the levels of the year 2010.

When analysing the data reported for recovery ratios of ELVs in the period 2017-2019, there is still room for countries to optimise their targets. Reliability of data reported is still low and needs to be improved. The European Commission is aware of the situation and the monitoring of the recovery targets will for sure be one of the issues addressed in the future regulation on ELVs. Just looking at the following graphs (Figure 15) it is clear that there are still no solid and reliable monitoring systems in some countries: some report levels of recovery above 100%, others show a “sudden” increase of 10% when just achieving an increase of 1% from one year to the next is extremely difficult, and finally many report levels of reuse and recycling near or over 95% being almost impossible to reach those targets without any energy recovery.

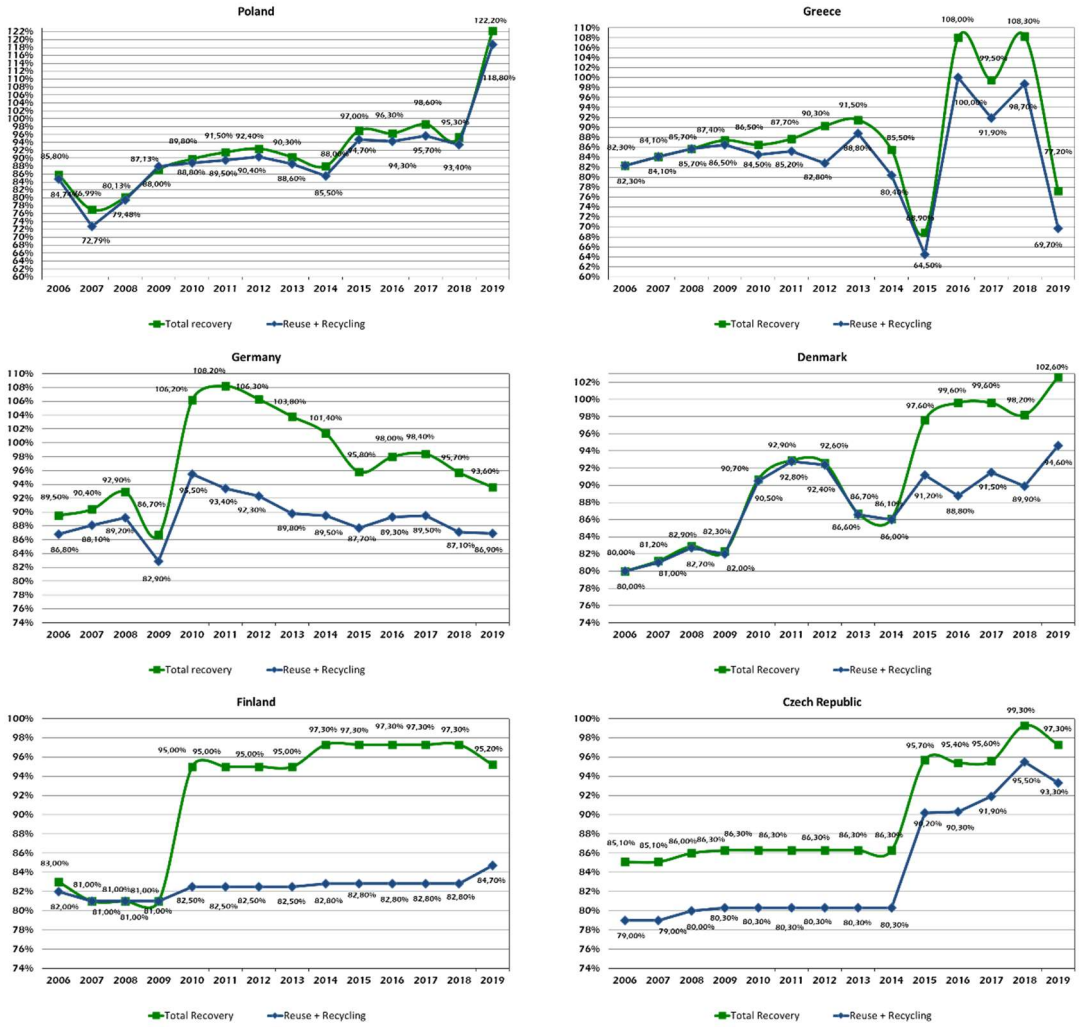

Figure 15. Recovery ratios for some countries reported from 2006 up to 2019

By looking at the data reported and taking into consideration that the treatment of ELVs is very similar all-around Europe because it is a competitive market and the technologies applied are well known and available, the actual recovery levels for ELVs are in the surroundings of 85-88% reuse and recycling and 94-96% total recovery. The main improvements in the future years will probably not be on higher recovery rates but instead it will probably be on increasing the recycling of materials that are being energy recovered such as many non-recyclable plastics that will be more and more recyclable as more and more vehicles produced taking into account ecodesign criteria get to the ATFs and are treated.

LIFE CIRC-ELV project is aimed for contributing to this improvement as the new model in recycling plastics from ELVs is validated. This model will be of high interest once the ELV Directive is reviewed by the end of 2022. Even when no official draft or action is published at the date this document is being updated, there exists the possibility that targets for ELV recovery could be material oriented or that recycled content in cars should be boosted. This applies for plastics in the broadest approach of the circular economy in ELVs and new vehicles.