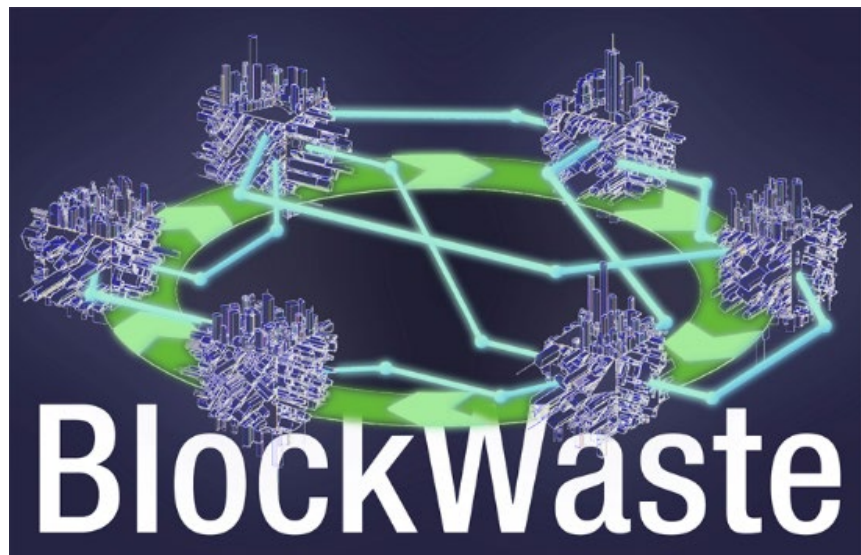


O1.A1. Comparative study of municipal solid waste (MSW) management regulations in each country



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Task leader: NTUA

Author(s): Dimitris Damigos, National Technical University of Athens, damigos@metal.ntua.gr, Greece

Viktoria Voronova, Tallinn University of Technology, viktoria.voronova@taltech.ee, Estonia

Bernd Kleinheyer, Bielefeld UAS, bernd.kleinheyer@fh-bielefeld.de, Germany

Reviewed by: Maria Menegaki, National Technical University of Athens, menegaki@metal.ntua.gr, Greece

Rainer Lenz, rlenz@fh-bielefeld.de, Bielefeld UAS, Germany, Christa Barkel, Saxion UAS, c.barkel@saxion.nl, Netherlands

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List of abbreviations

Abbreviation	Definition
MSW	Municipal solid waste
MSWM	Municipal solid waste management
NWMP	National Waste management Plan
EU-27	European Union of 27 countries
CE	Circular Economy
SMEs	Small and medium enterprises
IT	Information technology
GDP	Gross Domestic Product
PAYT	Pay As You Through

Executive summary

This document presents the results of the Activity O1/A1 “Comparative study of municipal solid waste (MSW) management regulations in each country”. The comparative study report aims to collect and analyse the existing regulations related to municipal solid waste management in the partner countries and the EU. Also, the regulations relating to municipal waste management and circular economy in the waste management sector are considered.

To this end, BlockWASTE retrieved and analysed data from Eurostat’s database regarding MSW generation and treatment and national accounts (basically GDP). The analysis involved descriptive statistics and econometric models (due to the time-series nature of the data the Prais –Winsten (1954) transformed regression estimator was used). Further, a review of the European and national legislations on circular economy and municipal waste (e.g., definitions, targets and incentives) was carried out based on published documents (grey and scientific literature) and German, Spanish, Dutch, Estonian and Greek law documents.

The European Commission’s target, which derives from the Waste Framework Directive (Directive 2008/98/EC, amended by Directive 2018/850), highlights waste prevention as the most favourable option. In the field of MSW management, the efforts focus primarily on reducing the amount of waste deposited in landfills and increasing the share of recycling. However, in around one-third of all Member States MSW production increases. Further, as far as MSW management is concerned, there are large differences among EU countries. For example, landfilling remains popular in Greece (more than 80% of MSW is landfilled), whereas it is almost non-existent in Germany and the Netherlands. From a policy perspective, this is attributed mainly to two reasons. First, much of the EU legislation relating to MSW management is in the form of “Directives”, and second, as regards waste prevention, EU Directive 2018/851 does not set specific quantitative targets except for food waste. Hence, it is evident that different challenges arise in the Member States on the way to achieve the targets set within the proposed EU Circular Economy Package for 2030.

The report is structured as follows: First, it discusses the different forms of classification of urban waste in each country studied and then presents the key figures regarding municipal solid waste (MSW) generation and management with the aim to reveal both similarities and differences between the partner countries. Following, it provides an overview of the main characteristics of the national and EU Circular Economy Action Plans and the MSW legislative acts and targets. The report concludes with the main findings of the comparative study, which will feed into the Activity O1/A3 “Handbooks of Circular Economy strategies applied to Municipal Waste Management using Blockchain technology”.

1 Introduction

1.1 Brief project description

The BlockWASTE project aims to address the interoperability between waste management and blockchain technology and promote its proper treatment through educational training, so that the data collected will be shared within a safe environment, where there is no room for uncertainty and mistrust between all parties involved. For this purpose, the objectives of BlockWASTE project are as follows:

- To conduct research on solid waste generated in cities and how it is managed, so that it can be used to create an information base of good practices, in order to reintroduce waste into the value chain, promoting the idea of Intelligent Circular Cities.
- To identify the benefits of the Blockchain Technology within the municipal waste management (MSW) process.
- To create a study plan that allows the training of teachers and professionals of organizations and companies of the sector, in the overlap of the fields of Waste Management, Circular Economy and Blockchain Technology.
- To develop an interactive tool based on Blockchain Technology, which will make it possible to put into practice the management of data obtained from urban waste, thus visualizing the way in which the data is implemented in the Blockchain and enabling users to evaluate different forms of management

BlockWASTE aims to implement transnationally new educational contents with the goal of training its students in the partner countries and providing them with the necessary basic skills that allow them to act professionally as future workers in the sector, adding digital competences required by companies that are embracing the process of digital transformation. In this sense, the project is addressed to:

- Enterprises and SMEs, IT professionals, urbanisms and waste management professionals.
- Universities (professors, students and researchers).
- Public bodies

The project includes four Intellectual Outputs as follows:

- O1. Learning materials for interdisciplinary Blockchain-MSW
- O2. European common curriculum on MSW applying Blockchain technologies to Circular Economy strategies
- O3. E-Learning tool based-on Blockchain-MSW focused on Circular Economy
- O4. BlockWASTE Open Educational Resource (OER)

1.2 Objectives and methodological approach

This document presents the results of the Activity O1/A1 “Comparative study of municipal solid waste (MSW) management regulations in each country”. The comparative study report aims to collect and analyse the existing regulations related to municipal solid waste management in the partner countries and the EU. Also, the regulations relating to municipal waste management and circular economy in the waste management sector are considered.

As far as the methodological approach is concerned, BlockWASTE retrieved and analysed data from Eurostat’s database regarding MSW generation and treatment and national accounts (basically GDP). The analysis involved descriptive statistics and econometric models (due to the time-series nature of the data the Prais –Winsten (1954) transformed regression estimator was used). Further, a review of the European and national legislations on circular economy and municipal waste (e.g., definitions, targets and incentives) was carried out based on published documents (grey and scientific literature) and German, Spanish, Dutch, Estonian and Greek law documents.

To this end, the report first discusses the different forms of classification of urban waste in each country studied and then presents the key figures regarding MSW generation and management with the aim to reveal both similarities and differences between the partner countries. Following this, the report provides an overview of the main characteristics of the national and EU Circular Economy Action Plans and the MSW legislative acts and targets. The report concludes with the main findings of the comparative study, which will feed into the Activity O1/A3 “Handbooks of Circular Economy strategies applied to Municipal Waste Management using Blockchain technology”.

2 Definition and classification of MSW

2.1 Definition

In the EU's Landfill Directive 1999/31, municipal solid waste (MSW) is defined as “waste from households, as well as other waste which, because of its nature or composition, is similar to waste from households”. According to Directive 2018/851, municipal waste means:

(a) mixed waste and separately collected waste from households, including paper and cardboard, glass, metals, plastics, bio-waste, wood, textiles, packaging, waste electrical and electronic equipment, waste batteries and accumulators, and bulky waste, including mattresses and furniture;

(b) mixed waste and separately collected waste from other sources, where such waste is similar in nature and composition to waste from households.

Municipal waste originates from households, commerce and trade, small businesses, office buildings and institutions (schools, hospitals, government buildings), and is collected door-to-door through traditional collection (mixed household waste), with specific fractions collected separately for recovery operations (through door-to-door collection and/or through voluntary deposits). This waste stream also includes waste from the same sources and similar in nature and composition which is collected directly by the private sector (mainly separate collection for recovery purposes) not on behalf of municipalities and waste originating from rural areas not served by a regular waste service. Municipal waste does not include waste from production, agriculture, forestry, fishing, septic tanks and sewage network and treatment, including sewage sludge, end-of-life vehicles or construction and demolition waste.

The above-mentioned definition is followed in practically all partner countries. To wit, in Germany, municipal solid waste in the terms of the Circular Economy Act § 5a is defined (KrWG2020) as any mixed or separate waste collected from: (i) private households, especially paper and cardboard, glass, metal, plastics, organics, wood, textiles, packaging, electric and electronic appliances, batteries, bulky waste including mattresses and furniture and (ii) other sources if this waste is comparable, by nature and composition, to private household waste. In Greece, according to the Hellenic Statistical Authority, the MSW category includes household and similar waste that is collected via the municipal collection system or through third parties. In Estonia (Waste Act, §2,7), municipal waste includes waste from households and waste produced in trade, provision of services or elsewhere, which because of its composition or properties is similar to waste from households. In the Netherlands, municipal waste is defined as household waste materials: waste materials originating from private households, except those components of that waste that have been designated as hazardous waste.

Finally, in Spain MSW is defined as waste generated in households as a result of domestic activities and similar waste generated in services and industry. It also includes waste generated in households from electrical and electronic equipment, clothing, batteries, accumulators, furniture and fittings, as well as waste and rubble from minor construction and repair work in households. Furthermore, waste from the cleaning of public roads, green areas, recreational areas and beaches, dead domestic animals and abandoned vehicles are considered as domestic waste (Law 22/2011 of 28 July on waste and contaminated soil).

2.2 Classification

Municipal waste, according to Eurostat (2017), consists of the following categories:

A. Separately collected waste from households:

- Paper and cardboard
- Textiles
- Plastics
- Glass
- Metals
- Organic materials from HH (kitchen waste, garden waste - home composting is not considered).
- Hazardous household waste (e.g., spent solvents, acids, alkalines, photochemicals, pesticides, used oils, paints, WEEE, batteries and accumulators, detergents, etc.)
- Other waste (e.g., edible oil and fat, rubber waste, etc.)
- Bulky waste

B. Residual waste:

- Mixed waste from households and similar institutions with the exception of separately collected fractions.

C. Waste from municipal services:

- Organic materials from municipality services
- Waste from public bins and street sweepings
- Market cleansing waste
- Cemetery waste

Practically the same classification is followed in Germany (Circular Economy Act, 2012, amended 2020, KrWG2020), Greece (National Waste management Plan, Official Gazette 185/A/29-09-2020), Estonia (Waste Act, 2004, amended 01.01.21), the Netherlands (National Waste Management Plan 2017) and Spain (Law 22/2011).

3 MSW generation and management

3.1 MSW generation

The generation of MSW in EU-27 was 224,503 thousand tons in 2019 (Eurostat, 2020). Although this was slightly higher than in 2018 (221 million tons), it was less than in 2008 (227.5 million tons). Denmark generated the most municipal waste per person (844 kg) among the EU-27, followed by Luxembourg (791 kg), Malta (694 kg) and Cyprus (642 kg). At the other end of the scale, four EU MS generated less than 400 kg of municipal waste per person: Hungary (387 kg), Estonia (369 kg), Poland (336 kg) and Romania (280 kg).

As far as the partner countries are concerned, in 2019, Germany had the highest municipal waste generation per capita (i.e. 609), followed by Greece (524 kg) and the Netherlands (508 kg). Municipal waste generation per capita in Spain (476 kg) was below the EU-27 average (i.e. 502 kg). Estonia, as mentioned before, produces far less waste (i.e. 73.5% of EU's average or 369 kg per capita).

The following Figure 1 shows the trend in MSW generation per capita between 2004 and 2019 for the partner countries and the EU-27. The Netherlands and Spain show, in general, a downward trend, contrary to Germany and Greece. Estonia presents a downward trend till 2012 and then MSW generation per capita increases (although in 2019, MSW generation is reduced by 8.8% compared to 2018). The EU-27 MSW generation per capita seems to range about the 500 kg level.

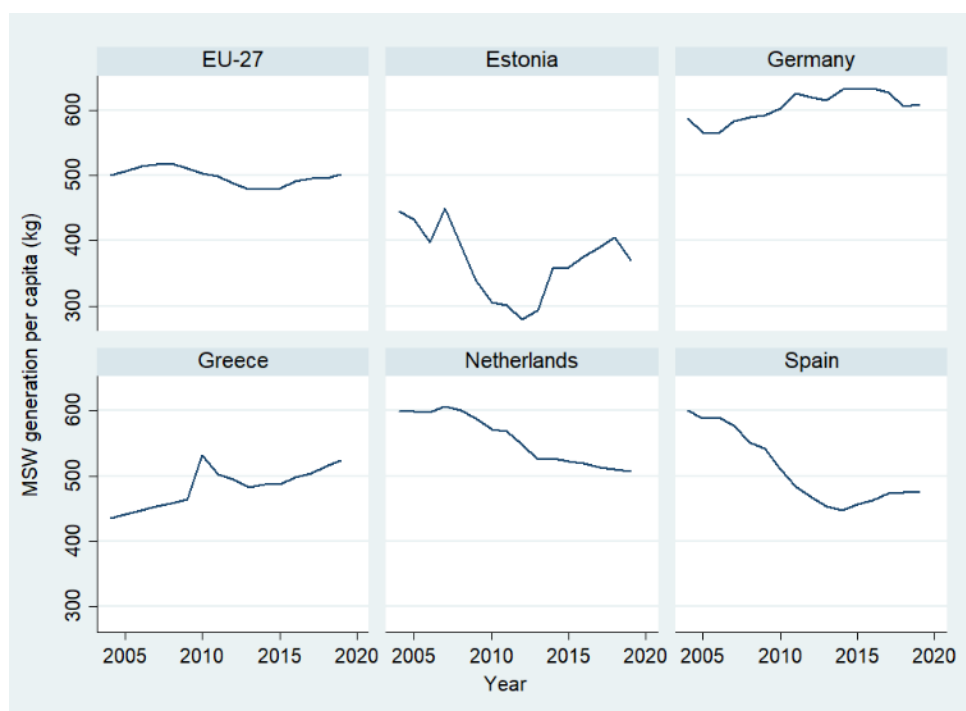


Figure 1: MSW generation per capita for the partner countries and the EU-27, between 2004 and 2019 (Source of data: Eurostat, 2021a)

Furthermore, Table 1 and Table 2 provide the total and per capita MSW generation respectively, in partner countries and the EU-27 over the last five years. MSW generation

increases in all partner countries except for Germany and the Netherlands. More specifically, the total MSW quantity increased in the EU-27 by 5.2%. The highest increase was recorded in Greece (6.4%) and Spain (6.0%). Estonia experienced an increase of 3.6%, lower than that of the EU-27. Finally, as mentioned, MSW generation in Germany and the Netherlands decreased by 2.0% and 0.7% respectively.

As regards per capita MSW generation, the average increase between 2015 and 2019 in the EU-27 was 4.6%. Again, the highest increase was recorded in Greece (7.4%). The increase in Spain and Estonia was 4.4% and 2.8% respectively. Finally, Germany managed to reduce per capita MSW generation by 3.6% and the Netherlands by 2.9%, accordingly.

3.2 Table 1: Total MSW generation in partner countries and the EU-29 over the last 5 years (in thousand tons)

Country	2015	2016	2017	2018	2019	Average
EU-27	213,409	218,027	220,642	221,093	224,503	219,535
Germany	51,625	52,133	51,790	50,260	50,612	51,284
Estonia	473	494	514	535	490	501
Greece	5,277	5,367	5,415	5,523	5,613	5,439
Spain	21,158	21,542	22,018	22,229	22,438	21,877
Netherlands	8,866	8,861	8,792	8,806	8,806	8,826

Source: EEA, 2020a

Table 2: MSW generation per capita in partner countries and the EU-29 over the last 5 years (in kg)

Country	2015	2016	2017	2018	2019	Average
EU-27	480	490	495	495	501	492
Germany	632	633	627	606	609	621
Estonia	359	376	390	405	369	380
Greece	488	498	504	515	524	506
Spain	456	463	473	475	472	469
Netherlands	523	520	513	511	508	515

Source: EEA, 2020a

It is commonly established that MSW generation is positively correlated to Gross Domestic Product (GDP). Considering all the observations of the dataset (i.e. MSW generation for the five partner countries and the EU-27), the Pearson correlation coefficient is estimated at 0.76 and is statistically significant at a 5% level. Figure 2 illustrates the relationship between per capita MSW generation and real GDP.

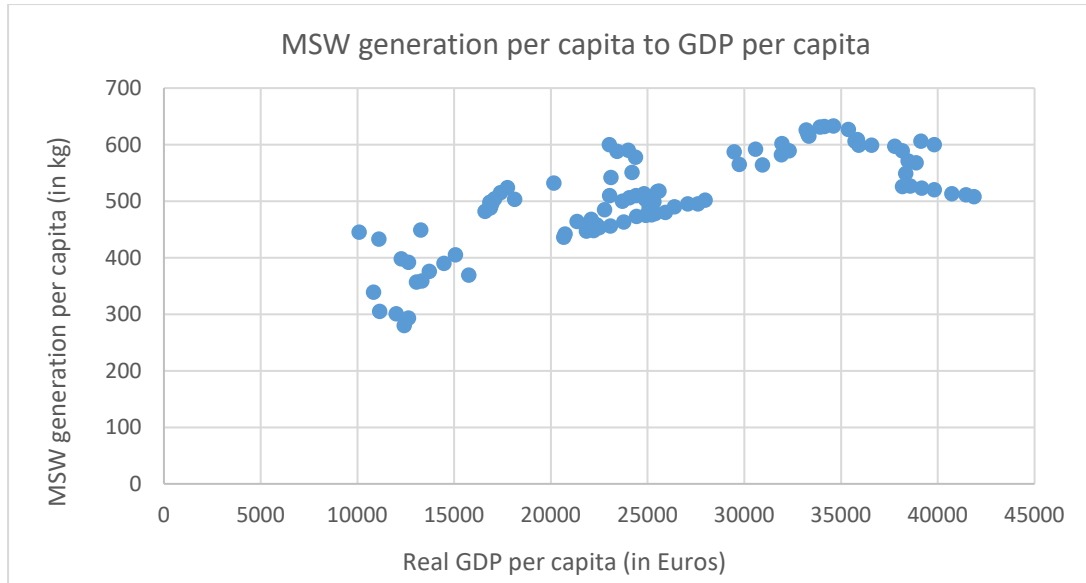


Figure 2: MSW generation per capita to real GDP per capita

To further explore this relationship between GDP and MSW generation, a random-effects Generalized Least Squares (GLS) regression model¹ of the following general form:

$$y_{it} = a + b_j x_{it} + v_i + \varepsilon_{it}$$

More specifically, the panel data from the five partner countries and the EU-27 was used for 2014 and onwards to leave aside the impact of the economic crisis that began in 2008 and peaked between 2010 and 2012. A log-log specification was employed to get a constant elasticity using the (log of) MSW generation per capita as the dependent variable and real GDP per capita as the explanatory variable. The results are presented in Table 3.

Table 3: RE GLS model results

	Coef.	Std. error	P> t
<i>ln (Real GDP p.c.)</i>	0.3312	0.1051	0.004
<i>Constant</i>	2.8466	1.0627	0.001
σ_u	0.1078		
σ_ε	0.0249		

The elasticity is 0.33 means that a 1% increase in the real GDP per capita is associated with a 0.33% increase in MSW generation per capita.

To further dissect the role of GDP in each partner country's waste performance, separate log-log models were run for each partner country. Given the time-series nature of the data, the serial correlation may be an issue in these models and, thus, least squares regression is inefficient and inference based on the least-squares estimates is adversely affected. The AR(1)

¹ The random-effects GLS model was preferred over the fixed-effects model after performing the Hausman's (1978) specification test (Prob>chi2 = 0.8974).

disturbances are most widely used and studied and, in such cases, a quasi-differenced equation, i.e.

$$y_t - \rho y_{t-1} = a(1 - \rho) + b_j(x_{t,j} - \rho x_{t-1,j}) + u_t \text{ with } u_t = \rho u_{t-1} + e_t$$

will have non-autocorrelated errors.

Some estimators, like the Prais –Winsten (1954) transformed regression estimator can handle this situation.

The results for the project countries are presented in the following Table 4.

Table 4: Prais –Winsten regression model results for the partner countries

	Coef.	P> t	Constant	P> t	rho	Adj. R ²
Germany	-0.7008	0.037	13.7659	0.004	0.0338	0.9847
Estonia	0.5512	0.034	0.6662	0.710	-0.8826	0.9998
Greece	1.2726	0.003	-6.1858	0.029	0.0241	0.9690
Spain	0.5129	0.000	0.9712	0.036	-0.1541	0.9999
Netherlands	-0.4413	0.000	10.9273	0.000	-0.6986	0.9999

It is interesting to note that Germany and the Netherlands have an unexpectedly negative coefficient for the period under investigation. In Germany, a 1% increase in the real GDP per capita results in a 0.7% decrease in the MSW quantity generated per capita. Similarly, in the Netherlands, a 1% increase in the real GDP per capita results in a 0.44% decrease in MSW quantity generated per capita. These findings are also illustrated in Figure 3.

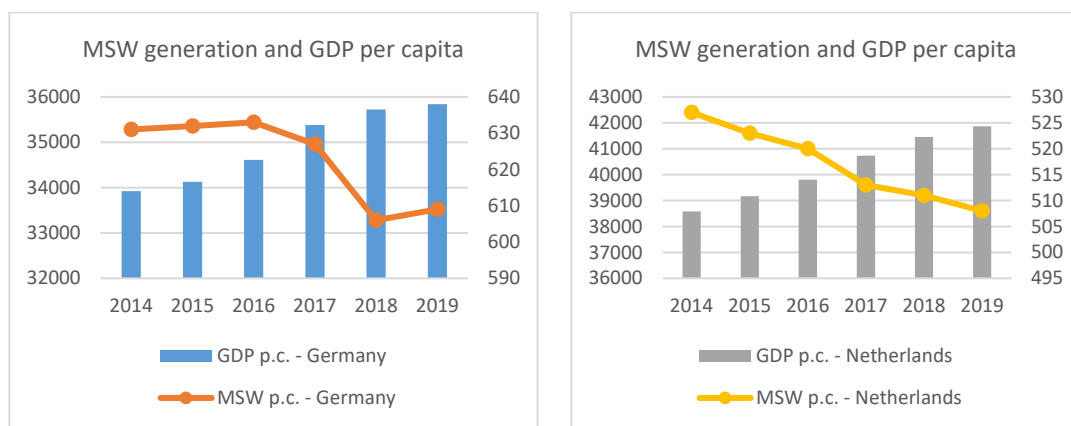


Figure 3: MSW generation and real GDP per capita for Germany and the Netherlands between 2013 and 2019

Three other partner countries, i.e., Greece, Estonia and Spain, present, as expected, positive coefficients. The increase in the MSW generation quantity per capita from a 1% increase in real GDP per capita is 1.27%, 0.55% and 0.51% for Greece, Estonia, and Spain, respectively. The differences between the countries are linked to the prevailing economic conditions and the consumption patterns in each country.

3.3 MSW management

As far as MSW management is concerned, there are large differences among the EU countries. Landfilling is almost non-existent in countries such as Belgium, the Netherlands, Denmark, Sweden, Germany, Austria, and Finland (incineration plays an important role alongside recycling in these countries). On the other hand, landfilling remains popular in the eastern and southern parts of Europe (in Malta, Cyprus, and Greece more than 80% of MSW is landfilled). Landfilling in Croatia, Romania, Bulgaria, and Slovakia is more than 60% (EEA, 2016a & 2020a).

Some countries use incineration and send a third or less of their MSW to landfills, such as Lithuania, Latvia, Ireland, Italy, France, Estonia, Slovenia, and Luxembourg. Germany, Austria, Belgium, Switzerland, the Netherlands, and Sweden recycled at least half of their municipal waste in 2014. There is a clear link between increasing recycling rates and declining landfilling rates, i.e., in countries with high municipal waste recycling rates, landfilling is declining much faster.

Also, differences exist among EU countries regarding recycling rates. Germany, Austria, Belgium, Switzerland, the Netherlands, and Slovenia present high recycling rates. The increase in recycling rates in many EU MS was at least 10% since 2004. Nevertheless, in some countries, e.g., Estonia and Malta, the rate of recycled municipal waste has barely changed. The amount of recycled waste for materials was 68.1 million tn (or 152 kg per person) in 2019 in EU-27. Furthermore, about 39 million tn (or 87 kg per person) of waste were composted in the same year (EEA, 2020b).

Focusing on the BLOCKWASTE partner countries, MSW treatment reaches 100% of the generated quantity in all countries but Estonia (the MSW treatment-to-generation ratio is 93%). There are, however, vast differences between the countries. As illustrated in Figure 4, landfilling was less than 10 kg per capita in Germany and the Netherlands in 2019, while in Greece it was more than 400 kg per capita and in Spain about 260 kg per capita. Finally, in Estonia, about 65 kg of MSW per capita were disposed of in landfills in 2019.

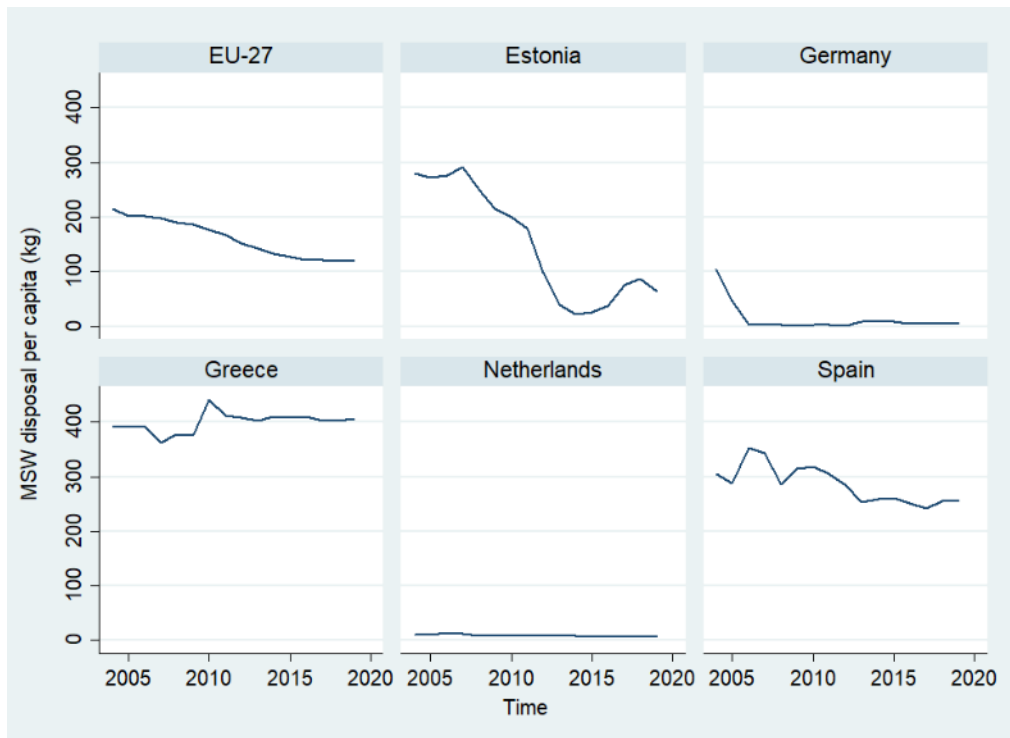


Figure 4: MSW disposal per capita for the partner countries and the EU-27, between 2004 and 2019 (in kg) (Source of data: Eurostat, 2021b)

As far as incineration without energy recovery is concerned, all five countries have practically abandoned (or never used in the period under consideration) this practice (Figure 5). Nevertheless, the picture is completely different as regards the incineration of MSW for energy recovery purposes.

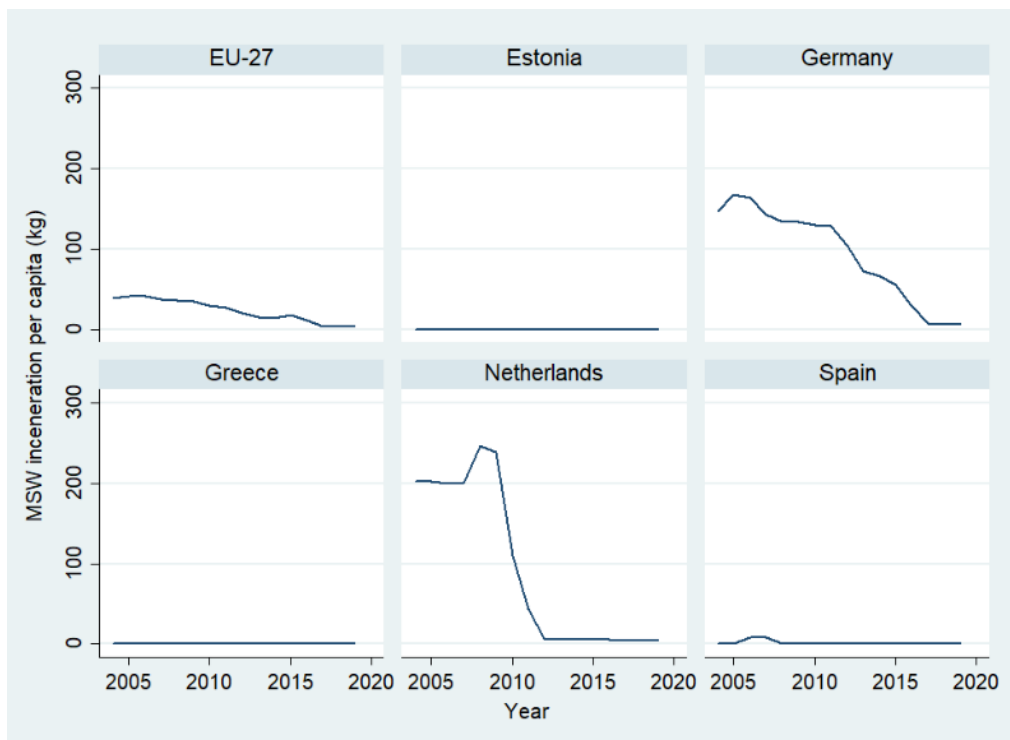


Figure 5: MSW incineration per capita for the partner countries and the EU-27, between 2004 and 2019 (in kg) (Source of data: Eurostat, 2021b)

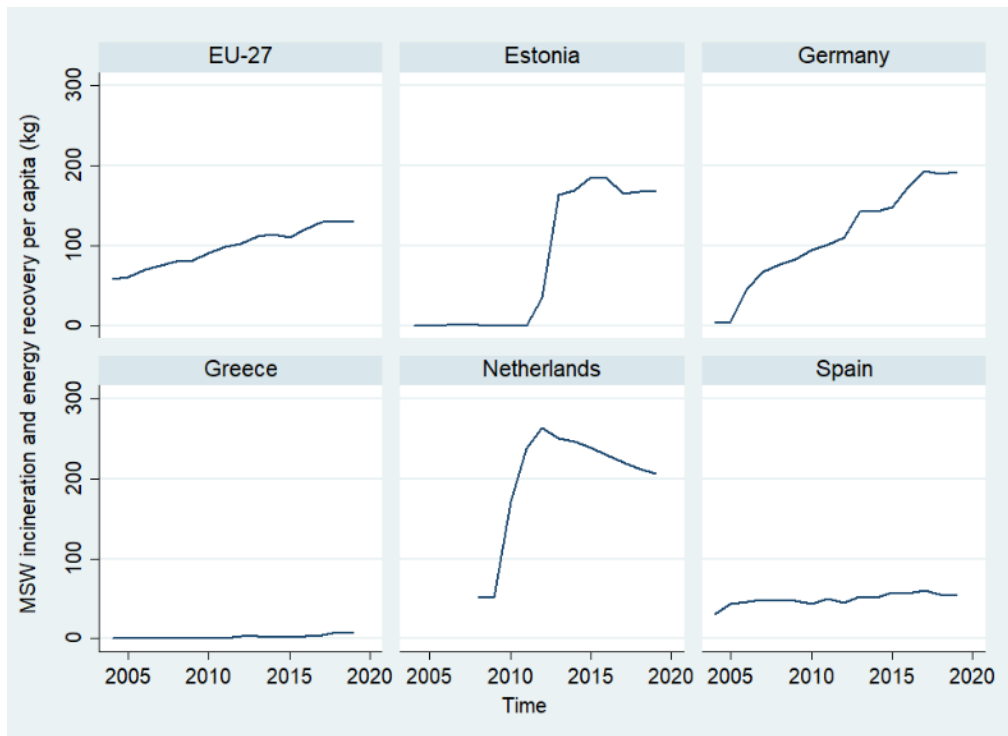


Figure 6: MSW incineration with energy recovery per capita for the partner countries and the EU-27, between 2004 and 2019 (in kg) (Source of data: Eurostat, 2021b)

According to Figure 6, incineration with energy recovery has more than doubled in Germany in the last 10 years. In Estonia, since incineration with energy recovery has skyrocketed since 2013 (from 35 kg per capita to 167 kg per capita, in 2019, i.e., an increase of about 380%). In Spain and the Netherlands, the increase of incineration with energy recovery has been around 20% in the last years. Finally, in Greece, this MSW management option is almost inexistent (i.e. about 7 kg per capita, on an annual basis).

Finally, as shown in Figure 7, MSW materials recycling is below 100 kg per capita in Greece, Spain and Estonia (corresponding to 16%, 18% and 28% of MSW generated), around 150 kg per capita in the Netherlands (28% of the waste generated) and 300 kg per capita in Germany (48% of the MSW waste generated), respectively. Also, Germany and the Netherlands recycle 114 and 148 kg of MSW per capita through composting (that is 19% and 29% of MSW waste generated). On the other hand, Spain, Greece, and Estonia recycle, through composting, 80, 26 and 9 kg of MSW per capita respectively (or 17%, 5% and 2% of MSW waste generated).

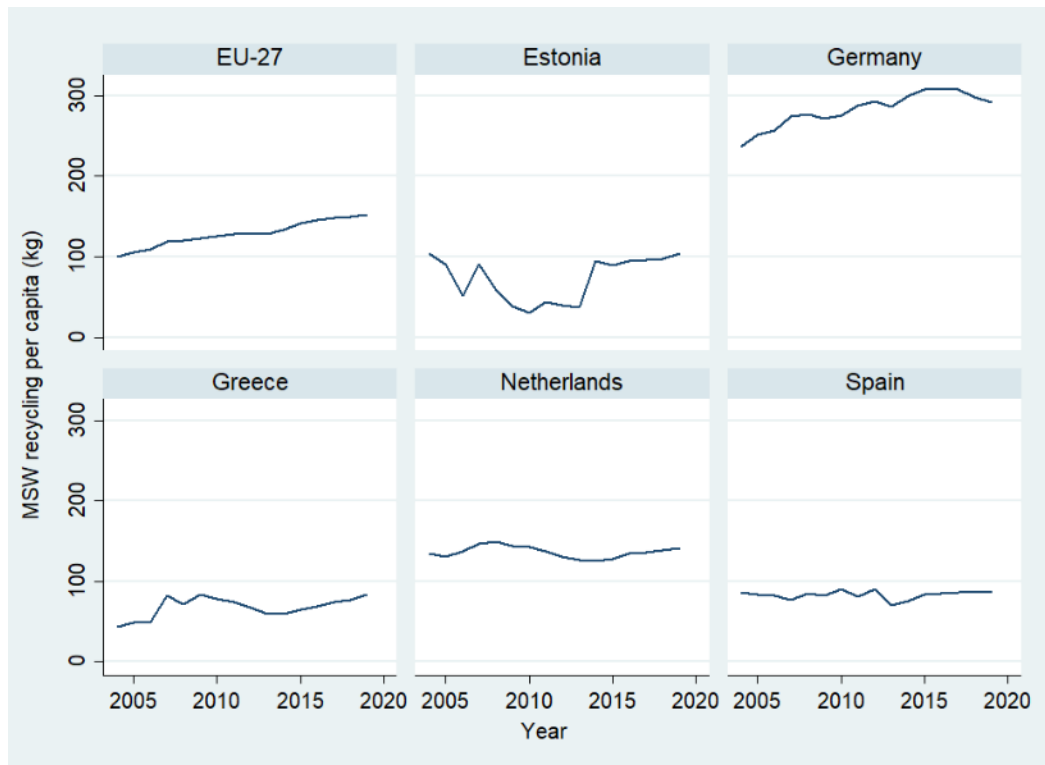


Figure 7: MSW recycling per capita for the partner countries and the EU-27, between 2004 and 2019 (in kg) (Source of data: Eurostat, 2021b)

The European countries that present higher recycling performance (such as Germany and the Netherlands) have a wider range of measures and instruments in place. Measures have included landfill bans on biodegradable waste or non-pre-treated municipal waste, separate collection of municipal waste types, especially bio-waste, well-functioning extended producer responsibility (EPR) schemes, and economic instruments such as landfill taxes, incineration and waste collection fees (such as pay-as-you-throw - PAYT). For instance, in Germany, there exists a roughly approximate PAYT system by which the size (i.e., fee level) of organics containers can be chosen, but without weighing of waste. Other factors, such as environmental awareness and effective implementation of waste management legislation, also affect the recycling rates. In general, countries that implement PAYT mechanisms present recycling rates above 45%, while most countries that do not employ them have recycling rates below 20%. Also, all the countries that show landfill rates well below the EU-27 average have either banned landfill of biodegradable or mixed municipal waste or implemented a ban combined with a landfill tax of at least EUR 30/tn.

The achievement of the 50% recycling target for municipal waste by 2020 varies significantly between the countries. Six countries (i.e., Germany, Austria, Belgium, Switzerland, the Netherlands and Sweden) already fulfil this target. Yet, several countries will have to intensify their efforts, particularly countries like Greece that currently recycle less than one-fifth of generated municipal waste.

While most of the recycled waste is collected separately, another part comes from extracting recyclables from mixed municipal waste in pre-treatment plants. This usually results in lower-quality recycled materials. Separate collection of municipal waste is steadily increasing across EU countries owing to the targets set by the amended Waste Framework Directive in 2018. It

is estimated that if all the potential for increased separate collection of waste is harnessed, separate collection rates of around 80% can be achieved (that means 111 million tons more material could be separately collected). This is mainly linked to food and plastics but also garden and textile wastes. The main barriers towards increasing separate collection are related to the price of recycled materials that results in relatively low revenues and threatens the economic viability of separate collection systems. Other drawbacks are the variable quality of recycled materials and the lack of recycling infrastructures, especially for recyclables such as plastics. Also, the fact that some waste materials are technically non-recyclable or are hard to separate poses significant barriers. The 2020 circular economy action plan addresses many of these barriers and also introduces measures that can be taken at product design and use stages.

Table 5 provides a comparison of the project countries and EU-27 regarding MSW generation and management for 2019. A brief presentation of the main characteristics of the existing national MSW management plans in each of the project's partner countries is provided hereinafter.

Table 5: Comparison of the project countries and EU-27 regarding MSW generation and treatment per capita (in kg), for 2019

	MSW generation (kg)	MSW treatment (kg)	MSW landfill (kg)	MSW incineration (kg)	MSW energy recovery (kg)	MSW recycling (kg)	MSW composting (kg)
<i>EU-27</i>	501	494	121	3	129	151	90
<i>Germany</i>	609	609	5	6	192	292	114
<i>Estonia</i>	369	345	64	0	167	104	9
<i>Greece</i>	524	524	407	0	7	84	26
<i>Spain</i>	472	472	241	0	52	93	86
<i>Netherlands</i>	508	508	7	5	206	141	148

Source: Eurostat (2021a & b)

3.3.1 Germany

In Germany, waste management is defined as a public duty. Public waste management organizations can, however, contract private service providers for performing public duties that have a proven 'reliability' record (defined in the Circular Economy Act), can submit a waste management plan and must then provide a financial deposit guaranteeing operability. States are obliged to set up state-wide waste management plans. State-level legislation can define waste management operators and which waste management facilities are to be used for specific categories.

Any planned new waste management unit is subject to a permit issued by the competent local bodies on the basis of environmental impact as defined by the national Law on Environmental Compatibility. Specific restrictions for landfills apply. Permits are not required for publicly operated facilities or private facilities certified for permit-requiring operations. Inspections of facilities are to be tolerated at any time. As regards public or private operators of facilities,

certification of equipment, qualifications and processes by an accredited body is mandatory and must be renewed in regular intervals.

Despite the efforts made by the Waste Prevention Program, absolute household waste volume remained relatively stable around 50 million tons between 2000 and 2018. As regards manufacturing and industrial waste outside construction, absolute amounts increased, as shown below, from 48 to 55 million tons (c +17%). Mining (c -16%) and construction waste (c -17%), in contrast, went down substantially (Figure 8).

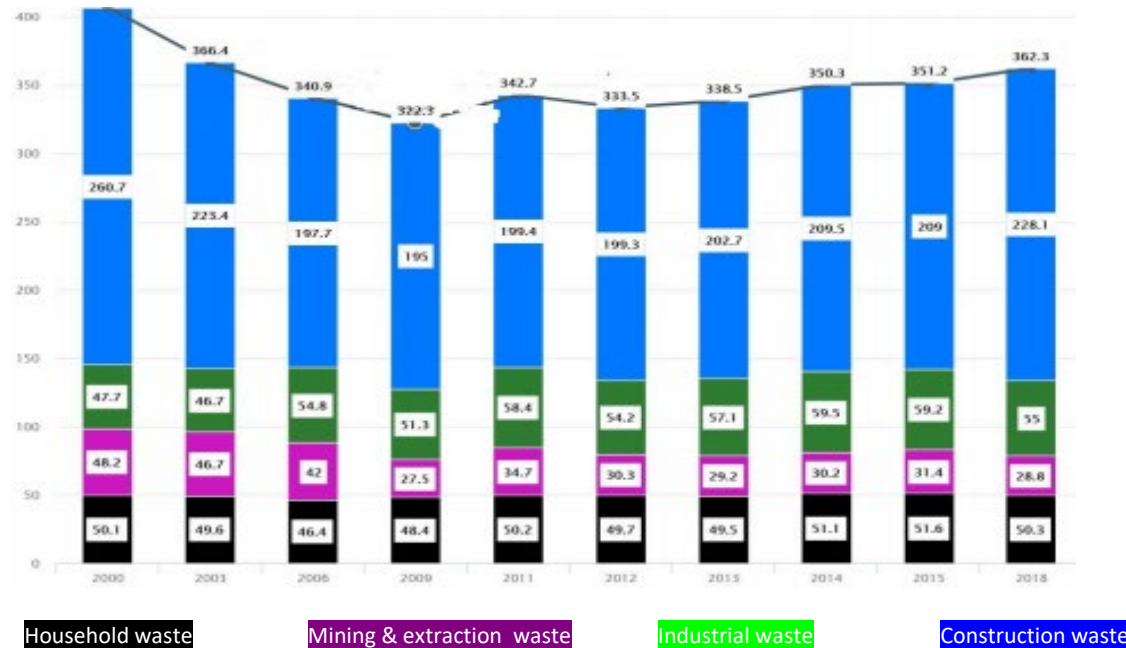


Figure 8: Waste by fractions in Germany (in million tons) (Source: <https://www.bmu.de/themen/wasser-abfall-boden/abfallwirtschaft/statistiken/allgemeine-abfallwirtschaft/abfallaufkommen>)

Residual mixed waste from households, i.e. waste excluding collected recyclable volumes of glass, paper, packaging/plastics and organics dropped by 22% between 2004 and 2017. As overall household waste has remained stable, this means that household output of recyclables has increased by the same factor. The following diagram illustrates the extent of waste behaviour change observed with households with respect to recycling (Figure 9).

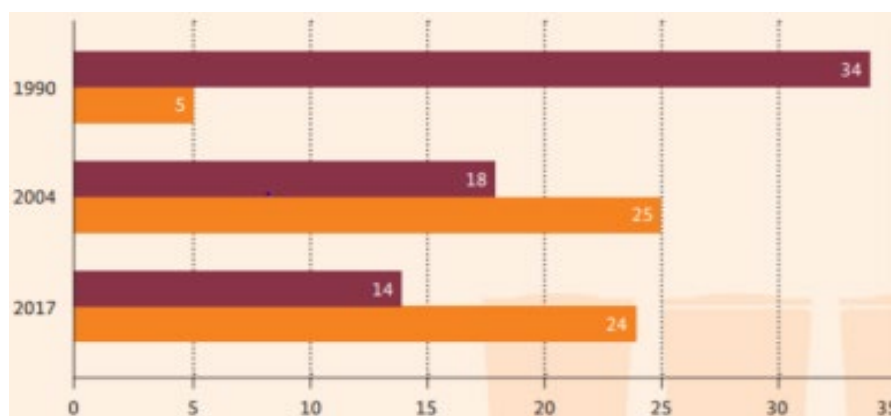


Figure 9: Household waste recycled, Germany 1990 to 2017 (in million tons) (Source: https://www.bmu.de/fileadmin/Daten_BMU/Pool/Broschueren/abfallwirtschaft_2020_bf.pdf)

One category of major concern, however, seems to be plastics - at least in terms of recovery - as high percentages go systematically into (energy-generating) incineration and not into classic recycling. Technical reasons quoted are inseparable compounds and high contamination. Critical voices (Boell_Plat2019) assume that it is also economic drivers that encourage feeding into incineration units. It must be also acknowledged that the diverse patchwork of collection and splitting modes between local areas (plastics / metal vs plastics & metal; bags vs containers etc.) has made it hard for consumers to follow recommended behaviour patterns.

Major achievements have certainly been the absolute and relative volume of recycling at households and the reduction of construction and industrial waste. When applying a holistic, i.e. a climate-aware perspective, the ongoing use of incineration of plastics and of organic waste as biomass are, in GHG terms, reasons for concern.

3.3.2 Greece

Nowadays, waste management in Greece depends mainly on sanitary landfill sites. The amount of MSW sent to landfill in 2018 was 4.3 million tons, equivalent to 78.4% of the total MSW generated compared to an average of 24% in the EU. The Law on Recycling was adopted in November 2017 to fully align existing waste legislation with circular economy principles. Yet, appropriate infrastructure and equipment such as “Green points” is still lacking. As a result, between 2015 and 2018 recycling from “collection at the source” increased from 790,000 tons (15%) to 913,000 tons (16.5%). Accordingly, the recycling of bio-waste increased from 109,000 tons (4.7%) in 2015, to 139,000 tons (5.7%) in 2018. In total, MSW recycled quantities increased from 833,000 tons (15.8%) in 2015, to 1,111,000 tons (20.1%) in 2018. MSW recycling (with pre-processing) and recovery rates in 2018 were 16.5% and 21.6%, respectively. The amount of biodegradable municipal waste (BMW) sent to landfill in 2018, was 2,771,773 tons, almost 2 million tons over the maximum allowable amount (910,000 tons). The recycled quantity of paper, glass, metals, and plastic was 759,620 tons (31%). The quantity of separate collection of recyclable materials (paper, glass, metals, and plastic) at the source was 752,620 tons (30.8%).

The performance of the national MSW management system was far from the pre-defined targets of the previous National Waste Management Plan (NWMP) of 2015. More specifically, the landfill rate was 26%, the recycling rate was 50% and the recovery rate was 74%. The separate collection of bio-waste also missed the target of 10% set by the Law 4042/2012 and that of the NWMP of 2015 (i.e., 40%). The same remarks apply to recyclable materials. The recycling rate of paper, glass, metals, and plastics was 50% according to Directive 2008/98/EC and 75% based on the 2015 NWMP. Similarly, the separate collection of recyclable materials at the source should be 65% following the NWMP of 2015. The targets of recycling and recovery of packaging waste, set by the Joint Ministerial Decree 9268/469/2007 (55% and 60%, respectively) have been fulfilled. Nevertheless, they are far from the recycling target set by the NWMP of 2015 (i.e., 80.2%). The target for the collection of batteries and accumulators

is less than the target required by the Joint Ministerial Decree 41624/2057/E103/2010 (i.e., 33.6% in 2018, while the target for 2020 is 45%). On the other hand, the target for the collection of waste of electrical and electronic equipment (i.e., 45%) is satisfied. As regards the small quantities of household hazardous waste contained within MSW (e.g., solvents, detergents, batteries, etc.), only the batteries and the fluorescent lamps are managed properly. Furthermore, based on the latest available data, there are 52 illegal dump sites all over Greece (for which the country has been paying fines) despite the ruling of the European Court of Justice of 2005 (case C-378/13), which dictated that by the end of 2008 all illegal dump sites should have been closed and rehabilitated. More specifically, 8 sites remained in operation, 24 sites are closed but not rehabilitated and 20 sites have been rehabilitated but the European Commission has not accepted the closure of the sites. The risk that Greece may not be able to meet the EU reuse and recycling targets was also mentioned in the European Commission's 2018 'early warning report'. A new NWMP, which replaces the previous one, came into force in September 2020 (Greek Ministerial Decision 39, Official Gazette 185/A/29-09-2020). The new NWMP has set ambitious targets (which are described in more detail in the next section) and aims to promote the production of secondary fuels from residual waste and the installation of 3 or 4 energy production units (waste-to-energy-plants). Besides, it will create a comprehensive and coherent legislative framework to confront challenges related to bureaucracy and other obstacles. In the same direction, the use of digital technologies is promoted (e.g., registers and databases and digital accounting tools) to facilitate the collection and analysis of reliable data and to make the charges more transparent, while the Regional and Local Waste Management Plans will be updated and submitted to an online platform.

Regarding economic instruments in Greece, waste charges are levied as part of a general flat-rate municipal tax, which is collected through household electricity bills. The amount of the waste levy is determined by multiplying the registered surface area of the residence with the general rates and any special rates the municipality might decide to apply considering economic and environmental factors. In 2012, a landfill tax was introduced (Law 4042/2012, Article 43) but it was not implemented. In 2019, the landfill tax was replaced by the "Circular Economy Levy", an environmental levy with lower fees. This levy, starting at 10 €/tn and increasing gradually per 5 €/tn with a maximum cost of 35 €/tn, is calculated annually by the solid waste management organizations ("FoDSA", in Greek) and distributed respectively to the affiliated municipalities. The new NWMP aims also to create incentives and disincentives for environmentally friendly and responsible waste management, to develop and implement digital tools, to utilise existing funding schemes and to promote green public procurement. The new economic instruments include pay-as-you-throw (PAYT) systems, reduced fees for separately collected bio-waste, constant fees for mixed waste that enters the Mechanical and Biological Treatment (MBT) plants, etc. The new NWMP will be supported by public awareness campaigns for separate collection of bio-waste and recyclable materials.

Finally, the main stakeholders involved in MSW management are the following:

- Ministry of Environment and Energy (YPEN), which is responsible for the development of environmental and waste management policy.
- Ministry of Interior (YPES), which is responsible for the supervision of Decentralised Administrations (DA) and local authorities (Regions and Municipalities)

- Hellenic Recycling Agency (HRA) or “Alternative Waste Management”, which is a public-interest, non-profit private entity supervised by the YPEN. Its main objective is the development, planning and implementation of a policy for the recycling and recovery of waste.
- Solid Waste Management Association (“FoDSA” in Greek), i.e. the regional non-profit waste management entities which are made up of municipalities within each Region and are responsible for the development, implementation and monitoring of the Regional Waste Management Plans. They can be state-owned or joint-stock enterprises under Public-Private Partnerships.
- Municipalities, which are responsible for the development and implementation of Local Waste Management Plans (based on the Regional Waste Management Plans).
- Extended Producer Responsibility (EPR) schemes and Producer Responsibility Organisations (PRO), which are private organisations, mainly sector-based, consisting of producers liable under the EPR policy. There are three PROs regarding packaging municipal waste:
 - the Hellenic Recovery Recycling Corporation (HERRCO), which is the most widespread system that has an extensive network of “blue bins” for packaging waste and a second network of “blue bells for the separate collection of glass
 - the Rewarding Packaging Recycling, which runs separate packaging municipal waste collections through 50 “Recycling Houses” distributed in major urban areas nationwide
 - the AB Vassilopoulos supermarket chain, which offers a separate collection of materials of packaging waste

The last two systems offer monetary incentives to citizens for recycling (1 euro for every 33 packages) via retail vouchers.

3.3.3 Estonia

On the national level, the main task of the Estonian Government and the Ministry of the Environment is to coordinate the implementation of an integrated waste management policy in cooperation with local governments, waste handlers (private companies), their associations and the third sector. An important governmental organization dealing with waste management is the Environmental Board as the issuer of an integrated environmental permit, waste permit, hazardous waste management license and waste operator registration certificate. Through its proposals, the Environmental Board evaluates the municipal waste management plan, waste management rules, and organized waste transport procurement documents. The Environmental Agency collects waste reports and compiles waste management overviews. The Environmental Inspectorate supervises waste management.

At a local level, the situation of waste management (especially municipal waste management) largely depends on the activities of local governments. Legislation imposes several obligations on local governments. The more specific tasks of local governments in organizing waste management are determined by the Waste Act. In addition to the Waste Act, the obligations of local governments are also regulated by the Packaging Act, according to which a local

government has the task of organizing the collection of packaging waste in its administrative territory. Here, the task of a local government is primarily to coordinate the operation of the collection system (agreements with recovery organizations, submission of requirements for the packaging waste collection system, information and supervision).

As far as the financing of waste management is concerned, until now, the main source of financing of the activities related to waste management of local governments has been the pollution charge for the disposal of municipal waste established on the basis of the Environmental Charges Act, 75% of the proceeds of which are directed to local government budgets. In addition to their own budgets, local governments can apply for support from the Environmental Investment Center (hereinafter EIC). Through the EIC, money from the EU Cohesion Fund and the European Regional Development Fund has also been directed to waste management projects in local governments.

At company level, waste management regulations require a waste permit, a waste operator's registration certificate and a hazardous waste management license. A separate waste permit is not required for holding an integrated environmental permit, because the integrated permit also provides requirements for waste management. If a company handles hazardous waste generated and transferred by other persons, in addition to the waste permit or integrated environmental permit, a hazardous waste management license must also be applied for.

Waste handling companies perform the following functions: collection of non-hazardous waste (incl. municipal waste, construction and demolition waste, etc.) and directing for further treatment (recycling, recovery or etc.); collection and further treatment of hazardous waste (except hazardous waste generated in the oil shale sector); participation in the waste recycling or recovery process (including preparation for waste re-use) and making a positive contribution.

As regards Producer Responsibility Organisations (PROs), their task is to organise the nationwide collection and recycling of packaging and packaging waste by packaging companies and to further develop the recovery system with the aim to ensure the recovery of packaging waste at least to the extent of the recovery targets set by the Packaging Act. As of 2019, there are 4 recycling organizations in Estonia. Three of them, namely the Eesti Taaskasutusorganisatsioon (ETO), the MTÜ Eesti Pakendiringlus and "The producer responsibility organization" (Tootjavastutusorganisatsioon) are engaged in collection of packaging without deposit system and one, i.e. the Eesti Pandipakend OÜ, with the collection and reuse of deposit packaging.

Extended producer responsibility applies to:

- batteries and accumulators from 1 May 2004;
- motor vehicles and their components from 1 January 2005;
- electrical and electronic equipment from 13 August 2005;
- tires from 1 January 2005;
- agricultural plastics from 1 January 2013.

Therefore, there are two organizations, one is MTÜ Eesti Elektroonikaromu ja Ekogaisma Eesti OÜ, that collects and reuses used electronic equipment in accordance with the requirements provided by legislation. In addition to electrical and electronic equipment, EES Ringlus organizes waste collection and recovery in companies engaged in the production and sale of

batteries and accumulators. Rehviliiit and Rehviringslus are producer responsibility organizations established by tire importers, distributors and re-sellers, whose main activity is the collection and reuse of used tires.

The general direction of environmental education is defined in co-operation between the Ministry of the Environment and the Ministry of Education and Research. The specialists of the Environmental Education Department of the Environmental Board and the region indirectly raise the awareness of the population through practical study programs and campaigns. Local authorities, waste handling companies, producer responsibility organizations and other environmental organizations also provide information on waste management.

3.3.4 The Netherlands

Rijkswaterstaat (RWS) is the executive organization of the Ministry of Infrastructure and Water Management. Rijkswaterstaat is the maintainer of a knowledge centre and creates the policy framework with and for 85 sector plans policies. RWS has developed a department of the Water, Traffic and Living Environment (WVL). Their ambition is to close raw material cycles and thereby bring a circular economy closer and work closely with other governments and business partners. Their primary activities are:

- Co-implement the Government-wide Circular Economy Program, including the From-Waste-to-Resource program, which aims at preventing and recycling waste generated by municipalities and the business community.
- Work on closing material or product chains, together with chain partners, by carrying out projects in the field of eco-design, sustainable procurement and recycling of material streams such as plastics and textiles.
- Co-implement the broad approach to litter and the drafting and implementation of a litter approach for the dry RWS area, including a litter framework.
- Support the Ministry of Infrastructure and Water Management in the development of policy and legislation and regulations and the implementation of policy monitoring of waste (policy) in the Netherlands.
- Co-implement The National Waste Management Plan².

Topics in this framework are waste streams like textile, plastics, batteries etc. The core of each sector plan is to describe and indicate how the waste material must be processed.

The Landelijk Afval Beheer Plan or LAP³, translated as Rural Waste Management Plan, is based on certain legal rules. The LAP has proved to be workable for licensing and standardizing the implementation of waste policy. Also, a program named VANG (Van Afval Naar Grondstof)⁴ has set the goal to reduce MSW from 250 kg waste per citizen to 100 kg per citizen.

² <https://lap3.nl/service/english/>

³ <https://lap3.nl/service/english/>

⁴ <https://www.vang-hha.nl/>

Waste policy in the Netherlands is monitored by collecting, analysing and reporting data at municipal and national level^{5,6}. Further information is provided by a knowledge centre of circular waste^{7,8}.

Waste is burned in big waste burning energy units mostly by private companies. They present themselves as sustainable companies on the grounds of their role of waste recyclers and energy suppliers to citizens and companies.

RWS wants to be circular by 2030 and no longer generate waste by 2050. This includes reuse of materials and products, the use of (sustainable) renewable raw materials and the reduction of primary resource use to zero.

Most inhabitants have two waste bins, called Green and Grey bins. The Green bin is for all organics, the Grey one for the rest. Besides those two bins, consumers are asked to separate paper, glass, plastics, metal, batteries, small chemical waste and textile. Waste of these categories can be delivered to the waste depots located in different places of an area. The Grey bin will be picked up by regional waste processing organisations (circle area of about max 50 miles) every two weeks. The Green bin is collected every week.

The municipality collects and processes waste at least once a week. All users of land or property where household waste can be generated pay a waste tax. The Basic tariff with or without a roll container is about 300 euro a year. Households can request an extra or a bigger container for 50 euro more or an extra container for about 100 euro more.

If there is space, organic MSW or part of it can be composted on the user's premises. That compost can then be used in a household's own garden. However, composting must be done properly, for example methane formation should be prevented. If that is not possible, organic waste should better be separated and fed into the municipal collection service.

3.3.5 Spain

The State Waste Management Framework Plan (PEMAR) 2016-2022 is the instrument to guide waste policy in Spain in the coming years, to promote the necessary measures to improve the deficiencies detected and to promote actions that provide a better environmental result and ensure that Spain complies with the legal objectives. This new Plan complies with:

- The Community obligation to have waste management plans, in view of the completion in 2015 of the current National Plan (Integrated National Waste Plan 2008-2015 (PNIR)).
- The fulfilment of one of the ex-ante conditions of the waste sector for access to community funds designated to this sector in next period 2014-2020.

The final objective of the Plan, as is the case with the Community waste policy, is to turn Spain into a resource-efficient society, moving towards a circular economy. In short, it is a question of replacing a linear economy based on 'produce, consume, and throw away', by a circular

⁵ <https://afvalmonitor.databank.nl/>

⁶ <https://www.afvalcirculair.nl/onderwerpen/linkportaal/publicaties/>

⁷ <https://www.afvalcirculair.nl/>

⁸ https://puc.overheid.nl/rijkswaterstaat/doc/PUC_632683_31/

economy in which the materials contained in waste are reincorporated into the production process time and time again to produce new products or raw materials.

The progress towards a circular economy is reflected in the PEMAR through the application, in all waste streams included, of the hierarchy principle established in Community regulations. This principle establishes that prevention must be the main priority in relation to waste policy, followed in this order by: preparation for reuse, recycling, other forms of recovery, including energy recovery, with waste disposal, mainly through landfill as the last option in the waste management hierarchy. This option must be reduced for all waste streams. In addition to this guiding principle, the following guidelines are also common to all waste flows:

- Coordination between all the administrations involved, especially through the Coordination Commission and its specific working groups to avoid barriers.
- Improving information and increasing transparency in the field of waste. In this sense, the implementation of the Waste Production and Management Register, a single and shared register for the whole of Spain, plays an essential role.
- Strengthening, increasing, and coordinating inspection, control and surveillance activities, especially to avoid market distortions associated with illegal waste management.
- Allocate more human and economic resources to the waste sector to, among others, improve knowledge on treatment and basic decisions on technical criteria.
- More and better communication and awareness-raising.
- Facilitate the reincorporation of materials from waste into the market, guaranteeing the protection of human health and the environment.

As a novelty of this Plan compared to previous ones, it is established that, to guarantee compliance with the national objectives, the Autonomous Regions must comply with these objectives at least with the waste generated in their territory, unless the sectorial regulations establish specific criteria for compliance. And if the targets affect municipal waste, the local entities will use all the means at their disposal to comply with these targets. In any case, the Autonomous Regions in their autonomous waste management plans may establish the contribution of the local entities, independently or in association, to the fulfilment of the objectives applicable to waste under municipal jurisdiction.

The State Framework Plan consists of 25 chapters, 15 of which are dedicated to waste streams with specific regulations. For all the waste streams included, the applicable regulations and objectives, the evolution of management in recent years and the current situation of waste management are described, and the objectives, guidelines, and strategic lines to achieve them are established.

The PEMAR may be updated when more information is available or when circumstances make it advisable and, in any case, no later than six years after its entry into force, with special attention to reuse and recycling. In relation to financing and considering the distribution of competences, the MAGRAMA will finance actions included in this Plan in accordance with its budgetary availabilities. The application and development of the guidelines established in the PEMAR will bring several types of benefits:

- Environmental: the correct management of waste guarantees the protection of human health, the atmosphere, water, and soil and contributes to protecting the climate.

- Economic: more business activity related to waste and an increase in the availability of raw materials used by industry in safe conditions.
- Social: job creation resulting from the promotion of preparation for reuse and recycling.

4 Circular Economy Action Plans and Strategies relating to MSW

On March 11, 2020, the European Commission adopted a new Circular Economy Action Plan intending to ensure that the resources used are kept in the EU economy for as long as possible. Building on the work done since 2015, the Action Plan includes measures covering the whole cycle, from production and consumption to waste management and the market for secondary raw materials.

Regarding waste management, the focus is on avoiding waste altogether and transforming it into a high-quality and well-functioning market for secondary raw materials. The Action Plan will set an EU-wide, harmonised model for the separate collection of waste and labelling and will put forward actions to minimise EU exports of waste and tackle illegal shipments. The Action plan also foresees actions on:

- batteries and vehicles – new regulatory framework for batteries for enhancing the sustainability and boosting the circular potential of batteries
- packaging – new mandatory requirements on what is allowed on the EU market, including the reduction of (over)packaging
- plastics – new mandatory requirements for recycled content and special attention to microplastics as well as bio-based and biodegradable plastics
- textiles – a new EU Strategy for Textiles to strengthen competitiveness and innovation in the sector and boost the EU market for textile reuse
- food – new legislative initiative on reuse to substitute single-use packaging, tableware and cutlery by reusable products in food services
- electronics and ICT – a 'Circular Electronics Initiative' to have longer product lifetimes, and improve the collection and treatment of waste
- construction and buildings – a comprehensive Strategy for a Sustainably Built Environment promoting circularity principles for buildings

As part of a shift towards a circular economy, the Action Plan includes four legislative actions introducing new waste management targets regarding reuse, recycling and landfilling, strengthening provisions on waste prevention and extended producer responsibility, and streamlining definitions, reporting obligations and calculation methods for targets.

As far as the BLOCKWASTE partner countries are concerned, all countries except for Estonia have an established CE strategy. A brief description of the national CE strategies concerning the management of MSW is provided hereinafter.

4.1 Germany

In Germany, the national Circular Economy Act (KrWG2020) defines the principle of shared public and private responsibility for waste management. Specifically, §68 of the act lists bodies to be consulted before legislation and directives are enacted:

- relevant science and research bodies
- associations of stakeholders affected including users
- businesses affected, involved and operating in the sector
- state-level authorities in charge of waste
- local authorities and purpose-specific association in charge of waste management

The Waste Prevention Program of 2013 (regular updates and amendments, AbVer2013) was devised on the basis of advice from the Federal Environmental Institute (UBA). It was decided after broad consultation with a diversity of public and private stakeholders including the civil society. The program defines scope and limits of legislation, stakeholders, objectives and indicators, principles, strategies, resources and budgets, consultation processes, and recommended measures. The Waste Prevention Program is regularly reviewed in terms of impact and need for updates in a dialogue between government and research institutes / science providers and broad stakeholder consultation. The consultation process involves, or it is claimed so, a broad inclusion of all relevant stakeholders, long-term scope and perspective, consensus building, information symmetry, impact monitoring, regular reviews of decisions. The program opts for non-quantifiable objectives of waste reduction as any assessment of mere volume is bound to produce distorted results regarding the aggregated environmental impact. This is due to external factors lying outside the field of waste (economic cycles, competing political objectives, absence of multi-level indicators, etc.).

The overall approach is characterised by:

- Qualitative over quantitative targets
- Recommendations over directives
- Multi-stakeholder consultation
- Voluntary stakeholder commitment over coercive regulation (e.g. taxation, bans)

Quantity-based classic indicators are seen as unfit to determine environmental impacts as long as they refer to aggregated volumes. Indicators make sense, according to the program, where specific performance or measures can be held against the generation of waste, such as:

- Re-use of end-of-cycle electric appliances. Ratio of re-used end-of-cycle appliances to total end-of cycle volume by category of appliance; year-on-year change and baseline year (to be determined).
- Re-use of packaging. Expansion of multiple use of containers by type of packaging in relation to total volume of packaging.
- Banning harmful substances. Number of substances affected; implementation of bans and substituting harmful by less harmful substances.
- Permits. Number of operation permits stipulating quantitative or qualitative targets aiming at preventing and reducing waste and involving verification.
- Environmental management systems (EMS). Number of businesses that have introduced EMSs defining quantitative or qualitative targets aiming at preventing and reducing waste and involving verification.

From a cross-cutting angle, the measures of the Waste Prevention Program are evaluated against the following indicators:

- Waste prevention effect of a measure
- Overall environmental impact of a measure
- Economic and social impact of a measure
- Administrative burden created by a measure
- Legal limitations relevant to a measure

The Waste Prevention Program involves different incentives, grants, tax breaks / charges, namely:

- Tax breaks for re-use of consumables (food, textiles)
- Charging disposal fees to waste producers
- Phasing out subsidies incentivizing the production of waste
- Tax breaks for marketing recycled substances and goods pre-processed for recycling
- Financial stimuli for local authorities for preventing waste production and introducing collection of recyclables
- Financial assistance to SMEs evolving towards reducing or preventing waste in manufacturing and supply chain
- VAT increases on products containing harmful or non-recyclable substances
- Introduction of deposit charges to consumers (e.g. plastic bottles)

4.2 Greece

Greece adopted a National Strategy and Action Plan for the Circular Economy in 2018. The following pillars of the National Strategy for Circular Economy are related to MSW management:

- Sustainable Resource Management, aiming among others at increasing their efficiency, reviewing value chains and rationalising waste management
- Support of Circular Economy, encouraging the idea of producing long-lifespan products, repair, re-usage, regeneration, supporting bio-economy, promoting green and circular public procurement, supporting secondary material use.
- Circular consumption, with full notification of citizens, training and basic aspirations for sustainable food consumption, deterring overuse of resources and prevention of waste generation through preparing for re-usage, repair and maintenance.

The National Strategy includes:

A. Regulatory and legislative reforms

- Implementation Action 1.1: Completion of the legislative framework for waste management. It aims at effectively implementing the prioritisation of waste management, promoting the prevention of creating waste and encouraging re-usage and recycling.
- Implementation Action 1.3: Processing proposals for reducing food loss. It aims at reducing food loss and combating food waste.
- Implementation Action 1.5: Clarification of the distinction between waste and products facilitating the transition to the use as secondary raw materials.
- Implementation Action 1.7: Developing innovative applications and cutting edge technology for waste management in the RIS3 context.
- Implementation Action 1.9: Developing a methodology to measure and monitor food waste.
- Action 1.15: Promoting the use of waste as a secondary fuel in industry. It aims to promote the use of waste, particularly of organic origin, as industrial fuel, when it cannot re-enter the productive process, particularly in energy-hungry sectors, such as cement production and other industries.
- Action 1.16: Establishing an institutional regulatory framework to facilitate the production of bio-methane (green gas) from organic waste and its injection into the natural gas grid or its use as vehicle fuel.

- Action 1.17: Drafting a Joint Ministerial Decision for compost from pre-selected organic waste.
- Action 1.20: Management, development of potential and reuse of waste products (such as clothing, furniture, devices, etc.).

B. Know-how and information actions

- Implementation Action 3.3: Special programmes for informing - raising awareness of food waste.

C. Governance Actions

- Implementation Action 4.3: Establishment of an Observatory for the Circular Economy

4.3 Estonia

Estonia has committed to developing a circular economy strategic document and action plan by the end of 2021. The documents will be prepared by the Ministry of the Environment. The required work is mainly divided into the following stages:

- Studies: Developing circular economy indicators (2019) and mapping the current situation of the Estonian circular economy (2020-2021)
- Compiling a strategic document and action plan for circular economy in Estonia (2020-2021)
- Stakeholder involvement throughout the process (2020-2021)

In this direction, the following financing measures are discussed:

1. Measure of recycling of waste and preparations for its reuse

The purpose of the grant is to increase the recycling and preparation for reuse of waste generated in Estonia to protect the environment. Activities to be supported include:

- Establishment of waste plants and stations, their expansion, and the purchase of inventory.
- Preparing waste for reuse, including the establishment of a reuse centre and the purchase of inventory.
- Recycling of waste collected by type.
- Preparations for recycling of waste collected by type if recycling is proven.

2. Circular economy program

The circular economy program aims at supporting activities that contribute to the efficient use of resources and help to introduce the circular economy principles, avoid the generation of waste and emissions, and reduce the environmental impact of the activities. Operations to be supported are as follows:

1. More efficient use of resources
 - carrying out resource audits
2. Implementation of the circular economy principles

- applied research and development directly related to the research or development of solutions;
- activities that support eco-innovation and circular economy (eco-design and circular economy training, audits and pilot projects), that contribute to the capability of enterprises to create new products, services, and business models;

3. Environmental management activities

- organising hazardous waste collections in non-urban settlements where there are no other options for disposing of household waste;
- managing resulting, including the promotion of recovery and recycling and the cleaning up of land, waste resulting from the tearing down of end-of-life buildings that are damaging the landscape, and the dismantling and flattening of degraded and decommissioned agricultural, industrial or military structures.

4.4 The Netherlands

In the government-wide program 'The Netherlands Circular in 2050', the government outlines how the Dutch economy can be transformed into a sustainably driven, fully circular economy in 2050. To achieve this, action must be taken, and clear milestones set at all levels of society. The first target is ambitious but not unattainable: 50% less consumption of primary raw materials (mineral, fossil, and metals) by 2030. This target is in line with the level of ambition in comparable countries.

More specifically, three strategic objectives are defined:

- Using raw materials in existing chains to a high standard. This efficiency improvement can lead to a reduction in the need for raw materials in existing chains.
- Where new raw materials are needed, fossil, critical and non-sustainably produced raw materials are replaced by sustainably produced, renewable and widely available raw materials. This not only makes the economy more future-proof, but also less dependent on fossil sources and their imports. Furthermore, the country's natural capital is preserved in this way.
- Developing new production methods, designing new products, and redesigning areas, as well as promoting new ways of consuming. This leads to other chains that give the desired reduction, replacement, and utilization an extra impulse.

The central government is taking various measures to give the circular economy plenty of space. For example, obstructive rules and laws are amended or removed in favour of the circular economy and entrepreneurs who save raw materials are supported. The measures are aimed at stimulating legislation and regulations, smart market incentives, financing, knowledge and innovation, international cooperation and behavioural change.

4.5 Spain

The Spanish Circular Economy Strategy, Spain Circular 2030, lays the foundations for promoting a new production and consumption model in which the value of products, materials and resources is maintained in the economy for as long as possible, in which waste generation is minimized and waste that cannot be avoided is used to the greatest extent

possible. The Strategy thus contributes to Spain's efforts to achieve a sustainable, decarbonized, resource-efficient and competitive economy.

The Spanish Circular Economy Strategy aligns with the objectives of the European Union's two circular economy action plans, "*Closing the loop: an EU action plan for the circular economy*" of 2015 and "*A new Circular Economy Action Plan for a cleaner and more competitive Europe*" of 2020, as well as with the European Green Pact and the 2030 Agenda for Sustainable Development.

The Strategy has a long-term vision, Spain circular 2030, which will be achieved through successive three-year action plans to be developed, which will allow incorporating the necessary adjustments to complete the transition in 2030. In this context, the Strategy establishes strategic guidelines in the form of a decalogue and sets a series of quantitative objectives to be achieved by 2030, of which those referring to waste are as follows:

- Reduce waste generation by 15% with respect to the level generated in 2010.
- Reduce food waste generation throughout the food chain: 50% reduction per capita at household and retail level and 20% in the production and supply chains from 2020 onwards, thus contributing to the SDGs.
- Increase reuse and preparation for reuse to 10% of municipal waste generated.

There are eight main lines of action on which the policies and instruments of the Circular Economy Strategy and its corresponding action plans will focus. Five of them are related to closing the circle: production, consumption, waste management, secondary raw materials and water reuse. The remaining three are cross-cutting: awareness and participation, research, innovation and competitiveness, and employment and training.

With regard to waste management, this plan states that in a global context in which raw materials are increasingly scarce and expensive, recycling only 37.1 % of the waste generated is a waste of available resources; and, therefore, a step forward must be taken in terms of recovery and recycling.

5 MSWM legislation and targets with emphasis on Circular Economy

The European Union's approach to waste management is based on the "waste hierarchy" which sets the following priority order: prevention, (preparing for) reuse, recycling, recovery and, as the least preferred option, disposal (which includes landfilling and incineration without energy recovery). The most important and recent legislative acts⁹ relating to MSW management and CE are the following:

- COM(2020) 798/3, Proposal for a regulation of the European Parliament and of the Council concerning batteries and waste batteries, repealing Directive 2006/66/EC and amending Regulation (EU) No 2019/1020
- COM/2020/98 final, A new Circular Economy Action Plan *For a cleaner and more competitive Europe*, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions
- Commission Delegated Regulation (EU) 2020/2174 of 19 October 2020 amending Annexes IC, III, IIIA, IV, V, VII and VIII to Regulation (EC) No 1013/2006 of the European Parliament and of the Council on shipments of waste
- Directive 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment
- Directive 2018/852 of the European Parliament and of the Council of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste
- Directive 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste
- Directive 2018/850 of the European Parliament and of the Council of 30 May 2018 amending Directive 1999/31/EC on the landfill of waste
- Directive 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
- COM(2017) 34 final, *The role of waste-to-energy in the circular economy*, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions

Based on the latest Directives and their amendments, the following timeline has been set:

- Separate collection of bio-waste by 31/12/2023 and of textiles and hazardous waste from households by 1/1/2025
- Preparing for re-use and recycling of municipal waste to a minimum of 55% by weight by 2025, 60% by 2030 and 65% by 2035, respectively
- Recycling of packaging waste to at least 65 % by 31 December 2025 and 70 % by 31/12/2030

⁹ It should be pointed out that there exist certain differences between EU Directives, Regulations, Decisions and Recommendations (https://europa.eu/european-union/law/legal-acts_en). Most EU legislation with regard to Circular Economy and MSW consists of Directives and provides much scope for national EU member states to fulfil the target and the speed of implementation by leaving 'transposition' to national legislators.

- Reducing landfill to a maximum of 10 % of generated municipal waste by 2035
- Ban on landfilling of waste suitable for recycling effective from 2030
- Recycling rate per material by 2025:
 - Plastics: 50%
 - Wood: 25%
 - Ferrous metals: 70%
 - Aluminium: 50%
 - Glass: 70%
 - Paper and cardboard: 75%
- Recycling rate per material by 2030:
 - Plastics: 55%
 - Wood: 30%
 - Ferrous metals: 80%
 - Aluminium: 60%
 - Glass: 75%
 - Paper and cardboard: 85%
- Separate collection of plastic bottles up to 3 lt, to achieve 90% recycling by 2029 with an interim target of 77% by 2025. These bottles should contain at least 25% recycled plastics as raw material by 2025 (for PET bottles), and 30% by 2030 (for all bottles).

5.1 Germany

As with most policy fields in Germany, governance regarding waste has three levels of decision-making: national / state / local level:

A. National level

Waste, recycling and circular economy regulations are national law, including transposition of EU directives. The national Law on the Circular Economy¹⁰ is the principal national legal document regulating waste, recycling and circular economy. Other national acts, by-laws and regulations oversee specific waste sectors. Those are for example:

- Packaging Act (Verpackungsgesetz, VerpackG),
- End-of-cycle Vehicles Directive (Altfahrzeug-Verordnung, AltfahrzeugV),
- Battery Act (Batteriegelgesetz, BatterieG)
- Electric and Electronic Appliances Act (Elektro- und Elektronikgerätegesetz, ElektroG)
- Landfill Regulation

The Federal Environmental Institute (UBA) monitors and researches waste recycling, disposal, the circular economy and overall strategies and advises legislators and the executive.

B. State level

State ('Länder') governments have ministries for environmental affairs, often in combination with agriculture, climate protection, consumer protection, and sometimes building/public works and traffic.

¹⁰ Gesetz zur Förderung der Kreislaufwirtschaft und Sicherung der umweltverträglichen Bewirtschaftung von Abfällen (Kreislaufwirtschaftsgesetz, KrWG, 2012, amended 2020, KrWG2020

Most state laws on waste define the implementation of the national Circular Economy Act (*Kreislaufwirtschaftsgesetz, KrWG*). National law on waste overrides state law, so state law follows national-level legislation.

State laws regulate waste disposal, recycling and waste reduction, e.g. in Hesse Hessisches Ausführungsgesetz zum Kreislaufwirtschaftsgesetz (HEKrWG_Aus)

State-level directives also define mid-term objectives as in Abfallwirtschaftsplan 2015, State of Hesse (HEAb_WP)¹¹. Most states also have state agencies for waste and the environment.

C. Local level

At a local level, municipal statutes define the tasks, objectives, service levels and fees of municipal departments of waste and circular economy. In rural areas, local communities often create purpose-specific regional associations of waste disposal ('Zweckverbände'). Calls for tenders to the private sector are exclusively initiated at local level. Local regulations are highly diverse in terms of fees, sorting guidelines of household waste, contracting of private service providers and waste collection processes.

German legislation on waste management does not define quantitative targets on waste reduction or generation. The strategic approach is based on a combination of qualitative targets ('decoupling'), a catalogue of highly specific recommendations regarding specific substance streams and a highly specific data monitoring system, summarised hereinafter (Table 6).

Table 6: The Waste Prevention Program of 2013 (AbVer2020)

Objective	Characteristics	Comment
<p><u>Overall ('qualitative') objective</u></p> <p>Protecting the environment and human health by decoupling economic growth from the impact of waste generation on man and the environment</p>	<p>Particular emphasis on decoupling evolution of waste volume from economic growth (GDP), i.e. emphasis on relative reduction. The reduction objective encompasses both upstream and downstream cycles and is to be assessed by a complete holistic lifecycle analysis. The objective of waste reduction is also to be weighed against social, technical and economic impacts.</p>	<p>Reduction of absolute volume not a priority. The relativism applied makes the assessment of impacts of measures extremely complex all the more as indicators and indexes of environmental impact are only emerging.</p>
<p><u>Operational objectives</u></p> <ul style="list-style-type: none"> • Reducing waste generation in relation to GDP, population and employment ('decoupling', principal objective) <ul style="list-style-type: none"> - Reduction of harmful impacts of waste - Reduction of harmful substances in materials and products including substitution of substances damaging human health and the environment 	<p>Qualitative approach, <i>waste intensity</i> / (volume against BIP) as a guiding indicator</p>	
<p><u>Sub-objectives and enablers</u></p> <ul style="list-style-type: none"> • Improving the population's awareness 	<p>All objectives generic and substance-unspecific</p>	

¹¹ https://umwelt.hessen.de/sites/default/files/media/hmuely/awp_hessen_2015_stand_24_04_2015.pdf

<p>and receptiveness regarding the necessity of reducing waste and harmful emissions;</p> <ul style="list-style-type: none"> • Enabling circular internal flow of substance streams within facilities; • Promoting consumer habits shifting towards acquiring low-waste and low impact products; • Low-waste product design; • Extending product life cycles; • Promoting re-use of products; • Increasing usage intensity of products. 		
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5.2 Greece

The legal framework that designates the direction of waste management in Greece follows closely the development of European waste management and the corresponding Directives. The most important laws, ministerial decrees and related EU Directives are the following:

- Ministerial Decision 39 (Gazette 185 A/2020) - Approval of the National Waste Management Plan, Official Gazette 185/A/29-09-2020
- Law 4685/2020 (Gazette 92 A/2020) - Modernisation of the Environmental Legislation, incorporation of Directives 2018/844 and 2019/692 of the European Parliament and the Council into Greek legislation and other provisions
- Greek National Circular Economy Strategy and Action Plan (2018)
- Law 4496/2017 (Gazette 170 A/2017) - Packaging and alternative management of packages and other products. Establishment of the National Organization for Alternative Management of Packaging and Other Products
- Law 4042/2012 (Gazette 24 A/2012) - Protection of the environment through criminal law in compliance with the Directive 2008/99/EC – Waste Production and Management Framework, in compliance with the Directive 2008/98/EC
- Ministerial Decree 41624/2057/E103 (Gazette 1625 B/2010) - Measurements, terms and program for alternative management of waste, electrical batteries and accumulators in conformity with the provision of the Directives 2006/66/EC and 2008/103/EC of the European Parliament and Council
- Ministerial Decree 9268/469/2007 (Gazette 287 B/2007) – Modification of the quantitative objectives for the recuperation and recycling of waste packaging according to article 10 (paragraph A1, last section) of law 2939/2001 (A' 179), as well as other provisions of this law, in conformity with provisions of the Directive 2004/12/EC

The timeline set for the different MSW management targets is practically the same as the one set by the EU Directives and CE strategy except for the separate collection of bio-waste (Greece's target has been set for 31/12/2022 instead of 31/12/2023) and of textiles and hazardous waste from households (Greece's target has been set for 2023 and 2022, respectively, instead of 2025). More analytically, the timeline is, as follows:

- Separate collection of bio-waste from 31/12/2022
- Preparing for re-use and recycling of municipal waste to a minimum of 55% by weight by 2025 and 60% by 2030, respectively
- Recycling rate of all packaging waste of 65% by weight by the end of 2025 and 70% by the end of 2030
- Recycling rate per material by 2025:
 - Plastics: 50%
 - Wood: 25%
 - Ferrous metals: 70%

- Aluminium: 50%
- Glass: 70%
- Paper and cardboard: 75%
- Recycling rate per material by 2030:
 - Plastics: 55%
 - Wood: 30%
 - Ferrous metals: 80%
 - Aluminium: 60%
 - Glass: 75%
 - Paper and cardboard: 85%
- Separate collection of metals, glass and plastics. By 2022, separate collection of hazardous waste produced by households and by 2023 separate collection of textiles/clothes.
- Separate collection of plastic bottles up to 3 lt, to achieve 90% recycling by 2029 with an interim target of 77% by 2025.

5.3 Estonia

In Estonia, the main legislative acts and targets relating to MSW management and CE are the following:

1. Waste Act
2. Packaging Act

The Waste Act and Packaging Act Amendment Act 190 SE was enacted on 11.05.2020. The draft amends the requirements and measures related to separate collection of waste, extended producer responsibility, waste prevention, local government and state waste management plans and more efficient waste recycling in order to achieve better results in waste re-use and recycling:

- By 31 December 2023 at the latest, on-site collection of bio-waste or, alternatively, on-site composting must be carried out.
- From 2025, local governments have to organize separate collection of textile waste on their territory.
- By 2030, landfilling of municipal waste must be reduced to at least 10% of the total amount of municipal waste generated.
- From 2025, at least 55% of municipal waste must be prepared for re-use or recycled, 60% after five years, and by 2035, recycling must have increased to 65%.
- The recycling of packaging waste must reach 65 percent by 2025 and 70% by 2030.

5.4 The Netherlands

Pursuant to the Environmental Management Act, the Minister for Infrastructure and Water Management is required to draw up a waste management plan at least once every six years. The plan covers the main points of policy on waste management, circular economy, details of the main aspects of individual types of waste and the policy on the import and export of waste. The National Waste Management Plan also complies with the obligation, derived from various EU directives, to formulate an explicit policy or devise certain programs relating to the various aspects of waste management.

All authorities must take into account the National Waste Management Plan when dealing with aspects of waste management. Central government must take into account environmental aspects when making policy plans and issuing decisions. In the case of waste management, the National Waste Management Plan is the frame of reference. For the Environment Minister, the National Waste Management Plan is the yardstick for issuing:

- collection permits for certain categories of (hazardous) waste
- decisions on notifications of the proposed import, export and transshipment of waste based on the EU Waste Shipments Regulation.

For provincial and municipal authorities and water quality managers the National Waste Management Plan is the yardstick against which they check all authorisations granted by virtue of the Environmental Management Act involving waste. This not only applies to permits for waste management establishments, but also to authorisations for companies generating waste.

- Scope

The National Waste Management Plan is intended for waste which is subject to the Environmental Management Act. The following waste does not come under the National Waste Management Plan:

- Radioactive waste: this is subject to the Nuclear Energy Act and the Policy Document on Radioactive Waste.
- Manure surpluses: this is governed by the Fertilisers Act.
- Dry rendering waste: this is governed by the Dry Rendering Act. In view of the possible effect of the processing of dry rendering waste on the waste disposal structure, a sector plan for animal waste is included in the National Waste Management Plan.
- Communal waste water (sewage water): subject to Chapter 10 of the Environmental Management Act, and the Policy Document on Water Management.

The following legislative changes were made in the last year¹²

1. Mixing waste (The Activities Decree regulated a ban on mixing hazardous waste prior to waste management)

¹² based on <https://aandeslagmetdeomgevingswet.nl/regelgeving/regels-voor-activiteiten/toelichting-milieubelastende-activiteiten/activiteitenbesluit-bor-bal/afvalbeheer-belangrijkste-veranderingen/>

2. Litter from companies. Previously, there was a regulation about cleaning up litter around industrial estates. This now falls under the specific duty of care. In addition, municipalities must include rules for this in their environmental plans.
3. Tailor-made regulations for waste materials that deviate from common raw materials were not specific enough. A custom prescription is now possible.
4. There is now a permit requirement for incineration and dumping waste on or in the soil. There are a number of exceptions to this.
5. Storing waste for more than 1 year before further disposal is not allowed anymore, the former maximum was 3 years.
6. The removal of waste after the end of an environmentally harmful activity falls under the duty of care. That is specifically mentioned. Disposal must take place within a reasonable period of time, which depends on the type of waste. The reasonable period is probably shorter for hazardous waste than for pruning, for example.
7. The compaction of waste is not allowed without a permit.

Based on the first goal of the government-wide program “The Netherlands Circular in 2050”¹³ the Netherlands will be fully circular in 2050. The target is ambitious but not unattainable. By 2030, the Netherlands must already use 50% less primary raw materials (minerals, metals and fossil fuels).

The ambition is to go from 250 kilos to 100 kilos of residual waste per inhabitant per year and 75% separation of household waste by 2020. That is the ambition of the Ministry of Infrastructure and the Environment, the VNG (Association of Dutch Municipalities), the NVRD and Rijkswaterstaat.

The following six substantive action lines are central to the transition agenda for the circular economy:

- increasing the supply of sustainably produced products
- optimal value of biomass and residual flows to circular bio-based products
- circular and regenerative use of soil and nutrients
- reduction of food waste
- the protein transition to more vegetable proteins
- "feeding and greening megacities" as Dutch revenue model

5.5 Spain

In Spain the most important regulations are regarding solid urban waste are the following:

Waste Legislation - General

Royal Decree 180/2015, of March 13, regulating the transfer of waste within the territory of the State. <https://www.boe.es/boe/dias/2015/04/07/pdfs/BOE-A-2015-3715.pdf>

¹³<https://www.rijksoverheid.nl/onderwerpen/circulaire-economie/nederland-circulair-in-2050#:~:text=Het%20kabinet%20heeft%203%20doelstellingen,er%20minder%20grondstoffen%20nodig%20zijn.&text=Dit%20maakt%20Nederland%20minder%20afhankelijk,is%20beter%20voor%20het%20milieu>

Law 5/2013, of June 11, amending Law 16/2002, of July 1, on integrated pollution prevention and control and Law 22/2011, of July 28, on waste and contaminated soils.
<https://www.boe.es/boe/dias/2013/06/12/pdfs/BOE-A-2013-6270.pdf>

Law 11/2012, of December 19, 2012, on urgent environmental measures.
<https://www.boe.es/boe/dias/2012/12/20/pdfs/BOE-A-2012-15337.pdf>

Royal Decree-Law 17/2012, of May 4, 2012, on urgent environmental measures.
<https://www.boe.es/boe/dias/2012/05/05/pdfs/BOE-A-2012-5989.pdf>

Law 22/2011, of July 28, 2011, on waste and contaminated soils.
<https://www.boe.es/boe/dias/2011/07/29/pdfs/BOE-A-2011-13046.pdf>

ORDER MAM/304/2002, of February 8, 2002, which publishes the waste recovery and disposal operations and the European waste list.
<https://www.boe.es/boe/dias/2002/02/19/pdfs/A06494-06515.pdf>

Law 10/1998, of April 21, 1998, on Waste.
<https://www.boe.es/boe/dias/1998/04/22/pdfs/A13372-13384.pdf>

Each type of urban waste has its own regulation. Some of the most relevant ones are listed below:

Waste Legislation - Used oils

ROYAL DECREE 679/2006, of June 2, which regulates the management of used industrial oils.
<https://www.boe.es/boe/dias/2006/06/03/pdfs/A21061-21070.pdf>

Waste Legislation - Electrical appliances and batteries

Royal Decree 106/2008, of February 1, 2008, on batteries and accumulators and the environmental management of their waste. <https://www.boe.es/buscar/pdf/2008/BOE-A-2008-2387-consolidado.pdf>

Legislation waste - Packaging and packaging waste.

LAW 11/1997, of April 24, 1997, on Packaging and Packaging Waste.
<https://www.boe.es/boe/dias/1997/04/25/pdfs/A13270-13277.pdf>

Waste legislation - End-of-life vehicles and tires.

ROYAL DECREE 20/2017, of January 20, on end-of-life vehicles.
<https://www.boe.es/buscar/pdf/2017/BOE-A-2017-656-consolidado.pdf>

Waste Legislation – Landfill

ROYAL DECREE 646/2020, of July 7, regulating the disposal of waste by landfill.
<https://www.boe.es/boe/dias/2020/07/08/pdfs/BOE-A-2020-7438.pdf>

As far as the timeline is concerned, by 2030 the targets are to:

- Reduce waste generation by 15% compared to the level generated in 2010.
- Reduce food waste generation throughout the food chain: 50% reduction per capita at household and retail consumption level and 20% in the production and supply chains from 2020, thus contributing to the SDG.
- Increase reuse and preparation for reuse to 10% of municipal waste generated over the next decade.

6 Conclusions

The European Commission's activities aim to reduce MSW production and increase the recovery of valuable raw materials from waste in line with the idea of the CE (Smol et al., 2020). This target derives from the Waste Framework Directive (Directive 2008/98/EC, amended by Directive 2018/850), which highlights waste prevention as the most favourable option in the waste hierarchy, above reuse, recycling and recovery (Magrini et al., 2020). The main reason behind that is that recycling requires additional energy and resources but in the field of MSW management the efforts of the European Commission for a transition to CE primarily focus on reducing the amount of waste deposited in landfills and increasing the share of recycling (EEA, 2016b; Magrini et al., 2020; Smol et al., 2020). Therefore, the two key challenges for the future, apart from reducing the relatively high amounts of untreated waste still landfilled in many Member States such as Greece, are: (a) to reduce levels of waste generation and (b) to align waste management objectives with those of the CE (Hollins et al., 2017). However, and despite the fact that almost all Member States have developed some type of policy towards preventing MSW generation, in around one-third of all Member States MSW production increases (Hollins et al., 2017). The latter category comprises Greece, Estonia and Spain, over the last five years. Moreover, moving beyond the perception of 'waste as a problem' to 'waste as a resource' is not an easy task. A general conclusion is that much of the EU policy on waste focuses on the diversion of waste from landfill to incineration or recycling (e.g., Germany), i.e. an end-of-life disposal perspective, while the goal of a CE is to create value-added from waste (Hollins et al., 2017).

As far as MSW management is concerned, there are large differences among EU countries. Hence, landfilling remains popular in Greece (more than 80% of MSW is landfilled), whereas it is almost non-existent in Germany and the Netherlands. Similarly, differences exist in recycling rates (e.g. MSW recycling is below 100 kg per capita in Greece, Spain and Estonia, around 150 kg per capita in the Netherlands and 300 kg per capita in Germany). From a policy perspective, this is attributed mainly to two reasons. First, much of the EU legislation relating to MSW management is in the form of "Directives", i.e., a legislative act that sets out a goal that all EU countries must achieve, but it is up to the individual countries to devise their own laws, define appropriate and specific qualitative or quantitative benchmarks and adopt measures on how to reach these goals (Magrini et al., 2020). Second, as far as waste prevention is concerned, EU Directive 2018/851 does not set specific quantitative targets except for food waste (even on packaging waste prevention, the EU does not set a quantitative target) and specifies a minimum set of prevention measures that must be included in national prevention programs (Magrini et al., 2020). The latter also explains the differences in the Member States' legislation. For instance, in Germany, governance regarding waste has three levels, namely national, state and local. Also, the German legislation on waste management does not define quantitative targets on waste reduction or generation. The strategic approach is based on a combination of qualitative targets, a catalogue of highly specific recommendations regarding specific substance streams and a highly specific data monitoring system.

Taking into consideration the above-mentioned observations, it is evident that different challenges arise in the Member States on the way to achieve the targets set within the proposed EU Circular Economy Package for 2030. According to Hollins et al. (2017), the targets and challenges vary as to the performance and the respective socio-economic conditions of EU countries, as follows:

- Countries with higher levels of GDP, high levels of waste per capita and relatively advanced waste management processes, like Germany and the Netherlands, should target reducing waste generation.
- Countries with moderate GDP per capita and an emerging waste treatment and recycling capacity, such as Greece, Estonia and Spain, should learn from what works elsewhere and accelerate, replicate and mainstream successful practices from more advanced countries.
- Countries with lower levels of GDP, lower levels of waste per capita and poor waste management processes and facilities need to develop management and treatment capacities economically and environmentally viable over the long term.

Finally, it is important to note that the variations do not exist only between Member States but also within Member States, i.e. between regions. For instance, Hollins et al. (2017) mention that, in Portugal, the regional variation in the percentage of waste going to landfill is 86.2%. The regional differences may be attributed to governance structures (i.e. the autonomy of the regions) as well as to economic and technical considerations, e.g. the feasibility of implementing separate collection and recycling schemes in rural areas. In this direction, it would be helpful to establish a more sustained transfer mission (e.g. a European agency, exchange programs, programming of transfer funding for less developed Member States, specific transnational training programs for tech staff and senior MSW management staff, etc.).

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