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COMPARATIVE STUDY

Comparison of waste management systems in Hungary, Slovakia, Romania and Ukraine

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АРР "ЗАКАРПАТТЯ"

CONTENT

COMPARISON OF WASTE MANAGEMENT IN HUNGARY AND UKRAINE

Comparison of legislation

Three of the countries examined (Hungary, Slovakia and Romania) have developed a similar regulatory regime as a result of harmonisation of the legislation applicable to them as Member States of the European Union.

Accordingly, **Hungary** also has a law regulating waste management, has a waste management plan, and follows the rules applicable to Member States in terms of the recovery and landfill targets to be achieved, which it is required to meet by a given deadline.

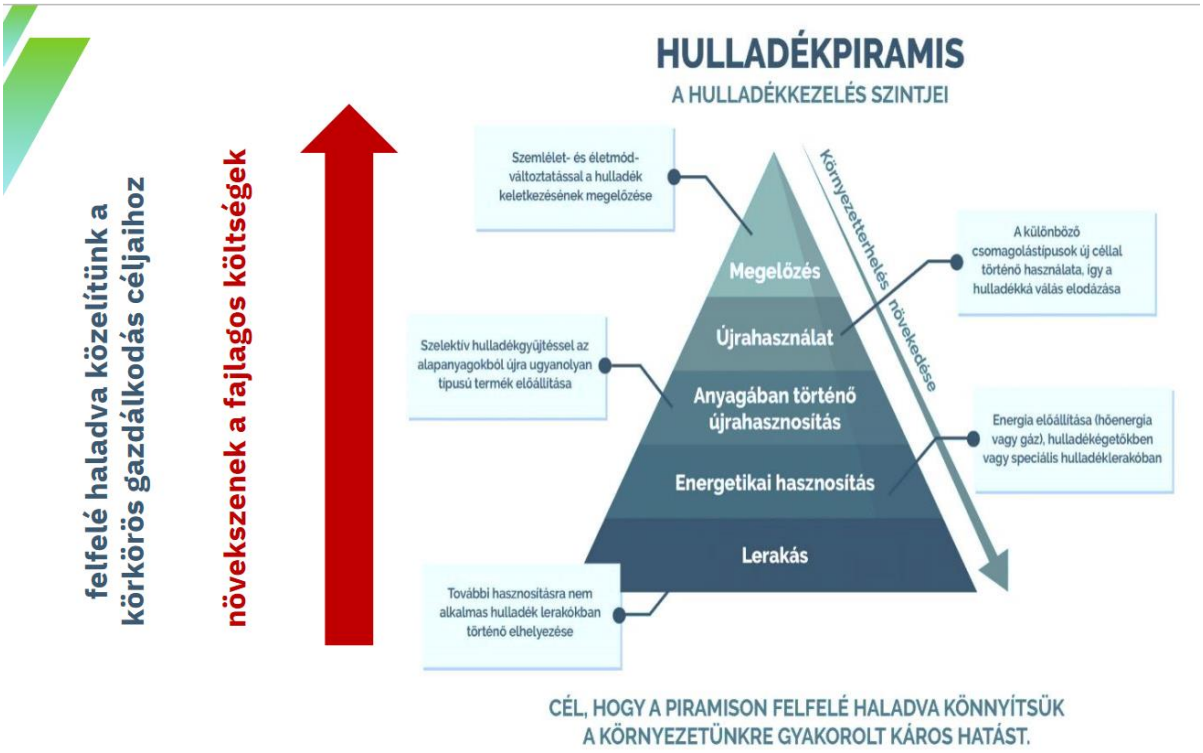
Since 2000, Hungary has introduced a new law on waste management (Act XLIII of 2000 on Waste Management), taking into account EU directives and requirements. Then, to facilitate the transition to a circular economy and the waste hierarchy, a completely new law (Waste Act CLXXXV of 2012 and a number of implementing regulations) was enacted to repeal this Act and to facilitate the transition to a circular economy.

The aim of the circular economy is to recycle as much of the packaging materials, raw materials from production that have become waste, intermediate waste from production and discarded products that are no longer used by users, into useful raw materials for industry, after appropriate collection and pre-treatment. This is true for municipal solid waste, inert waste (construction, demolition), biodegradable waste, green waste, textiles and even household cooking oil.

This can be in the form of raw material that has been reprocessed several times (aluminium-based packaging materials are a very good example), or it can be a one-off thermal waste that is no longer suitable for further material recycling.

Another important criterion, alongside recycling, is that both industry and consumers should strive to reduce waste production. As the costs of waste generation have been rising year on year for the industry, all actors are striving to reduce waste generation, not only from an environmental point of view, but also from an economic and financial point of view, and to sell as much of their waste as possible as a profitable material, at a lower cost to them. Of course, this way of thinking is only really implemented in countries where waste management systems

and regulation have reached a level at least comparable to that of Hungary. In addition to regulation, it is also important to monitor compliance with waste management and environmental protection rules and to sanction non-compliance.



1. **Figure 3: The waste pyramid as a hierarchy and system for waste management** Source.

Unfortunately, where a state does not properly regulate waste management and environmental protection, where there are no proper data reporting and monitoring systems in place, both the public and industry will choose the easier and cheaper way to get rid of the waste they generate.

As has already been shown in the previous chapters on Hungary, it can be seen that, in addition to the numerous pieces of legislation, there is a very strict system of reporting obligations on both sides dealing with waste treatment or production. And there are many possibilities for control of data reporting and compliance with the legislation by the different authorities. Moreover, not only companies with waste management permits or production-related permits that are in the view of the authorities are subject to control, but also illegal waste disposal and commercial activities are subject to control. A number of solutions and good practices have

been developed to tackle illegal waste. Examples include the "Clean up the country", "You pick it" and "PET cups" illegal waste collection and disposal actions. Also, the "waste radar" app, which allows users to report illegal waste piles to the competent authorities. In 2021 alone, the government has allocated HUF 7 billion for the clean-up of illegal waste piles under the "Clean up the country" programme (source: https://kormany.hu/hirek/illegalis-hulladeklerakok-felszamolasa-januar-vegeig-meg-beadhatok-a-palyazatok-a-kormanyzati-tamogatasra).

In contrast to the above, the EU-Ukraine Association Agreement, ratified on 16 September 2014, set out a roadmap for the gradual harmonisation of Ukrainian waste and resource management legislation in an environmentally friendly way, taking into account the EU Member States' specific waste management directives. Subsequently, Ukraine committed to separate all waste by material type into recyclable, landfillable and hazardous waste from 1 January 2018. This is provided for in Article 32 of the Law of Ukraine "On Waste". The Law of Ukraine "On Waste" prohibits the disposal of unprocessed household waste in landfills from 1 January 2018. Instead, it requires Ukrainian citizens to sort waste and place it in appropriate containers.

On 9 July 2023, the new Law of Ukraine "On Waste Management", adopted on 20 June 2022, entered into force. It is structured in a similar way to the Hungarian Act XLIII of 2000 on Waste Management, and the same measures are included in the Hungarian legislation, the Waste Act CLXXXV of 2012 and its implementing provisions.

The real difference is in the way the law is implemented. Ukraine's progress in the functioning of its waste management system is greatly hampered by the ongoing war in the country. Indeed, with the hopefully early end of the war, it presents a number of waste management challenges that would not be a major problem in peacetime. These will include the immense amount of construction and demolition waste, the disposal of hazardous waste generated during the war, and the clearance of areas of munitions.

In addition to the laws on waste management, the preparation of waste management plans and strategies for the countries concerned is an obligation. Progress is also being made in this respect. In order to reform and modernise the waste management system, the National Strategy for Waste Management in Ukraine until 2030 was approved in 2017. Shortly afterwards, the third edition of the National Waste Management Plan for Hungary was published, covering the period 2021-2027.

Statistical analysis

For the two countries, we can speak with different levels of detail and accuracy in terms of the databases available. While a lot of information is available in the so-called Eurostat system, which is the database of EU member states, the figures on waste management in Ukraine could only be obtained from various studies and publications working with local data, in which the data also show minor major differences, but on average, differences and similarities can be seen for the two countries. As a preliminary point, however, it can be said that Hungary has a stricter data reporting obligation and the associated monitoring system. Since its accession to the European Union on 1 May 2004, Hungary has benefited from a number of advantages in the development of its waste management system. As already mentioned in the case of Hungary, it is important to underline that since accession, more than HUF 238.85 billion of EU funding has been spent on the two KEOP and KEHOP projects. Additional funds were also available under the ISPA accession scheme, which provided, among other things, the opportunity to assess and recultivate existing landfills and to develop new, more economical regional waste management systems. Since the late 1990s, several European waste management companies have invested in the country (ASA, AVE, RWE Umwelt, Remondis), and have contributed to the development of the sector on a large scale, mainly in the field of public services, by providing expertise and financial resources, together with a number of developments.

ANNUAL WASTE GENERATION BETWEEN THE TWO COUNTRIES

According to the database of the Hungarian Central Statistical Office (KSH), the annual amount of treated waste in Hungary as of 2018 is around 18.2 million tonnes, with a slowly decreasing trend, including municipal, industrial, agricultural and inert waste. For a population of nearly 10 million, this figure is 1865 kg/person/year. Based on Ukrainian figures, this is more than 10 000 kg/capita/year. These figures are very high if we add that the waste recovery rate is only a few percent of this.

It is also worth looking at the figures for municipal solid waste. In this case, the annual amount of municipal waste collected from public services in Hungary is 3.75 million tonnes/year, which is slightly more than 380 kg/person/year on average per population, based on 2018 data. The

same in Ukraine is almost 281 kg/person/year on average, and the projection based on the nationally generated amount of municipal solid waste is 11.86 million tonnes/year in 2019.

Year 2018-2019	waste generation (million tonnes/year)	specific value (tonnes/person/year)	municipal solid waste (million tonnes/year)	specific value (kg/person/year)
Hungary	18,2	1,86	3,75	382
Ukraine	462	10	11,86	280,5
EU	2135	4,8	225,7	505

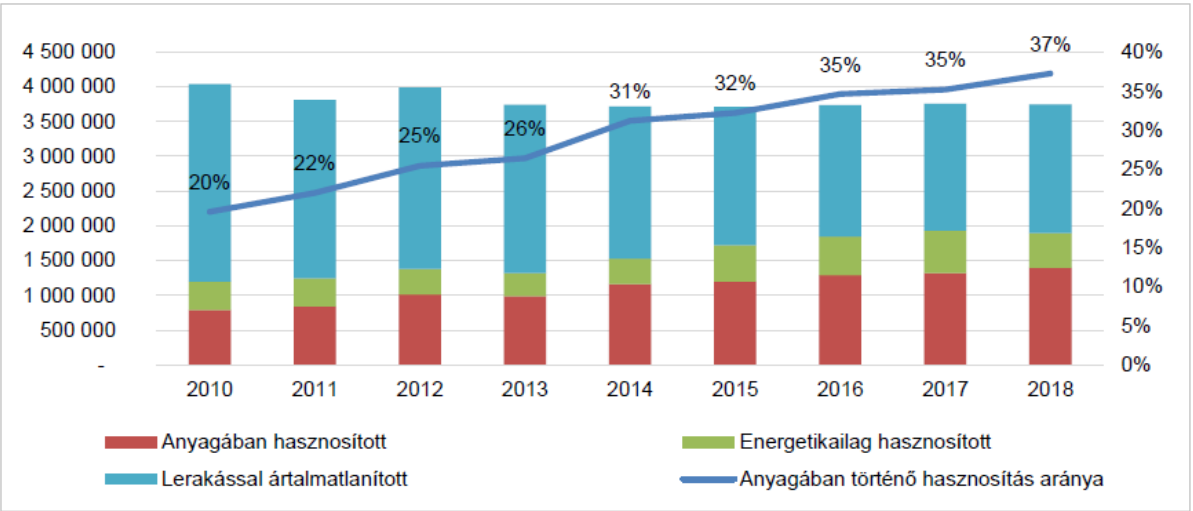
1. Table 2: Waste generation by country and by EU
Source: own editing, based on Eurostat

The EU average per capita annual waste generation is 4.8 tonnes per person per year, compared to more than double that in Ukraine. Estonia is closest with 12.1 tonnes per capita per year. However, the specific quantities of municipal waste generation are clearly more correlated with the level of consumption. Thus, Hungary and Ukraine also produce less than the EU average. The difference between the two countries is about 100 kg/person/year in favour of Hungary.

UTILISATION RATES

With regard to the transition to a circular economy, it is important to look at the recovery rate of waste. A higher recovery rate is more conducive to sustainability, an appropriate level of the waste pyramid and the servicing of the circular economy.

For Hungary, the utilisation rates almost doubled from 20% in 2010 to 38% in 2018, a trend that has not stopped since. The plan is to reach 50% by 2025, with a chance to do so if the introduction of the deposit scheme from 2024 onwards is successful. It follows from the figures that, in the distribution of waste collected and treated, if recovery increases, the amount of waste landfilled should also decrease. The amount of municipal waste landfilled should be reduced to 10% of the total amount of municipal waste generated by 2035.



2. Figure 1: Distribution of municipal waste treatment between 2010 and 2018 (tonnes)
Source: OHT 2020-2027

Ukraine's waste recovery indicators are still in a very early stage. 93% of the collected municipal solid waste is landfilled. There are 26 sorting facilities in the country, although their exact technical equipment and capacity is not known. However, the facilities per county cannot be overloaded if the landfill rates are so high. The main reason for this is that separate waste collection is not functioning properly in the country.

Ukraine's waste management strategy aims to increase recycling rates and promote resource recovery. A large number of initiatives to promote recycling are included, such as the implementation of recycling programmes and the construction of recycling infrastructure. It is also important to encourage and educate the public in the area of waste awareness, selective waste collection and the development of appropriate collection and sorting systems.

In Hungary, in addition to separately collected packaging materials, cooking oil and biodegradable waste, mainly green waste, are also collected separately as part of the public service.

The volume of used cooking oil is estimated at 40-80 thousand tonnes. Of this, more than 25 thousand tonnes were recovered for recycling in 2018. Ukraine should also catch up in this area, as it would be worthwhile to ensure that this waste stream is also recovered.

No concrete data on the use of green waste from the Ukrainian side. In Hungary, the amount of green waste landfilled in landfills had to be reduced to below 35% from 2016, which it achieved and maintained at 27%. Interestingly, it is worth noting that in the EU in 2020, 40 million

tonnes, or 90 kg of waste per capita, will have been composted, almost three times as much as in 1995 (14 million tonnes, or 33 kg per capita).

Differences between countries are reflected in consumption patterns and economic prosperity, as well as in different ways of collecting and treating municipal waste. The amount of waste collected and treated together with commercial waste differs from country to country.

In 2020, 67 million tonnes of municipal waste will have been recycled in the EU.

The amount of waste recycled in 2020 is unchanged from the previous year. Although the recycling of materials decreased to 67 million tonnes from 68 million tonnes in 2019, equivalent to 151 kg per person, the specific value is the same as in 2019. Compared to 1995, 44 million tonnes, or 97 kg more per person, were recycled in 2020.

Despite more waste being generated in the EU, the total amount of municipal waste landfilled has decreased.In 2020, total municipal waste landfilled will have fallen from 121 million tonnes in 1995 to 52 million tonnes (-58%), an average annual decrease of 4%.

WASTE INCINERATION

Energy recovery from waste is working to some extent, although still at a low percentage. In Ukraine, of the 11.6 million tonnes of waste, only 3.73% is thermally recovered, about 430,000 tonnes.

In Hungary, this figure is close to the amount treated in the Budapest incinerator, which averages 400 thousand tonnes per year. In addition, RDF is incinerated at a rate of 140-170 thousand tonnes/year nationwide. It should be noted that, in addition to municipal solid waste incineration, other waste streams are also incinerated, a significant part of which is also from household consumption, such as more than 12 thousand tonnes of textile waste and 32 thousand tonnes of waste tyres, which are used for electricity generation and 45 thousand tonnes are disposed of by incineration in cement plants.

SITUATION OF LANDFILLS

Since 2009, only landfills with adequate technical protection can operate in Hungary. Of the more than 2,600 landfills previously in operation, only regional landfills remain in operation, with just over 200 awaiting recultivation. Today, the total number of landfills operated under public waste management services is 51, with a combined capacity of 11 million tonnes per year.

By contrast, Ukraine has nearly 5,500 landfills covering 8,500 hectares, but around 30% of these do not meet the required standards, so around 1,650 landfills would have to be closed, dismantled and replaced by a new landfill with adequate containment and capacity on a regional scale. According to expert estimates, a significant proportion of landfills in Ukraine do not meet European requirements (Council Directive 31/26/EC of 27 April 1999 on the disposal of waste)

Dividing the above figures, the average size of landfills is 1.5 hectares. By contrast, in Hungary, a landfill site designed for 200 000 people covers an area of about 10 hectares, which can accommodate about 2 000 000 m3 of waste. The most urgent thing for Ukraine would be to develop regional landfills with adequate technical protection as soon as possible, and then, as far as possible in parallel, to close down and recultivate the technically unsuitable landfills and to eliminate the smaller ones.

The Ukrainian Waste Management Strategy also addresses these problems: modernisation of waste treatment and disposal facilities, such as landfills and incinerators, is key. The strategy includes measures to ensure that landfills meet environmental standards and incineration processes are environmentally sustainable.

According to the Ukrainian National Waste Management Plan 2030, the following waste management facilities are planned to be implemented:

-Ukraine is divided into 152 regional waste management zones.

- The new treatment and disposal infrastructure planned for 2032 will include 4 incineration plants, 27 MBH plants, 32 mixed waste sorting plants, 152 regional landfills, green waste composting plants.

- The type of treatment plant is adopted on the basis of the size of the regional waste management zones. The exact facilities will be decided and defined in cooperation with the regional waste management facilities.

The above suggests that landfills of a similar size and coverage to Hungary are envisaged in terms of population and region, although if landfills serve regions of around 200 000 inhabitants, as the Hungarian average shows, then perhaps close to 50 more regional landfills would be needed. It is important to note that in this case it is not sufficient to have a minimum landfill area of 10 ha and the associated capacity, but the proximity principle must also be taken into account. Experience in Hungary has shown that the ideal distance to landfill sites is a maximum radius of 50 km, above which it is worth using so-called transfer stations to transport the collected waste to the end points for the necessary treatment and disposal. The same applies to other treatment facilities. Because of the specific weight of separately collected packaging waste, it is not worthwhile collecting this type of waste stream economically from larger areas than the above without pre-treatment or sorting. It is therefore advisable to build them around the central point of generation.

Both their waste management strategy and their waste management plan show that they are aware of the problems, highlight the weaknesses of the current waste management system and take into account the trends already in place in EU Member States. They want to implement the polluter pays principle (PAYT, or Pay As You Throw). However, the more waste we deal with, i.e. the more pre-treatment or treatment it undergoes, and the higher up the waste pyramid we go, the more expensive the charge will be. Under current law, municipalities are responsible for the waste generated in their area. The cost of landfilling waste is between Rs 58-110 per tonne of waste, according to Recycling Solutions. This is not nearly enough to cover the cost of recycling, which would require a fee of at least Hr 500/tonne in 2019.

The Ukrainian study also addresses the issue of willingness to pay and its extent, showing that there are limits to the population's ability to pay, which should be taken into account when building up systems and waste management solutions that increase the constructiveness of the population in actively participating in waste management processes.

In addition to the construction of landfills and treatment facilities, the reduction of waste generation is also an important objective, which becomes important not only from a material and cost-saving point of view, but also from an environmental point of view. One of the most significant greenhouse gas (GHG) emissions from waste management, apart from those from waste transport, incineration, waste water treatment and composting, is landfill gas, which is a significantly higher GHG than carbon dioxide. This is because the spontaneous decomposition of organic matter in landfills also produces methane, which makes up 40-60% of landfill gas.

Green and bio-waste, as well as waste disposed of in landfills, are characterised by the production of large amounts of methane during the decomposition processes, which also increases the greenhouse effect. Therefore, in addition to diverting waste from landfill, it is important to generate as little waste as possible. To this end, the Ukrainian plans set the following targets and objectives:

Its elements are:

1. Reducing waste and preventing waste generation
    a. Develop regulations introducing extended liability for manufacturers of goods with an expiry date (packaging, medicines, electrical household appliances, tyres, cars, etc.)
    b. Development and implementation by local enforcement authorities and local governments.
    c. Implementing household solid waste management and involving local authorities.
    d. Introducing financial and economic mechanisms for the development of solid waste management infrastructure and services, notably VAT exemptions and tariff concessions to allow the import into Ukraine of equipment that is not produced in Ukraine.
2. Social advertising campaigns to reduce municipal waste generation
3. Improving waste water treatment methods, promoting recycling and recovery.
4. Improving wastewater treatment

In the absence of the above, the problems caused by waste management deficiencies in Ukraine are also felt significantly in Hungary. Just think that since 2004, there has been a regular pollution of the Upper Tisza rivers with municipal waste of foreign origin, mostly from Ukraine. The reason for this is that the population dumps waste in the floodplain, which is carried by even small tidal waves and transported to our country, and the waste management system in the country responsible is not developed enough to prevent the problem. The pollution of the Tisza, especially the Upper Tisza, Szamos, Kraszna, Bodrog with municipal waste (most commonly PET bottles) is not a recent problem. The problem is basically due to the lack of waste management in the neighbouring country or its inadequate extent. The rivers act as a transport medium and transmit environmental problems in the catchment areas of the upstream countries

to the downstream countries. In some river stretches (North-East Hungary, Tisza), nearly half of the environmental damage is caused by foreign-generated municipal waste pollution.
The intensity of pollution can be determined by the number of bottles passing through a given section per minute. In the Upper Tisza, the pollution intensity has sometimes reached 300-500 bottles/minute over the last decade or more. The intensity of the pollution varies over time, but the total volume of waste can arrive over a period of days during a tidal surge. The cost of cleaning up this type of pollution can be measured in billions of dollars. A joint strategy with the Hungarian government is needed to prevent this.
Municipal waste is almost negligible compared to industrial waste, which includes a large amount of hazardous waste. The management and disposal of these types of waste is also a priority for Ukraine in order to clean up the country. The number of hazardous waste landfills and storage facilities is officially estimated at 300 across the country. The capacity of these should also be reviewed and those with adequate containment should be established. The potential for recycling hazardous waste is very low, so proper disposal must be ensured. In Hungary, 11 hazardous waste landfills are in operation, but there are also other ways of disposing of hazardous waste. These dispose of certain types of hazardous waste by incineration.

Overall, both countries have the targets they need to meet according to the plans and guidelines. In terms of compliance, the figures show that the countries that have joined the EU are better able to comply, are better prepared in terms of infrastructure, and the population and economic operators understand and accept waste management rules and environmental issues.
The appropriate data systems have been developed and are now fully digitised. Appropriate official control systems have also been established and are in place to ensure effectiveness. The latter would be crucial for achieving the goals in Ukraine. By setting up a clean and honestly functioning control authority, they can start to implement their plans. However, without the resources being put in place, waste management reform will not succeed. Large companies with experience abroad and aid from other countries, as well as EU support schemes, can help to generate resources. All this requires a stable political, social, legal, ethical and economic environment.

BRINGING WASTE MANAGEMENT IN SLOVAKIA AND UKRAINE CLOSER TOGETHER

Comparison of the legislative background on waste

THE SLOVAK LEGAL SYSTEM

The Waste Management Programme of the Slovak Republic is an important strategic document for waste management in the Slovak Republic for the period 2021-2025. It has been developed in line with the requirements for sustainable growth presented in the EU Action Plan for the Circular Economy published on 2.12.2015, the European Green Deal published on 11.12.2019 and the new EU Action Plan for the Circular Economy published on 11.03.2020. The content of the (Waste Framework Directive) of the Slovak Republic complies with the requirements of EU and Slovak legislation, in particular Act No 79/2015 on waste and amendments and supplements to certain acts (hereinafter referred to as the Waste Act), as amended, and Decree No 371/2015 of the Ministry of Environment of the Slovak Republic, which implements certain provisions of the Waste Act, as amended.

The Waste Act has been amended several times since its entry into force on 1 January 2016. Act No 460/2019 amending the Waste Act is a particularly important amendment for the preparation and content of the Waste Framework Directive of the Slovak Republic. The main reason for the amendment is the transposition of the Waste Package, which had to be brought in line with the following amended EU Directives:

- Directive (EU) 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 2018/851/EC of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste,
- Directive (EU) 2018/849 of the European Parliament and of the Council of 30 May 2018 amending Directive 2000/53/EC on end-of-life vehicles, Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators and Directive 2012/19/EU on waste electrical and electronic equipment,
- Directive (EU) 2018/852/EC of the European Parliament and of the Council of 30 May 2018 amending Directive 94/62/EC on packaging and packaging waste.

The Waste Management Programme of the Slovak Republic for the period 2021-2025 is the sixth national programme setting out the basic requirements, objectives and measures in the field of waste management. It is based on the evaluation of the previous Waste Management Programme of the Slovak Republic for the period 2016-2020 and on the analysis of the current situation and needs of waste management in the Slovak Republic.

The structure of the Waste Framework Directive of the Slovak Republic for the period 2021-2025 is in line with the requirements of Article 28 of Directive 2008/98/EC of the European Parliament and of the Council on waste and repealing certain Directives (hereinafter referred to as the Waste Framework Directive), as amended.

It is essential that the Waste Act No 79/2015 is further amended in order to prevent possible legal action by the European Commission in the future (An example of such a legal case is the action brought by the European Commission before the Court of Justice of the European Union on the issue of improperly closed landfills in the Slovak Republic. *The plaintiff brought legal proceedings against the Slovak Republic for non-compliance with Directive 2008/98/EC, alleging that the defendant had failed to properly manage the remediation and permanent closure of 21 disused landfills.*)

THE UKRAINIAN LEGAL SYSTEM

In 2017, the Order of the Cabinet of Ministers of Ukraine "On approval of the National Waste Management Strategy in Ukraine until 2030, 2017", hereinafter referred to as the "Strategy", was approved to reform and modernise the waste management system. The Strategy sets out the main directions in the field of public regulation and waste management, taking into account European approaches to waste management. The main objective of the Strategy is to "create favourable conditions for raising living standards by introducing a systematic approach to waste management at the state and regional level, reducing waste and increasing waste recycling and reuse. At the same time, the National Waste Management Plan until 2030 was adopted to implement the measures of the Strategy (Verkhovna Rada of Ukraine 2019 Order of the Cabinet of Ministers of Ukraine "On approval of the National Waste Management Plan until 2030, 2017). However, many of the points of these documents are in practice grossly violated by both individuals and legal entities.

The strategy has the following objectives:

- to identify development directions and priorities for secondary resource use, taking into account both current real opportunities and the long-term economic, social and environmental interests of society;
- the widespread introduction of public-private partnership, interaction and cooperation in central and local executive authorities and local government;
- to support the scientific, technological and methodological management of waste on an innovative basis;
- to significantly increase the role of regions and civil society in waste sector reform;
- financing and implementing certain measures to further improve the waste management system on a traditional basis.

Ukraine has committed to separate all waste by type of material and divide it into reusable, landfill and hazardous waste from 1 January 2018. This is provided for in Article 32 of the Law of Ukraine "On Waste".

The ban on the use of certain types of plastic bags in Ukraine is implemented by the adoption of the Law of Ukraine "On Restriction of Placing Plastic Bags on the Market in Ukraine". Article 2 of this law bans the marketing of ultra-thin, thin and oxo-disintegratable plastic bags in retail, catering and service provision (it does not apply to biodegradable plastic bags and ultra-thin plastic bags used as primary packaging by retail stores). These changes came into force on 9 March 2022.

In order to achieve EU membership, legislative reforms are underway in Ukraine at both local and national level to encourage businesses to move to the latest production methods, including the circular economy. An innovative approach to farming starts by treating "waste" as an opportunity, not a problem.

In June 2022, the "Law on Waste Management" (the "Waste Management Law") was adopted, paving the way for the future development of the previously poorly regulated and fragmented waste management system in Ukraine. The legal framework of the Waste Management Law introduces regulation of waste management relations and is modelled on EU directives (e.g. the EDG). The adoption of the Waste Management Law opens the door for Ukraine to start meeting the requirements for EU membership and attracting investors. At the same time, the "polluter pays" principle has been developed, which will help to separate and recycle waste. The Waste

Management Act came into force on 9 July 2023, giving regulators and businesses time to adapt to the new circumstances.

The newly proposed waste management system will tighten permit requirements for the collection and treatment of hazardous waste and help achieve sustainable development goals as part of EU directives. The Waste Management Act introduces

- the new European waste hierarchy and planning system at local, regional and national level,
- the "polluter pays" principle and extended producer responsibility, which requires manufacturers to guarantee the complete disposal of the packaging they place on the market with the product.
- a new information system designed to streamline accounting and reporting and to implement permit procedures in waste management,
- a publicly accessible subsystem of registers containing information on licences issued, ERP vendors and their products, to increase accountability.
- procedures for the collection, transport, processing and recycling of household waste.
- specific rules on the disposal of waste in the current geopolitical climate due to bombing and the closure and rehabilitation of obsolete landfills.

This Waste Management Framework Law sets out the principles and objectives of public policy on waste management, the waste management hierarchy, the general requirements for the collection, transport and treatment of waste, and the penalties for non-compliance.

Article 10 of the law also introduces extended producer responsibility (EPR) for certain waste streams, including packaging, electrical and electronic equipment, batteries and accumulators, end-of-life vehicles, lubricants (oils), tyres and textiles.

The law sets out two possible ways to comply with the EPR: collective compliance through the establishment of a collective compliance scheme and individual compliance through the establishment of an individual compliance scheme. The law also sets out collection and waste management obligations, financial and information obligations and certain product design requirements (Fmoita, 2023).

The new waste management system will create the conditions for the development of a modern waste recycling infrastructure in Ukraine in line with European directives and open the borders

for investors. In other words, the new waste management system will create the basis for a transition to a circular economy (Lindskog, 2023)

Limitations of waste management in Ukraine

The new waste management scheme sets out innovative guidelines for a much-needed modernised waste management system, which can provide a good basis for circular economy principles. A number of sectoral laws and regulations will need to be adopted to implement the full reform and lay the foundations for a circular economy. The development and implementation of waste programmes are covered by light administrative and environmental sanctions and fines, which do not encourage producers to extend their responsibilities. In addition, Ukraine lacks action plans, basic legislation and legislation on different types of waste (e.g. batteries and packaging). Without this legislation, Ukraine is unlikely to achieve the EGD, despite promises to do so.

Even if we disregard the permissive legislation, Ukraine is still in a very precarious position, as it is adopting laws and strategies in line with EU ideas by being a party to an armed conflict on its territory. The long-term sustainability of the proposed changes is therefore questionable. Nevertheless, improving the development of waste management and the implementation of circular economy principles is a stepping stone for Ukraine, as it offers a greater chance of achieving EU candidacy and a green recovery. While the Circular Economy Principles are being discussed and slowly implemented at national level, no circularity is yet in motion (Lindskog, 2023)

Waste management

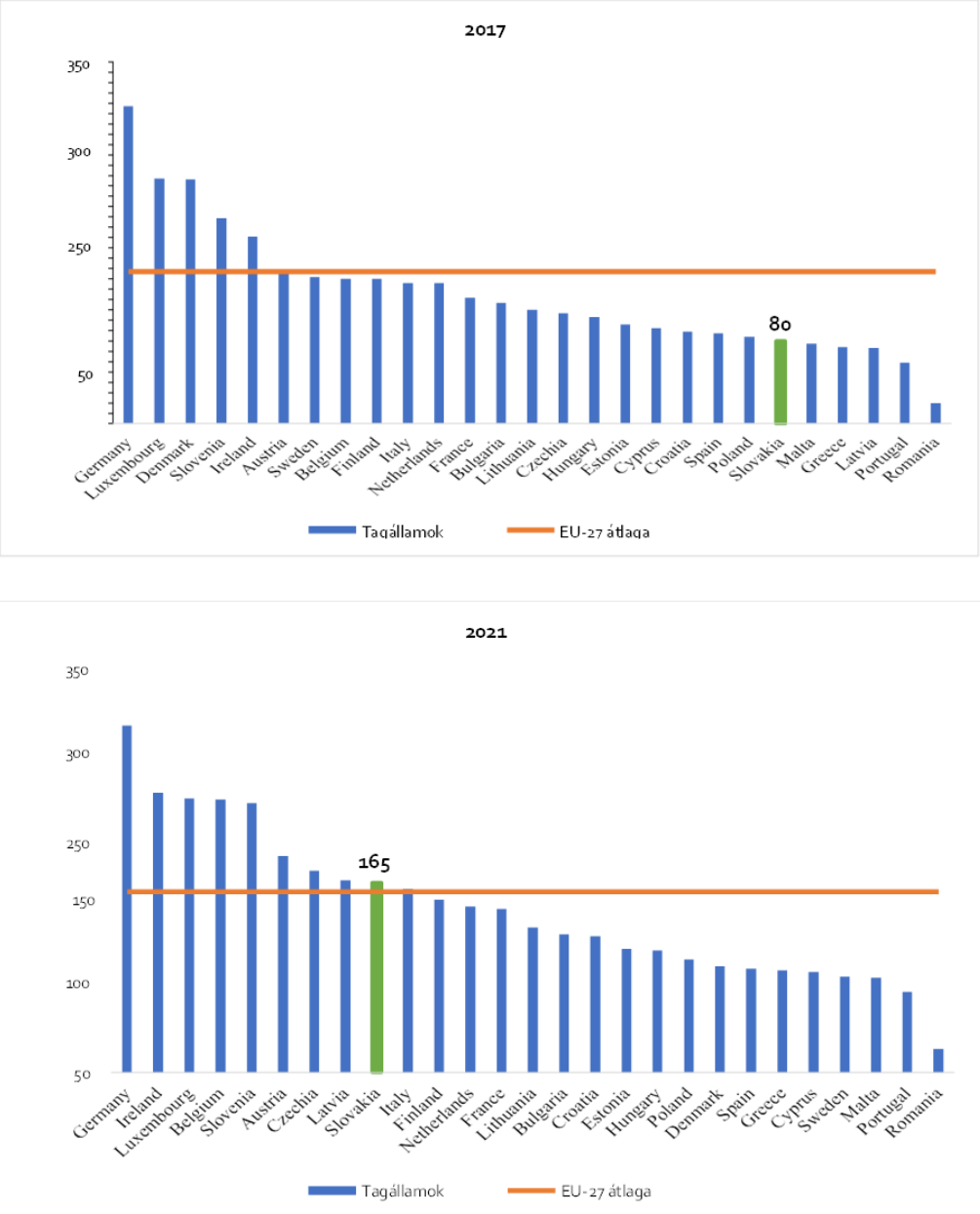
SLOVAKIA

Taušová et al. (2020) conclude that Slovakia currently faces a number of environmental problems, such as poor air quality, low recycling rates of waste and ecosystem preservation.

Environmental problems wreak havoc on the economy, employment and general well-being (Sinclair et al., 2010)

Furthermore, climate change is already affecting Slovakia, as it is the rest of the world, with visible consequences that will have environmental, economic and health problems in the future (Hoffman, 2005).

The Slovak Republic has made significant progress in waste recycling, separate collection and composting between 2017 and 2021.



3. Figure Recycled materials in EU-27 in 2017 and 2021 (kg/capita)

Source: Valencikova-Mandel, 2023, p. 14.

It is a major achievement that the Slovak Republic has improved above the EU average in this respect in 5 years.

The environmental policy strategy adopted in 1993 was in force for a considerable period. However, because it is outdated, it has not been able to adequately address the problems and challenges posed by the environment.

As a result, the Institute of Environmental Policy, in coordination with the Ministry of Environment of the Slovak Republic, has developed an innovative environmental policy strategy for 2030. By 2030, the recycling rate of municipal waste will increase to 60%, including preparation for reuse, and by 2035 the landfill rate will be below 25%.

Báreková et al (2020) agree that biodegradable municipal waste should be consistently separated and recycled.

All environmental costs, such as soil, water, air pollution and other economic costs, are included in the landfill fee. Increasing landfill fees is an effective incentive for people to separate their waste, reduce the amount of waste and increase recycling.

Over time, higher fees have been shown to reduce landfill rates if selective collection is discriminated against by those who do not. Also, if separately collected waste is not included in the mixed waste that is landfilled especially if it is weight based and measured and then charged for, but this needs to be used in conjunction with other policies. In Slovakia the cost of landfilling municipal waste is one of the lowest in the EU.

Municipalities will gradually introduce volume-based incentives for municipal waste collection. As only a few municipalities in Slovakia have opted for volume-based waste collection as an option, municipalities are gradually introducing volume-based incentives for municipal waste collection (Radvan 2016).

As set out in the Envirostrategy 2030, municipalities will gradually introduce one of the quantitative waste collection techniques. It should be borne in mind that the transition to a quantitative waste collection system can be gradual, starting with a flat-rate system of discounts depending on the type of waste sorted.

Slovakia also wants to halve food waste by 2030, which means that restaurants and grocery stores will be obliged to use food in some way, for example by donating food that meets food safety standards to charity.

If we compare recycling-composting and self-degradation, the average for the 27 EU Member States was 84 kg/capita in 2017 and 100 kg/capita in 2021. Austria, for example, ranked first with 182 kg/capita and showed slight fluctuations over the study. Denmark and Luxembourg followed closely behind. *The Slovak Republic has made greater progress since 2017 and is in the middle of the pack among Member States in terms of success rate.* However, it still needs to catch up with the EU average of 100 kg per capita by 2021, and has not made significant progress since 2017.

Research shows that people in Germany, Finland, Sweden, the Netherlands, Belgium and Denmark have the most efficient waste management systems, with almost no municipal waste going to landfill.

In 2017, an average European citizen threw 127 kg of municipal waste into landfills, compared to 229 kg per capita in the Slovak Republic.In 2021, an average European citizen produced 121 kg of landfilled waste per capita, compared to *202 kg per capita in the Slovak Republic. Again, the situation has improved*

To reap the full benefits of the Circular Economy Action Plan, a key element of the European Green Deal, full implementation of EU landfill legislation is a key condition.

However, the Slovak Republic has yet to fully implement these regulations. The European Commission has made public its decision to refer the Slovak Republic to the European Court of Justice for failing to reclaim and close more landfills as notified by the European Commission, contrary to the requirements of the 1999 EU Landfill Directive.

At the same time, the Slovak Republic has implemented a number of environmental policy requirements under EU law.

The Waste Management Programme for 2021-2025 and the Waste Prevention Programme for 2019-2025 are important strategic documents that *require the Slovak Republic to divert as much waste as possible from landfills to other methods of recycling and to reduce the amount of waste generated on its territory.*

The Slovak Waste Management Programme has the primary objective of diverting municipal waste from landfills by 2025. The *financing of the* collection and disposal of municipal waste *through the Extended Producer Responsibility (EPR) scheme and the* levies on local municipal waste and small quantities of construction waste is based on and has been adopted. However, the separation of municipal waste, in particular biodegradable waste such as kitchen waste,

needs to be improved. *Municipal* waste *receives the most attention, despite accounting for only a small proportion of total waste generation. This particular attention is due to the collection and treatment of municipal waste by the public sector.* Marišová and Fandel (2022) found that efforts are being made to recover waste in line with Slovak strategies.

Consequently, a *coherent definition of municipal waste was one of the most significant obstacles in the adoption of the new waste package*, which followed the EU's Central European Action Plan for a Circular Economy.

The calculations show that *biodegradable municipal waste is the most common component of mixed municipal waste*. Following the European Union's Green Programme *also obliges the Slovak Republic to improve its public administration.*

As regards municipal waste, the main objectives of the Environment Strategy 2030 for a circular economy are:

- *The rate of municipal waste recycling, including preparation for re-use, is expected to rise to 60% by 2030*.
- *By 2035, the proportion of municipal waste going to landfill will be reduced by 25%*.

According to the latest data from the Statistical Office of the Slovak Republic for 2021, *a high percentage of municipal waste (40.68%) will be landfilled.* The *annual decrease in landfilling is positive;* for example, in 2011, 74.71% of municipal waste in the Slovak Republic was landfilled. Nevertheless, *the Slovak Republic lags behind developed countries in waste management, where the recycling rate for municipal waste is 12th among the 27 EU countries* (42.2% in 2020), compared to *an EU average of 48.6%.*

Overall, the results showed inequalities in the management of municipal waste across the EU. *The amount of municipal waste generated in the EU increased in almost all Member States between 2017 and 2021.*

The proposed reform package aims to shift the EU economy towards a circular model, requiring *at least 65% of municipal waste to be recycled by 2035* and *limiting the amount of municipal waste going to landfill to a maximum of 10%*.

Achieving these targets will be a major challenge for the Slovak Republic as they aim to achieve a landfill rate of at least 25% by 2035 as part of their waste strategies.

Mohammadi et al. (2019) showed that non-recyclable waste is treated in waste-to-energy plants equipped with different technologies. In developing countries, the biggest challenge is the need for formal recycling infrastructure, and in addition, *certified composting needs to be developed in most countries, including the Slovak Republic.*

Today, the majority of municipal waste is landfilled - 40.68% in 2021. *There are currently two waste-to-energy plants in the Slovak Republic, in Bratislava and in Košice.*

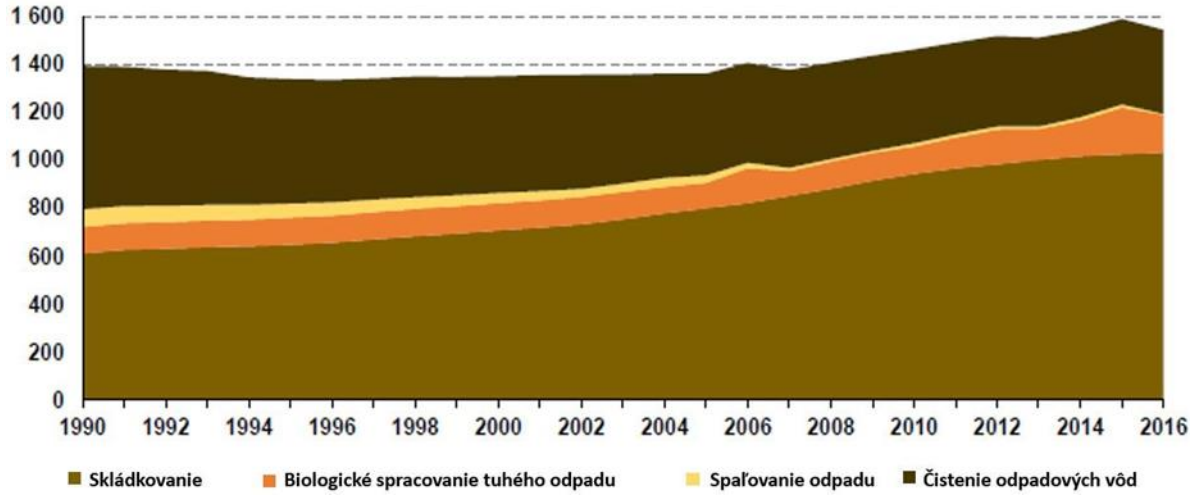
Recycling in the form of composting is more important for the Slovak Republic than other forms of recycling in terms of the amount of compostable bio-waste generated.

However, landfills are still needed for waste management, as not all waste can be recovered (materially or energetically) at present, and the *creation of new landfills is prohibited by EU and Slovak legislation.*

Producers are responsible for the collection, transport and delivery of these categories of waste to treatment facilities, and at the same time bear the costs involved.

The Slovak Republic has one of the highest rates of landfilled waste in the EU, but also one of the lowest landfill fees. The aim of the fee law is to discriminate against landfilling and to create incentives for the selective collection of municipal waste and to increase the recycling of municipal waste.

The Slovak Waste Management Programme 2021-2025 sets specific deadlines and responsibilities for the implementation of the targets and tasks set.



4. Figure: Evolution of total GHG emissions from the waste sector 1990-2016 (Gg CO2 equivalent) - by category
Source: SHMÚ (Slovak Ministry of Environment)

The projections for emissions from the waste sector up to 2040 focus on activities in the municipal waste management and municipal waste water treatment sectors. These two main emission sources account for more than 80% of the estimated emissions from the waste sector.

The assessment of the concrete measures for the interim implementation of the objectives and actions of the Waste Management Programme of the Slovak Republic *2016-2020 has shown that most of the original objectives have not been achieved.* It can be assumed that in order to achieve the above objectives, existing incinerators will continue to increase their operation steadily up to their full capacity, i.e. 285 kt/y.

Method of treatment or disposal	**2014**	**2015**	**2016**	**2017**	**2018**
Landfill	3 776 454	3 933 537	3 789 477	3 830 389	3 352 292
Other disposal	537 830	443 759	379 196	405 034	313 079
Combustion without energy conservation	59 944	47 321	36 342	47 109	40 857
Waste incineration with energy recovery	313 464	323 288	557 795	740 520	569 321
Other uses	775 252	675 958	366 038	336 403	273 159
Material recovery (recycling)	3 285 341	4 753 047	3 707 808	3 846 904	3 721 477
Other loading	305 372	386 488	1 462 130	2 973 460	3 951 851
Use of waste for landscaping			372 468	72 362	1 256 000
Total	**9 053 657**	**10 563 398**	**10 671 254**	**12 252 182**	**13 478 035**

2. Table Total waste management in the Slovak Republic in 2014-2018 (t)

Source: Statistical Office of the Slovak Republic

In the Slovak Republic, municipalities are obliged to introduce separate collection of municipal waste at least for paper, plastic, metal, glass and composite packaging materials and biodegradable municipal waste, except for waste generated by kitchen operators. The municipality is also obliged to ensure separate collection of bulk waste, small construction waste and waste containing harmful substances. Nevertheless, the *separate collection of municipal waste is considered to be insufficient and many municipalities do not fully comply with the legal obligation.*

Waste type/waste stream	**2014**	**2015**	**2016**	**2017**	**2018**
Paper and cardboard (t)	63 201	67 088	72 557	86 400	105 332
Glass (t)	50 227	53 518	55 984	62 085	66 251
Plastics (t)	31 568	34 658	36 123	44 386	49 795
Metals (t)	17 803	30 833	110 269	219 591	347 275
Total (4 "dry ingredients") (t)	**162 799**	**186 097**	**274 934**	**412 461**	**568 653**
Biodegradable waste (t)	131 094	147 012	166 344	199 415	233 608
E-waste[1)] (t)	7 588	8 172	11 098	12 064	15 544
Used batteries and accumulators[2)] (t)	422	454	920	2 869	7 299
Clothing and textiles (t)	3 100	4 008	4 507	3 413	3 416
Total of all ingredients (t)	**305 003**	**345 744**	**457 803**	**630 223**	**828 521**

3. Table Development of separate collection of the components of municipal waste in the Slovak Republic

Source: Statistical Office of the Slovak Republic

For completeness, it should be added that the obligation to introduce separate collection of biodegradable household waste competes with a number of exemptions from this obligation, which ultimately have a negative impact on the introduction of separate collection of biodegradable municipal waste in municipalities.

From 2023, municipalities can only apply for an exemption from this obligation if they can prove that 100% of households compost their own waste.

It can be seen that selective collection of waste is being implemented in the Slovak Republic.

The preparation and adoption of the new law on charges is the result of a number of activities at Slovak and EU level, through which the Ministry of Environment of the Slovak Republic has long been warning, among other things, about the high rate of waste going to landfills and the low charges for landfilling.

At the European Commission level, this is the "Early Warning Report for Slovakia" published on 24 September 2018, in which the Commission warns of the risk that Slovakia will not be able to meet its municipal waste targets (as set out in EU law and the Waste Act) by 2020. Indeed, Slovakia did not meet this target by the deadline.

In 2018, the majority of hazardous waste generation in the Slovak Republic came from chemicals, while other groups accounted for a much smaller share of hazardous waste generation.

Only around 17% of hazardous waste was recycled in 2018, *but up to 45% of hazardous waste was reported as "other treatment". The proper management of hazardous waste is also a problem in the EU, and data on its management is partly lacking. The* reports seem to be somewhat "cosmeticised" everywhere, or use a specific projection basis, which may account for the discrepancies.

In the Slovak Republic, only partial data are available due to the lack of monitoring of material flows. Therefore, *it is necessary to establish an electronic register of hazardous waste, thus strengthening the mechanisms for registration and traceability.*

Raising awareness of the hazardous properties of hazardous waste for the environment and human health is very important, therefore *it is necessary to raise the awareness of the population of the Slovak Republic about the harmful effects of hazardous waste on the environment and its proper management.* (Raising public awareness is important in both Slovakia and Ukraine, but in Ukraine it is necessary to start from the bottom up!)

Target 2025: Increase the amount of hazardous waste collected in the Slovak Republic.

Measures

- Identify reporting gaps in the management of hazardous waste.

Responsible: Ministry of Environment of the Slovak Republic
Deadline: December 2022

- Promote research, development and innovation in new technologies to reduce hazardous substances in value cycles and in new technologies for hazardous waste management.
  Responsible: the Ministry of Education, Science and Higher Education of the Slovak Republic, the Ministry of Economy in cooperation with universities and colleges, scientific research institutions and the business sector.
  Deadline: ongoing

Here you can see that the Slovak waste strategy attaches specific responsibilities and deadlines to the targets and measures (I note that this is an EU norm)

The current remanufacturing industry is not designed and optimised to exploit critical raw materials, which are typically found in small concentrations in complex structures. Nevertheless, some critical raw materials are recovered, but losses are high at various stages of collection and processing. This needs to be addressed and an efficient mechanism for the recovery of critical raw materials from waste needs to be established, also following the Commission Communication COM(2020) 474 final on the EU inventory of critical raw materials 2017. Therefore, more emphasis should be put on improving the collection, sorting and recovery of waste containing significant amounts of critical raw materials.

It can be seen that there are still gaps in waste management in Slovakia.

UKRAINE

Ukraine is one of the countries with the largest absolute generation and accumulation of waste. Ukraine generates about 10 tonnes of waste per capita per year. In contrast, Slovakia generates 479 kg of municipal waste per capita per year.

The volumes in Ukraine are significant, considering the very poor level of recovery and disposal compared to the EU waste accumulation indicators.

Solid waste is the most difficult to manage. Ukraine produces 10 million tonnes of solid waste every year. 79% of the population is covered by household waste collection services. 93% of

waste is landfilled. Only 4% of waste is recycled. There are 33 000 unauthorised landfills in Ukraine.

The country's largest city, Kyiv, is served by only two official landfills - landfill No 5, located in the village of Pidhirtsi in the Obukhiv district of Kyiv Oblast (covering an area of 63.7 hectares) and the construction landfill.

The amount of waste landfilled each year was supposed to fall from 95% in 2016 to 30% in 2030 with the help of laws and new containers, but by 2019 it had fallen by only 1.2%. Experts say this is not just because *there are hardly any Ukrainians willing to separate waste - unofficial statistics report that only 4% of the population recycle their waste.*

However, Ukraine *lacks the necessary infrastructure*, such as recycling facilities and adequate waste collection containers near homes (Ukrainian National Waste Management Strategy, 2021).

Ukraine's Ministry of Environment and Natural Resources started an inventory of Ukraine's landfills in 2016. In particular, an interactive map of landfills and dumpsites is being developed. It contains about 3000 items (https://ecomapa.gov.ua/)

Incinerators are an important part of the waste disposal process in Ukraine. There have been 5 incinerators in Ukraine at different times (Kiev, Dnipro, Kharkiv, Rivne and the now occupied Sevastopol). Now only the "Energia" plant is operating in Kiev. Today the issue of chemical flue gas cleaning is acute in the company. Similar problems are common to all incinerators. Incineration products contain almost all elements of the periodic system, the most dangerous heavy metals, acids and sulphur dioxide. Modern flue gas cleaning technologies are able to completely neutralise the negative effects of these substances (Doyga, T, 2012). There are many positive examples of well-functioning incinerators in the EU Member States (Figure 5)

5. Figure Incinerators in Eropian countries (status 2017)

Source: https://www.fkf.hu/storage/app/media/Kiadvanyok/2018-FHHM - MAGYAR.pdf

In 2020, the installation of a system for chemical cleaning of flue gases at Energia's Kiev incinerator started. However, it is the *only permanent incinerator* in Ukraine that disposes of only a quarter of Kiev's solid waste. This means that almost all other waste goes to landfills, and only a small proportion of solid waste is processed at waste collection points.

Of course, ensuring the environmental safety of incinerators and introducing modern methods for cleaning the flue gases will significantly increase the construction costs of such plants. These costs can represent up to 50% of the total construction cost structure. The cost of building a new plant to process 500,000 tonnes of waste per year ranges from USD 300 to 400 million. Raising such funds is an extremely difficult task for most municipalities. Many of them are therefore actively seeking investors for the construction of incinerators (Savulyak and Berezyuk, 2016).

Currently, waste can be used to produce clean energy sources. This has many potential benefits for sustainable development. The production and use of biogas brings the idea of a closed economy to life. It has benefits in terms of reducing greenhouse gas emissions, improving waste management and improving resource efficiency. Energy security is one of the most pressing issues in different countries. Renewable energy has become an integral part of the modern economy. There has also been a significant gap in the development of biogas plants compared to the development of other renewable energy sources. Waste is transformed into product (biogas) and valuable organic fertiliser, thus closing the cycle of processing from soil to crop, product, waste and return to soil. Active government support for the development of biogas technologies is largely driven by increased greenhouse gas emissions and their devastating impact on the environment (Pryshlyak, 2021)

In Ukraine, biogas extraction systems have been installed in 26 landfills, and experts estimate that 30 MW of electricity generation capacity is in operation, using gas extracted from landfill waste bodies through gas engines. The volume of biogas used in 2020 will be 64.0 million m3 (50% methane) (Zhuk, 2019).

The separation of waste by all citizens and the processing of primary and secondary waste can significantly improve the environmental situation in Ukraine.

Unfortunately, Ukraine has no waste management policy. This leads to the loss of millions of tonnes of valuable material every year. Solid waste can contain up to 40% of valuable materials on average, according to environmentalists. Potential secondary raw materials are destroyed and contaminated, and the amount of valuable resources is reduced to 5-10%, as most waste in Ukraine is collected in 'communal' containers (Polischuk et al. 2019).

Waste sorting is one of Ukraine's biggest problems. *People do not know how and why to sort waste properly*. Meanwhile, proper disposal and sorting of waste can solve many environmental and financial problems. It is important to understand why sorting is necessary to motivate everyone to collect waste separately.

There are many good reasons why you should not put all your waste in one bin and then dump it in landfill.

It is important to understand that waste can be divided into two basic categories: hazardous and non-hazardous.

Non-hazardous waste: organic residues, cardboard and paper, garden waste - wood, leaves. These wastes are non-toxic to water sources and soil, and are not hazardous to humans, animals or plants when they decompose. In addition, organic waste is useful because biodegradable green waste can be used for soil improvement, following composting.

Hazardous waste includes batteries and accumulators, expired medicines and vaccines, paints and varnishes, car tyres, polyethylene, mercury lamps, thermometers, etc. Hazardous waste is toxic and can poison soil, water and groundwater for tens of kilometres if it is landfilled with ordinary waste.

One important indicator of a country's civilisation is its approach to the problem of waste sorting and disposal. Therefore, Ukraine should create conditions for a more convenient and automated approach to sorting, processing and reuse of different types of waste.

The first thing to start with is environmental education: building and developing the environmental competence of every citizen. Ideally, we should start by educating the younger generation, instilling in children and young people the habit of sorting waste and making them aware that they can become environmentally aware citizens of their country under the slogan "I am doing something for a clean and healthy future".

It is also useful to *keep the public informed* about the environmental, economic and social consequences of the accumulation of industrial and household waste and how to tackle the problem. Public information (education) is therefore provided through a variety of methods: posters, publicity, conferences and events, environmental tours, etc.

At the same time, *one of the main challenges in tackling waste management is to encourage the public to separate their waste through financial means and social advertising in the media.*

Measures should also be taken at state level to encourage polyethylene and polypropylene packaging producers to produce biodegradable products and primary plastic producers to produce compostable and biodegradable biopolymers as raw materials for biodegradable products.

Today, *Ukraine needs to review the principles of recycling existing businesses,* as companies that use waste as a source of energy are causing great damage to the environment. However, a lot of money has to be spent to make these enterprises environmentally friendly.

The environmental impact of different types of household waste can be reduced by:

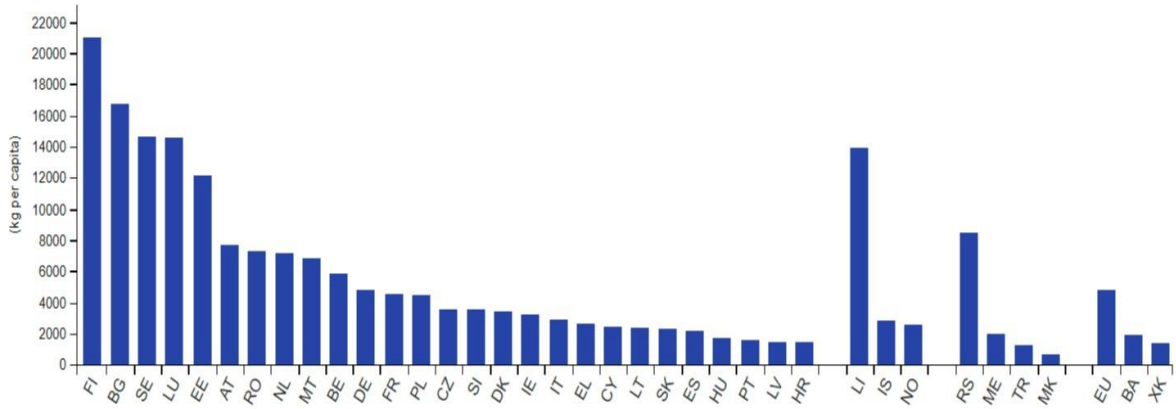
- improving existing regulations and their implementation;
- it is important to predict the amount of municipal solid waste (SDW) and to study the morphological composition of waste due to changes in environmental and social factors that influence the morphological composition of waste;
- mathematical modelling of the distribution of pollutants in the components of the environment generated in landfill sites;
- inspecting and registering landfills;
- relocation of landfills;
- sorting household solid waste;
- construction of waste processing and incineration plants;
- informing the public about the environmental, economic and social consequences of the accumulation of industrial and household waste and how to tackle the problem;
- review the waste recycling principles of existing businesses;
- implementation of measures to encourage polyethylene and polypropylene packaging producers to produce biodegradable products, and primary plastic producers to produce compostable and biodegradable biopolymers, etc;
- introduction of environmentally friendly waste treatment technologies - biogas extraction systems and gas engines.

TOTAL WASTE GENERATION FOR THE 4 COUNTRIES

According to Eurostat (2023), the total amount of waste generated by all economic activities and households in the EU in 2020 was 2 135 million tonnes, or 4 815 kg per capita (Eurostat, 2023)

This is 7388 kg/person in Romania, 2340 kg/person in Slovakia, 1759 kg/person in Hungary and 10 600 kg/person in Ukraine (Tymochko, 2019).

These show that the *amount of waste per capita is very significant, double the EU average in Ukraine*, but significantly higher than the EU average in Romania and lower than the EU average in Slovakia and Hungary, where it is lowest (Figure 6)



6. Figure Waste generation per capita, 2020

Source: Eurostat (2023): online data code: env_wasgen

Table 3 shows the distribution of waste generation by economic activity and household.

In 2020, 37.5% of all waste in the EU came from construction, followed by mining and quarrying (23.4%), waste and water services (10.8%), manufacturing (10.6%) and households

(9.4%); the remaining 8.2% was waste from other economic activities, mainly services (4.4%) and energy (2.3%).

The pattern in Hungary is different from the EU average. Households (27.6%) are the largest waste producers. This is followed by the construction sector (including demolition waste), which generates a quarter of all waste, followed by manufacturing (15.2%), then water and energy. In contrast, mining and quarrying produces hardly any waste.

In Slovakia, the largest amount of waste is generated by other economic activities (32.5%), followed by manufacturing (24%) and households (18.5%). Mining and quarrying also contribute only marginally to waste generation in Slovakia.

In Romania, on the other hand, mining and quarrying contributes a particularly high share of waste generation, 84.3%, with manufacturing second at 4.6% and energy third at 3.1%. Households also contribute almost exactly the same share of total waste (3.0%).

In Ukraine, according to 2019 data (Rubel & Kurakina, 2021), the largest contributor to total waste generation is agriculture and forestry, followed by mining and quarrying, orders of magnitude behind. Data for households are not shown in Table 4.

This suggests that the *distribution of waste generation by economic activity and by household differs significantly between the four countries*. While households are the largest waste generators in Hungary, most waste is generated by other economic activities in Slovakia, mining in Romania and agriculture and forestry in Ukraine.

Waste generation by economic activities and households, 2020

(% share of total waste)

	Mining and quarrying	Manufacturing	Energy	Waste/water	Construction and demolition	Other economic activities	Households
EU	23.4	10.6	2.3	10.8	37.5	5.9	9.4
Belgium	0.0	20.9	1.5	31.4	30.5	7.9	7.8
Bulgaria	81.6	4.2	5.2	2.9	1.6	2.5	2.0
Czechia	0.3	12.1	1.1	15.5	42.9	12.2	15.9
Denmark	0.1	5.4	3.9	7.5	54.8	10.3	18.0
Germany	1.3	13.7	2.0	12.0	56.3	5.1	9.6
Estonia	15.2	24.6	35.0	4.6	9.8	7.4	3.4
Ireland	9.4	22.4	1.0	12.6	32.6	10.1	12.0
Greece	31.7	11.1	5.3	11.4	19.1	5.5	15.9
Spain	2.3	12.4	0.8	20.8	30.8	11.5	21.3
France	0.1	6.0	0.3	8.1	68.5	6.3	10.8
Croatia	11.6	7.5	1.1	16.3	23.8	19.5	20.2
Italy	0.8	15.2	0.9	24.6	37.8	4.1	16.6
Cyprus	6.9	9.5	0.1	6.6	50.2	9.8	17.0
Latvia	0.0	17.0	4.1	33.7	9.7	12.9	22.6
Lithuania	1.0	32.7	2.3	18.4	8.3	16.3	20.9
Luxembourg	1.1	6.5	0.3	3.5	82.1	4.2	2.2
Hungary	0.8	15.2	11.4	12.1	25.4	7.5	27.6
Malta	1.1	0.9	0.0	2.5	85.3	4.7	5.6
Netherlands	0.1	10.6	0.4	7.4	65.4	8.7	7.4
Austria	0.1	7.5	0.6	3.5	76.5	5.2	6.7
Poland	36.6	16.1	6.6	13.4	13.0	6.6	7.8
Portugal	0.1	17.8	1.3	22.9	10.7	15.4	31.8
Romania	84.3	4.6	3.1	2.0	0.9	2.2	3.0
Slovenia	0.1	17.9	12.1	3.8	6.3	51.4	8.4
Slovakia	1.6	24.0	5.5	8.9	9.0	32.5	18.5
Finland	75.1	8.2	0.8	1.0	11.8	1.0	2.1
Sweden	76.5	3.1	1.2	4.5	9.3	2.3	3.1
Iceland	0.0	24.2	0.0	2.0	3.6	31.0	39.2
Liechtenstein	0.0	1.1	0.0	0.3	92.5	0.1	6.0
Norway	1.3	13.6	1.6	8.0	44.2	12.9	18.4
Montenegro	25.3	2.5	29.0	0.3	13.8	10.5	18.5
North Macedonia	35.1	35.0	0.5	17.9	3.8	7.7	0.0
Serbia	78.0	1.9	13.5	1.1	1.2	0.9	3.5
Türkiye	25.6	19.2	22.6	0.3	0.0	5.8	26.5
Bosnia and Herzegovina	11.3	27.3	46.3	0.0	1.3	0.4	13.4
Kosovo (*)	19.9	9.4	52.5	0.3	0.2	3.1	14.6

(*) This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion Declaration of Independence.

Source: Eurostat (online data code: env_wasgen)

eurostat

4. Table Waste generation by economic activity and household, 2020

Source: Eurostat (2023): online data code: env_wasgen

	2010	2015	2016	2017	2018	2019	2020
	425,914.2	**312,267.6**	**295,870.1**	**366,054.0**	**352,333.9**	**441,516.5**	**532,000**
Total	**419,191.8**	**306,214.3**	**289,523.6**	**360,196.0**	**346,790.4**	**435,619.8**	**462,373.5**
From economic activity	,8568.2	8,736.8	8,715.5	6,188.2	5,968.1	6,750.5	25,000.7
Agriculture, forestry and fisheries	347,688.1	257,861.9	237,461.4	313,738.2	301,448.9	39,0563.8	n/a
Mining and quarrying	50,011.7	31,000.5	34,093.0	32,176.7	31,523.2	30,751.8	n/a
Processing industry	7,245.4	4,222.2	5,089.8	6,446.5	5,818.4	5,581.4	n/a
including food production	8,641.0	6,597.5	7,511.5	6,191.7	6,322.7	5,959.2	n/a
Electricity, gas, steam and conditioned air supply	1,698.7	594.2	457.4	408.7	397.4	411.8	n/a
Water supply	329.4	376.2	300.2	493.8	378.8	188.7	200.0
Construction	2,254.7	1,047.2	984.6	998.7	751.3	994.0	458,0
Other types of economic activity	**6,722.4**	**6,053.3**	**6,346.5**	**5858.0**	**5,543.5**	**5,896.7**	**4,000.0**

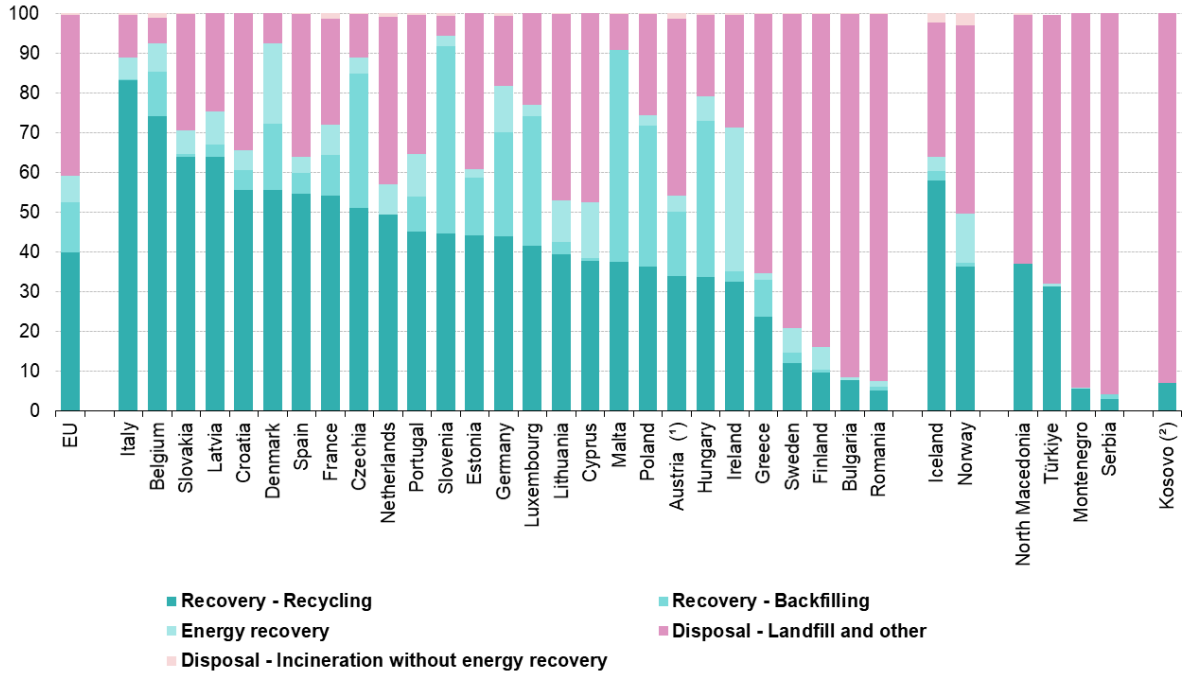
5. Table: Structure of waste generation by type of economic activity and household in Ukraine (tonnes)

Source: Rubel & Kurakina, (2021) based on data from the Ukrainian Statistical Office

In 2020, more than half (59.1%) of waste in the EU was treated in recovery operations: recycling (39.9% of all waste treated), backfilling (12.7%) or energy recovery (6.5%). The remaining 40.9% was either landfilled (32.2%), incinerated without energy recovery (0.5%) or otherwise disposed of (8.2%). There are significant differences between EU Member States in the use of different treatment methods. For example, in some Member States the recycling rate was very high (Italy, Belgium, Slovakia and Latvia), while in others landfilling was the predominant treatment category (Romania, Bulgaria, Finland, Sweden and Greece, see Figure 7).

Hungary has a relatively high rate of recovery operations, including recycling and backfilling. Of the four countries, Slovakia has the highest recycling rate (above 60%), but less backfilling than Hungary. However, in Romania and Ukraine, recovery operations are not common at all, while landfilling is the most common waste treatment method.

Waste treatment by type of recovery and disposal, 2020
(% of total treatment)



(1) Value of incineration for Austria estimated by Eurostat.
(2) This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo Declaration of Independence.
Source: Eurostat (online data code: env_wastrt)

eurostat

7 Figure Waste treatment by recovery and disposal type as % of total treatment, 2020

Source: Eurostat (2023): online data code: env_wasgen

COMPARISONS BASED ON THE EARLY WARNING REPORT

The following comparisons are based on the latest (8.6.2023) Commission Staff Working Documents, more specifically the Early Forecast Reports (SWD (2023) 189 final, SWD (2023) 198 final and SWD (2023) 199 final). These are the Commission's reports to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the identification of Member States at risk of not meeting the 2025 targets for recycling municipal and packaging waste and the 2035 landfill reduction target.

The aim of the Early Warning Report is to help Member States that are at risk of not reaching the next targets:

1. a target of 55% for the preparation and recycling of their municipal waste for re-use by 2025 (this target is set in Article 11(2)(c) of Directive 2008/98/EC), and
2. a 65% target for packaging waste recycling by 2025 (this target is set in Article 6(1)(f) of Directive 1994/62/EC).
3. The report also provides an update on Member States' progress towards the target of sending no more than 10% of their municipal waste to landfills by 2035 (the target is set in Article 5(5) of Directive 1999/31/EC).

Expected achievement of the targets

Hungary: Based on the data collected and an analysis of existing policies in the field of waste management, Hungary is considered to be at risk:

i. a 55% target for the preparation and recycling of municipal waste for reuse by 2025; and
ii. a target of recycling 65% of packaging waste by 2025.
iii. There is also concern about the gap between Hungary's current landfill rate and the 2035 target of landfilling up to 10% of municipal waste.

Slovakia: Based on the data collected and the analysis of existing waste management policies, Slovakia is at risk of

iv. will not reach the 55% target for 2025 forthe preparation and recycling of municipal waste for reuse.
v. Although Slovakia reported levels above the 2025 target of recycling 65% of packaging waste, data quality issues raise concerns about actual performance.
vi. Slovakia's current landfill rate and the target of up to 10% of municipal waste going to landfill by 2035 are also a cause for concern.

Romania: Based on the data collected and the analysis of existing waste management policies, Romania is at risk of not fulfilling

vii. a 55% target for the preparation and recycling of municipal waste for reuse by 2025; and
viii. the target of recycling 65% of packaging waste by 2025.
ix. There is also concern about the gap between the current landfill rate in Romania and the 2035 target of landfilling up to 10% of municipal waste.

Ukraine: on the basis of the available data, it is almost certain that Ukraine will not meet any of the targets by the deadlines set, and probably not even beyond.

MUNICIPAL WASTE GENERATION

EN

Municipal waste generation in Hungary in 2019 was significantly below the EU average (387 kg per capita compared to the EU average of 502 kg per capita).

SK

Municipal waste generation in Slovakia in 2020 (421 kg/person/year) was below the EU average (505 kg/person/year).

RO

Municipal waste generation in Romania is the lowest in the EU, about half the EU average in 2020 (287 kg/person/year compared to 505 kg/person in the EU).

PACKAGING WASTE

EN

The packaging waste generated in 2018 was also below the EU average (142 kg/person compared to the EU average of 177 kg/person). This may indicate that some municipal waste and packaging waste generated is under-reported.

SK

In particular, packaging waste generated in 2018 was also well below the EU average (105 kg/person vs 174 kg/person). This low value may indicate that the significant amount of packaging placed on the market does not report the amount of packaging waste generated.

RO

Packaging waste generated in the country in 2018 was also well below the EU average (80 kg per capita compared to 174 kg per capita in the EU). However, these seemingly low figures may indicate that a significant amount of waste generated is not reported

RECYCLING RATE AND LANDFILL RATE

EN

In 2020, the recycling rate for municipal waste reported by Hungary was 32% (23 percentage points below the 2025 target), while the landfill rate was 54% (more than double the EU average). In addition to the absolute level of recycling, overall recycling trends in Hungary are also a cause for concern. Indeed, the recycling rate fell from 34.7% in 2016 to 32% in 2020, while the landfill rate increased by around 3 percentage points over the same period.

SK

The recycling rate of municipal waste in Slovakia has increased by almost 20 percentage points over the last 5 years and will reach 42.2% in 2020. However, this increase seems to be due more to changes in statistical reporting than to improvements in recycling performance. Despite a significant decrease in the proportion of waste going to landfills over the period 2016-2020 (from 65.4% to 49.7%), Slovakia still relies heavily on landfills (49.7% of waste will be landfilled in 2020, more than double the EU average).

RO

In 2020, the recycling rate of municipal waste reported by Romania was 13.7% (more than 40 percentage points below the target of 55% by 2025), while the landfill rate was 74.3% (more than three times the EU average). Overall recycling trends in Romania are also a cause for concern: there has been no significant improvement in recycling rates over the last 5 years (13.4% in 2016 and 13.7% in 2020), while the landfill rate has increased by around 5 percentage points over the same period, from 69.3% to 74.3%.

UKR

In 2021, over 90% of Ukrainian household waste was landfilled, only 7% was recycled and 1.7% was incinerated. Of the 6,000 landfills in operation; 824 did not meet environmental standards, 371 needed renovation and 230 were overcrowded. At the time, Ukraine was the only European country without extended producer responsibility. Since 2014, no permits have been issued for waste management activities, including landfills and landfills (https://voxukraine.org/en/waste-management-reform).

Before the Russian aggression, Ukraine was already facing waste management problems, despite having developed a number of national strategies, reforms and policies to counter the effects. The main objective of waste management reforms is to eliminate the scattered landfills that are part of Ukraine's current waste management practices. The war period has also exacerbated the situation, with a significant increase in the amount of construction, demolition and hazardous waste, which in turn is poorly managed due to the lack of a proper system for categorising different types of waste (Lindskog, 2023)

BIO-WASTE (COMPOSTING AND DIGESTION)

EN

One of the main reasons for Hungary's low recycling performance is the too low rates of composting and biodegradation. The current capacity for separate collection and treatment of bio-waste can handle only a small part of the total bio-waste generated in Hungary. The amount of municipal waste going to landfills is also too high.

SK

Slovakia's excessively low bio-waste collection rate (only 36% of bio-waste generated in 2020 was collected) is seen as a key factor limiting the country's current waste management performance. Slovakia does not have sufficient capacity to treat all bio-waste, especially in view of the plans for separate collection of more bio-waste from 2023. Furthermore, the country still lacks legally binding national quality standards for compost and a quality management system for compost produced from separately collected bio-waste.

RO

Romania's excessively low composting and anaerobic digestion rates are one of the main reasons for its poor performance. Romania does not have sufficient capacity for the selective collection and proper treatment of bio-waste: it is estimated that the available capacity to treat separately collected bio-waste is only able to handle around 27% of the amount generated (estimated at around 1.7 million tonnes). Likewise, the country still lacks legally binding national quality standards for compost, and there is no quality management system for compost produced from separately collected bio-waste. The amount of municipal waste going to landfills is also too high.

PACKAGING RECYCLING RATES

EN

In 2019, the overall recycling rate of packaging materials in Hungary reached 47.3%, which is a significant distance from the 65% target set for 2025. This situation is particularly worrying due to identified problems with the quality of packaging data (inconsistencies in calculation rules).

SK

In Slovakia, the recycling rate of all packaging waste reached 67.5% in 2019, exceeding the 65% target for 2025. However, data quality problems have been identified for packaging waste. For example, there is a notable difference between the relatively low recycling rate for municipal waste and the very high recycling rate for packaging waste. The data sets for municipal waste and packaging waste appear to be inconsistent, as most of the packaging waste is generated in households and thus included in municipal waste. In addition, the forthcoming application of the new calculation rules for packaging waste recycling could lead to lower

recycling rates. In 2020, the recycling rate of all packaging waste increased to 70.8%; however, the new calculation rules have not been applied.

RO

In Romania, the overall recycling rate of packaging waste reached 57.9% in 2018, which is quite close to the 65% target for 2025; however, in 2020 the recycling rate decreased to 39.9%. In addition, data quality issues have been identified for packaging waste. For example, the discrepancy between the low recycling rate for municipal waste and the rather high recycling rate for packaging waste is noteworthy. The data sets for municipal waste and packaging waste appear to be inconsistent, as most of the packaging waste is generated in households and thus forms part of municipal waste. An analysis of the national composition of municipal waste is still not available, so it is not possible at present to compare the data on packaging waste with those on municipal waste.

WASTE MANAGEMENT PERFORMANCE - CHALLENGES FOR THE 4 COUNTRIES

EN

Significant improvements are needed to bring Hungary's waste management performance in line with the EU waste hierarchy. Some of the main challenges for the country's waste management are:

- the country's plan to move to a single national waste management concession, which entails a complete reorganisation of the sector and a redistribution of responsibilities and could lead to further delays in achieving waste management targets;
- low collection rates of recyclable waste in the separate collection system (23-44% for dry recyclables and less than 5% for bio-waste);
- limited recovery of bio-waste and limited efficiency of bio-waste treatment facilities;
- inadequate waste management infrastructure, in particular insufficient capacity to sort and recycle separately collected packaging waste and mixed dry recyclable materials.

SK

Significant improvements are needed to bring waste management in Slovakia in line with the EU waste hierarchy. The main challenges facing waste management in the country include:

- the lack of economic incentives for households to separate recyclable waste (in two thirds of municipalities in Slovakia, the treatment fees for collected waste cover only a fraction of the actual costs of waste collection);
- inefficient and fragmented collection and treatment of municipal waste, which does not benefit from economies of scale (partly due to the large number of municipalities in Slovakia, totalling some 3 000 municipalities);
- data quality problems in reporting and calculating national recycling rates, especially for packaging waste.

RO

Although Romania has earmarked significant resources for waste infrastructure in recent years, it still needs significant improvements to bring its waste management in line with the EU waste hierarchy. The main challenges facing the country's waste management include:

- the tools needed to implement central government policy at the local level are limited due to extensive local autonomy, insufficient institutional cooperation and lack of accountability among stakeholders;
- lack of adequate infrastructure for separate collection and treatment of bio-waste and packaging materials;
- problems with the quality of data on packaging waste (there is a significant gap between the low recycling rate for municipal waste and the high recycling rate for packaging waste).

UKR

Although Ukraine is continuously harmonising its legislation with that of the European Union, including waste legislation, and trying to comply with EU waste directives, it still has a huge backlog in waste management. However, Ukraine's catching up has been made almost

impossible by the Russian-Ukrainian war and its consequences (destruction of nature, damage, population crisis, etc.).

- Waste and pollution clean-up was and remains a major issue for Ukraine even before the war, and has become even more urgent, which should be addressed immediately, but for which there are no resources (financial, human or infrastructural).
- An acute problem is the lack of waste management infrastructure and the poor state of existing infrastructure.
- Waste imports are a major problem for Ukraine.
- The low level of environmental awareness and insolvency of the population is a major challenge.

Ukraine did not have a modern waste management system in place before the war, but its status as a candidate for EU accession could create new opportunities to introduce a modern waste management system.

GOOD PRACTICES

Below, we have collected and presented some good practices from early warning reports that can serve as examples for Ukraine to follow.

HUNGARY

The following measures implemented by Hungary could be considered as good practices that could be replicated and help Ukraine to achieve its mitigation targets:

Food Waste Prevention Centre

In 2021, a national food waste prevention scheme was set up. This scheme, established by Hungarian legislation6 , involves the creation of a dedicated Food Waste Recovery Centre. The Centre acts both as a coordinating body and as an intermediary between grocery stores and various organisations to help distribute food that is nearing its expiry date, thus preventing waste. Organisations that distribute food include public bodies (municipalities or governments), member organisations of the Charity Council and other religious and private organisations.

Waste paper collection in schools

This is a well-established initiative in Hungary that has been in place for several decades. The twice-yearly initiative encourages teachers and students to collect paper waste from educational institutions. The collected paper waste is weighed on the spot and then handed over for recycling. There is also a competitive aspect to the initiative, which encourages children to compete for the title of the class that collects the most paper waste.

SLOVAKIA

Study on improving **the quality of packaging data**

The Slovak Environmental Protection Agency, which is responsible for providing data to Eurostat, has submitted a project proposal under Eurostat's call for proposals "Statistics for European Green Business". The proposed project would carry out a thorough analysis of

available databases, comparing existing data and estimating the proportion of 'free riders' among plastic packaging producers. This study is expected to significantly improve the quality of packaging data in Slovakia.

ROMANIA

Establish a **national system for collecting and monitoring data on waste**

On 1 January 2023, the SIATD, a single data collection and tracking system, became operational. The system, which was initially piloted for 2 years for the packaging waste stream, will now also cover the data flows for electrical and electronic equipment and batteries. One of the main objectives of the system is to put in place processes that allow reliable verification of transactional waste management data.

Regional associations of municipalities focusing on waste management

The Romanian national authorities have supported the creation of development associations involving virtually all municipalities in Romania's 41 regions.Such municipal cooperation is expected to lead to economies of scale and more efficient collection and treatment of municipal waste, including through the promotion of significant investments from EU Structural Funds in large-scale waste infrastructure assets.

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