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Is a common EU target for municipal waste recycling achievable?

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Abstract
The paper analyses the Commission Decision (2011/753/EU) establishing rules and calculation methods for Amendments adopted by the European Parliament on 14 March 2017 regarding the proposal for a directive of the European Parliament and of the Council amending Directive 2008/98/EC on waste (COM(2015)0595 – C8-0382/2015 – 2015/0275(COD)). We present an analysis of the calculation of recycling targets for municipal waste in the period 2010 – 2015 carried out using 4 calculation methods for the Member States of the European Union (EU). We try to assess the differences in interpretation of the EU Municipal Waste (MW) definitions and the impact that different recycling rate calculation methods have on final recycling figures. We discuss significant inconsistencies in the data collection methods and interpretation of the definition of MW used to support the opinion of the European Parliament from March 14, 2017 that the calculation of recycled MW should be based on one harmonised method which will prevent Member States from reporting discarded waste as recycled waste.
A case study of the Czech Republic is discussed with respect to the common EU 50 % target for recycling MW in 2020 and 65 % target for recycling MW in 2030, with consideration given to whether this goal is achievable in the Czech Republic.

Keywords
Municipal waste, recycling rates, household waste, recycling analyses, circular economy.

Introduction

Municipal Waste (MW) management in Europe has become more and more complex in the last decade. This complexity is due to some extent to the introduction of additional facilities for the pretreatment of waste, mainly mechanical biological treatment and sorting for recovery. In addition, there are legal requirements for increasing the recovery of certain waste streams, resulting also in increasing cross-boundary transports of waste for recovery. Depending on national waste management and waste data collection systems, the approaches for MW data collection established in the European Union (EU) Member States (MSs) vary to a large extent, thus hampering data comparability across MSs. Moreover, MW statistics have gained importance as they currently constitute one of the options that can be utilised to provide evidence of compliance with the recycling target set by the Waste Framework Directive (WFD) [1].

Recycling of waste is defined as any recovery operation by which waste materials are reprocessed into products, materials or substances, whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery or the reprocessing into materials that can be used as fuels or for backfilling operations.

The differentiation between the terms *reuse*, *recycling* and *recovery* is important for the understanding and application of the targets stated in EU waste legislation. Definitions for *recycling* and *reuse* in waste-specific directives partially deviate from the corresponding definitions of the WFD [1]: In particular, the term *recycling* specified in waste-specific directives does not include backfilling operations. The definition of *reuse* in the Packaging Directive 94/62/EC [12] and the WEEE Directive 2002/96/EC [13] comprises specifications that the WFD does not include.

With a revised EU Circular Economy (CE) package passed on March 14, 2017 by the European Parliament (EP) [7], the debate about the scope and role of any new recycling targets and how the performance of EU MSs is calculated and compared is more pertinent than ever. Members of the EP voted on Tuesday 14 March 2017 on four directives concerning waste management, mainly waste from households and small firms, representing 8% of total waste. These plans are a first step towards creating a circular economy where products are designed in order to facilitate reuse. One of the key issues is how ambitious targets should be for recycling rates and limiting landfilling, which is probably the most harmful way of getting rid of waste. Moving to a more environmentally-friendly economic model involves reducing the amount of waste by reusing, collecting, recycling and repairing as much as possible. Landfilling is the cheapest way to dispose of waste but also the most harmful option for the environment and potentially for human health. That why it is necessary to limit landfilling to the minimum and move towards other methods, such as incineration, or even better recycling, reusing and repairing. Lower rates of landfilling usually go hand in hand with higher rates of recycling. The less a country uses landfills, the more it tends to recycle.

MW constitutes approximately between 7 and 10% of the total waste generated in the EU; however, this waste stream is one of the most complex ones to manage, and the way it is managed generally gives a good indication of the quality of the overall waste management system in a country. The challenges of MW management result from its highly complex and mixed composition, the direct proximity of the generated waste to citizens, its very high public visibility and its impact on the environment and human health. As a result, its management requires a highly complex waste management system that includes an efficient collection scheme, an effective sorting system, the proper tracing of waste streams, the need to actively engage citizens and businesses, the need for infrastructure adjusted to the specific waste composition, and an elaborate financing system. MSs which have developed efficient MW management systems generally perform better in terms of overall waste management, including the achievement of recycling targets. However, proper management of MW alone is not enough to boost the transition to a circular economy in which waste is considered a resource. It is necessary to take a life-cycle approach to products and waste in order to trigger this transition [7].

To ensure that recycling targets are based on reliable and comparable data and to enable more effective monitoring of progress in attaining those targets, the definition of municipal waste in the WFD [1] should be aligned to the definition used for statistical purposes by the European Statistical Office (Eurostat) and the Organisation for Economic Co-operation and Development (OECD), on the basis of which MSs have been reporting data for several years. The definition of MW in the WFD [1] is neutral with regard to the public or private status of the operator managing waste.

Eurostat established the *Environmental Data Centre on Waste* as one of data centres of the Shared Environmental Information System (SEIS) [11] with the following main objectives [12]: to provide robust data, indicators and other relevant information to support the assessment of policy effectiveness; to manage data, perform quality assurance, and coordinate data and information managed by other

bodies (e.g. the Directorate General (DG) for the Environment, Eurostat, the Joint Research Centre (JRC), the European Environment Agency (EEA), other EU institutions, international organisations such as the OECD and the United Nations); to be the central entry point for the reporting of data under EU legislation on waste; to be the reference point for answering specific policy questions related to (statistical) information on waste and the associated environmental impacts; and to cooperate with the DG for the Environment, the JRC and the EEA to develop and coordinate the methodologies necessary to produce statistical data, information and indicators on the environmental impacts of waste generation and waste management within a life cycle perspective.
The European Commission (EC) has proposed a target of 65% MW recycling and a maximum of 10% MW landfilling by 2030. The new legislative package for the Circular economy includes four separate directives on waste, landfills, packaging and vehicle, battery and electronic equipment recycling.
We are concerned about the value (and potential misuse of) comparative MW statistics and data across Europe. In this article, we have tried to assess the differences in the interpretation of the EU's municipal waste definitions and the impact that different recycling rate calculation methods have on final recycling figures. The 2016 report by Greenfield [6] shows that there is, indeed, significant inconsistency in data collection methods and the interpretation of the definition of MW. In particular, the materials included in MW vary from MS to MS, for example through the inclusion or exclusion of home composting, waste from small firms and recycled packaging.
The paper tries to answer current questions regarding recycling rates for municipal waste and presents an analysis of the calculation of these targets for municipal waste in the period 2010 - 2015 using four calculation methods for EU Member States. The differences in interpretation of the EU MW definitions and between different recycling rate calculation methods are discussed in this paper.

Material and Methods

Theoretical and legislative background

Waste statistics data were collected in the EU on the basis of an Organisation for Economic Co-operation and Development (OECD)/Eurostat joint questionnaire (JQ) until the adoption of the Regulation on Waste Statistics [3-4]. However, the data collection concerning municipal waste (MW), continued after 2004 based on a subset of the JQ, where MW includes *household and similar wastes*, including:

- bulky waste (e.g. white goods, old furniture, mattresses); and
- garden waste, leaves, grass clippings, street sweepings, the content of litter containers, and market cleansing waste,

if managed as waste.
It includes waste originating from:

- households,
- commerce and trade, small businesses, office buildings and institutions (schools, hospitals, government buildings).

It also includes:

- waste from selected municipal services, i.e. waste from park and garden maintenance, waste from street cleaning services (street sweepings, the content of litter containers, market cleansing waste),

if managed as waste.
It includes waste from these sources collected:

- door-to-door through traditional collection – (materials of mixed household waste), and
- fractions collected separately for recovery operations (through door-to-door collection and/or through voluntary deposits).

For the purpose of this JQ, MW refers to waste defined as above, collected by or on behalf of municipalities.
The definition also includes waste that is from the same sources and similar in nature and composition to them which:

- is collected directly by the private sector (business or private non-profit institutions) and not on behalf of municipalities (mainly separate collection for recovery purposes),
- originates from rural areas not served by a regular waste collection service, even if it is disposed of by the waste generator.

The definition excludes: waste from the municipal sewage network and sewage treatment; municipal construction and demolition (C&D) waste.
The most comprehensive definition for statistics on MW is still the simple definition provided by the OECD/Eurostat JQ: *Municipal waste covers household waste and waste similar in nature and composition to household waste*.

This definition has evolved over time by operationalising it along the three main dimensions for waste statistics: *waste origin, waste materials* and *waste collectors* [8].
Eurostat's *Guidance on municipal waste data collection* [8] from October 2016 identified that MW consists of the following *waste materials* (packaging waste of the individual fractions is included):

a) Separately collected waste from households:
   - *Paper and cardboard*: Consists of packaging paper and cardboard as well as graphic paper (newsprint, magazine paper and copy paper.
   - *Textiles:* Consists of clothes and other textiles, e.g. carpets.
   - *Plastics:* Consists of plastic packaging and plastic products.
   - *Glass:* Consists of container glass as packaging waste and of other glass, e.g. flat glass, lamps or dishes. Comprises clear glass and stained glass.
   - *Metals:* Consists of metal packaging, e.g. cans, and scrap metal from households. Comprises ferrous and non-ferrous metals.
   - *Organic materials from households*: Kitchen waste (food leftovers, etc.), garden waste (grass clippings, leaves, etc.). Home composting is not included.
   - *Hazardous household waste* [1-2]: Spent solvents, acids, alkalis, photochemicals, pesticides, used oils, paints, inks, adhesives and resins (partly hazardous), WEEE (partly hazardous), batteries and accumulators (partly hazardous), detergents (hazardous parts), hazardous medicines.
   - *Other waste*: Edible oil and fat, rubber waste, ceramics, etc.
   - *Bulky waste:* Waste that has special management requirements due to its bulky character. It includes bulky wood waste and other bulky materials which are mentioned in the above fractions, e.g. bulky metal products.
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 municipal services*: Garden and park waste from municipalities, waste from the maintenance of roadsides, if managed as waste. Grass clippings, which are left on the ground, are excluded. Kitchen and canteen waste.
   - *Waste from public bins and street sweepings*.
   - *Market cleansing waste.*
   - *Cemetery waste.*

To understand how consistently the definition of MW is applied across the EU's 28 MSs (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom), the following analysis was carried out [6] between MSs. It focuses in particular upon which materials each country includes in its definition of MW, and on recycling rate calculations. This definition of MW is still open to interpretation by individual EU MSs. Table 1 provides a summary of the materials each MS includes in their definition of MW.

Table 1. Waste materials included in the national definition of MW. Source: [6] and authors

Main Material Category	*Material Subcategory*	*Country*
Residual waste, bulky waste	Reused products	Finland, Ireland
	Material recyclables (paper and cardboard, textiles, plastics, glass, metals and other recyclables, such as wood waste)	EU-28
	Packaging waste from private sector	EU-28 *except* for the Czech Republic, Estonia, Finland, France, Germany, Latvia and Romania
	Biowaste (food waste and garden waste)	EU-28
	Hazardous household waste	EU-28 *except* for Cyprus
Waste from municipal services comprises the following fractions:	Street sweepings	EU-28
	Biowaste (garden and park waste, maintenance of	EU-28

	roadsides, cemetery waste)	
	Kitchen and canteen waste	EU-28
Waste from commerce and trade, small businesses, office buildings and institutions	Collected with households or by the municipality services	EU-28
	Collected by private sector	EU-28 *except* for the Latvia, Netherlands and Spain
Other waste from municipal services	C&D waste	Romania
	Waste from municipal sewage network and treatment[1]	Germany, Romania

We can see from Table 1 that home composting was classified as *reuse products* by Finland and Ireland, and that packaging waste recycling was not included under this category by the Czech Republic, Estonia, Finland, France, Germany, Latvia and Romania as a result of that material being collected by the private sector. The non-inclusion of privately collected commercial wastes of a similar nature to household waste by Latvia, Netherlands and Spain is also visible in Table 1, as is the inclusion of municipally collected C&D and sewage sludge wastes by Germany and Romania.

Methods of calculating the recycling target

For the purposes of verifying compliance with the MW target set in Article 11(2)(a) of the WFD [1], Member States of the European Union shall apply the target to one of the following:

1) the preparation for reuse and recycling of paper, metal, plastic and glass household waste;
2) the preparation for reuse and recycling of paper, metal, plastic, glass household waste and other single types of household waste or similar waste from other origins;
3) the preparation for reuse and recycling of household waste;
4) the preparation for reuse and recycling of municipal waste.

The EC Decision of 18 November 2011 [2] specified the use of one of the following calculation methods for the calculation of the target:

1) *Calculation method 1* (in %):

Recycling rate of paper, metal, plastic and glass household waste =
(Recycled amount of paper, metal, plastic and glass household waste)
/ (Total generated amount of paper, metal, plastic and glass household waste)

MSs shall use national data. Data from other waste reporting obligations can be used and adapted to national conditions. Each MS shall submit, together with the data, a report explaining how the amounts generated and recycled have been calculated and how these amounts relate to the data on household waste to be reported under Regulation 2150/2002 [3] and Commission Regulation 849/2010 [4].

2) *Calculation method 2* (in %):

Recycling rate of household and similar waste =
(Recycled amount of paper, metal, plastic, glass waste and other single waste streams from households or similar waste streams) / (Total generated amount of paper, metal, plastic, glass waste and other single waste streams from households or similar waste)

MSs shall use national data. Data from other waste reporting obligations can be used and adapted to national conditions. MSs shall submit, together with the data, a report explaining which materials are covered and from which activities they result by marking the relevant cells in the table in Annex II to this Decision [2]. They shall also state how the amounts generated and recycled have been calculated. Where a MS includes home-composted waste in the calculation, it shall explain how the amounts generated and recycled have been calculated. The report shall also explain how these amounts relate to the data on household waste and other economic activities to be reported under Regulations [3-4].

3) *Calculation method 3* (in %):

Recycling rate of household waste =
(Recycled amount of household waste) / (Total household waste amounts excluding certain waste categories)

MSs shall use national data to report on the recycled amount of household waste. They shall submit, together with the data, a report explaining which materials are covered by marking the relevant cells in the table in Annex II to this Decision [2], as well as how the amounts recycled have been calculated. The report shall also explain how these amounts relate to the data on household waste and other economic activities to be reported under Regulations [3-4]. The total

[1] waste from the municipal sewage network and sewage treatment could be excluded

amounts of household waste shall be taken from the data to be reported according to point 1.2 of Section 8 of Annex I to Regulation [3]. Waste with the following waste codes shall be excluded from the calculation: 08.1. - Discarded vehicles; 11-13 - Sludges and mineral wastes.

4) *Calculation method 4 (in %):*

Recycling of municipal waste =
(Municipal waste recycled) / (Municipal waste generated)

MSs shall rely on the statistical data on municipal waste reported annually to Eurostat.

The existing possibility of using 4 calculation methods for the 2020 recycling target for MW will be maintained mainly for reasons of legal certainty and to minimize any short-term disruption to the waste management plans adopted by many EU MSs. The method used to determine the recycling rate is different for each EU MS; the following Table 2 summarizes these methods for all EU MSs and Norway, Switzerland and Turkey. However, this table does not cover the potential of recycling materials from MMW. There is a great deal of additional recycling potential in the mixed municipal waste (MMW) produced by MSs. The additional recycling potential concerns particularly paper and cardboard, plastic and biowaste, and MSs calculate this potential with different weights.

Table 2. Methods of calculating MW recycling rate in different countries EFTA. Source: [6]

Method 1	*Method 2*	*Method 3*	*Method 4*	*Method*
Recycling rate of paper; metal; plastic and glass household waste [%]	*Recycling rate of household and similar waste [%]*	*Recycling rate of household waste [%]*	*Recycling of municipal waste [%]*	*Currently not signed up to one of the four methods*
Ireland	Austria	Bulgaria	Belgium	Norway
Malta	Croatia	Luxembourg	Denmark	Switzerland
	Cyprus	United Kingdom	Finland	Turkey
	Czech Republic		Germany	
	Estonia		Latvia	
	France		Netherlands	
	Greece		Slovenia	
	Hungary		Spain	
	Italy			
	Lithuania			
	Poland			
	Portugal			
	Romania			
	Slovakia			
	Sweden			
2	15	3	8	3

Table 2 shows that Methods 2 and 4 are most popular, having been adopted by 23 of the 31 states of the European Free Trade Association (EFTA) considered.

The Eurostat approach

Within the JQ, MW is defined in the European List of Waste (LoW) by Chapter 20 and subchapter 1501 [5]. Whilst being detailed, the definition is still open to interpretation by individual MSs.

Focusing on the aspect of the similarity of certain waste types to household waste, Eurostat's *Guidance on municipal waste data collection* [8] offered an option allowing the scope of MW to be expressed in terms of European classifications. This option is based on the principle that the scope of MW includes household waste and similar waste types generated by other sources than households, regardless of whether municipalities or private actors are responsible for their collection. Recent experience demonstrates that a relevant number of MSs include amounts of MMW (LoW code 20 03 01) from all NACE activities in the MW data (group 38). Furthermore, one can argue that the overall target is to reduce the unsorted MMW regardless of its origin. If this should be done, it is consistent to cover the separately collected fractions from all origins as well. Therefore, the starting point for the waste types to be included are the waste codes listed in Chapter 20 of the European List of Waste (LoW), with some additions from subchapter 15 01 [5].

When discarded items are handed over to the waste management system, they are classified as a certain waste type, ideally by 6-digit codes according to the LoW or another (national) classification. The weight and code are usually registered at the weighbridge of a waste management facility. Thus, the

key to any definition of MW is certainly the material classification of the waste, since this classification best determines its similarity to household waste "*in nature and composition*". The definition of MW shall therefore be covered by the LoW codes of Chapter 20 and subchapter 1501.
The scope of potential recycled MW materials is based on selected LoW codes, which are specified in Table 3 for calculation.

Table 3. Municipal waste materials and relevant sources for calculation methods 1, 2 and 3 of Annex I [5]. Source: [5]

Waste materials	*LoW waste code according to Decision [5]*
Paper and cardboard	20 01 01, 15 01 01
Metals	20 01 40, 15 01 04
Plastic	20 01 39, 15 01 02
Glass	20 01 02, 15 01 07
Biodegradable kitchen and canteen waste	20 01 08
Biodegradable garden and park waste	20 02 01
Non-biodegradable garden and park waste	20 02 02, 20 02 03
Wood	20 01 38, 15 01 03
Textiles	20 01 10, 20 01 11, 15 01 09
Batteries	20 01 34, 20 01 33*
Discarded equipment	20 01 21*, 20 01 23*, 20 01 35*, 20 01 36
Other municipal waste	20 03 01, 20 03 02, 20 03 07, 15 01 06

Composition of mixed municipal waste

Due to MW recycling targets, interest in the composition of MMW and other municipal waste (OMW) has increased in recent years. MMW refers to the part of MW that remains after the source separation of different waste material fractions (e.g. paper and cardboard, plastic, glass and metal and organic materials (biowaste), which are typically source separated in MS). MMW comprises a major part of the total amount of MW. MMW generated by households by year and waste category decreased (see Table 7) and was 54% of all MW in 2014 in the EU [10].
Information on the composition of MMW is needed in the planning and environmental assessment of waste management at both the regional and national level when preparing a Waste Management Plan [16]. The composition of MMW can be determined through a composition study, i.e. by manually sorting MMW fractions into different categories. Internationally, studies have been carried out using various methods, e.g. [17-23]. The variety of methods used is due to e.g. different source separation systems, sorting guidelines, waste collection systems and information needed about the composition of MMW. The EC [24] introduced its own method for solid waste composition studies in 2004.

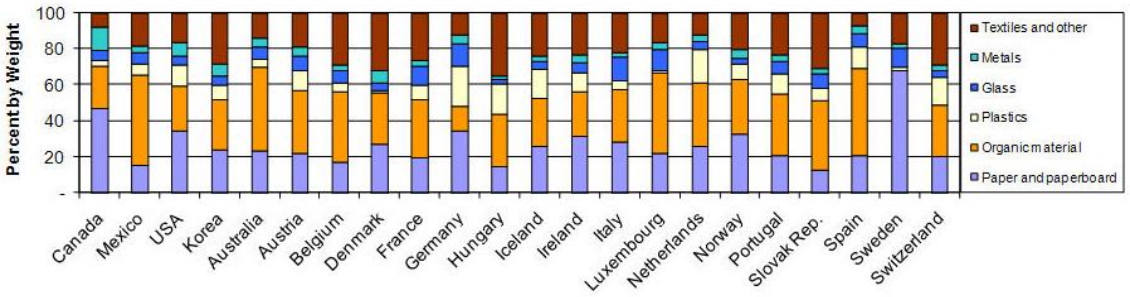

Fig 1 Composition of MMW by country in 2015. Source: [25]

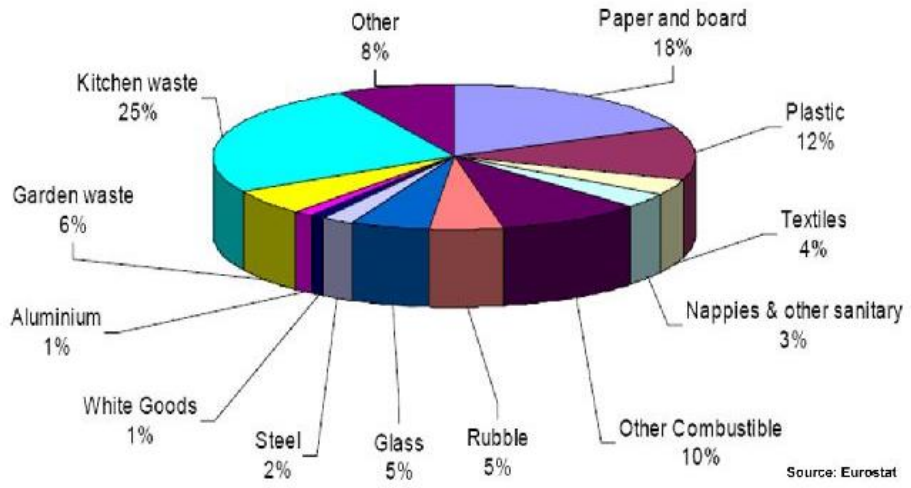

Fig. 2 Composition of MMW in the EU-27 in 2007. Source: Eurostat

We summarize Eurostat's [8] suggestions for reporting on MW generation and treatment as follows:

- The scope of the term MW shall be understood on the basis of the definition taken from the OECD/Eurostat JQ on waste and shall be interpreted on the basis of the LoW codes/material streams listed in the Annex [8], i.e. the waste codes listed in Chapter 20 of the LoW with some additions from subchapter 1501 [5], regardless of the type of collection method;
- Coverage by origin shall be considered for waste materials where the LoW code/material allows no distinction between production waste and waste from municipal sources (as listed in the definition in the Annex [8] in green);
- MW shall also cover packaging waste; it is suggested that packaging waste be covered even if a clear distinction between commercial and private household origin is not possible because of the collection system;
- Municipal waste or municipal solid waste (MSW) treatment shall be broken down into the four categories *landfill, incineration, recycling* and *composting (incl. fermentation)* as shown in Figure 3 with recycling R and disposal D codes [1];

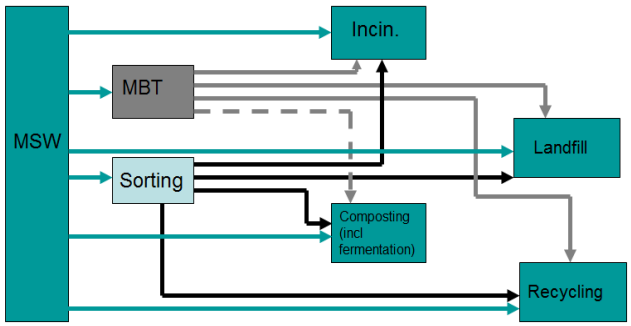

Fig. 3 Municipal waste treatment options. Source: [8]

- For sorting and Mechanical Biological Treatment (MBT) facilities, the outputs shall be allocated to the above four treatment categories. For MBT, the annual input of MW shall be reported in the quality report in kilotonnes;
- For composting/digestion, only separately collected organics are accepted for reporting. Biological treatment of mixed waste shall be excluded from the composting figures and shall be regarded and reported as being treated in MBT facilities, i.e. such waste shall be allocated in the form of residues to the incineration or landfilling category;
- Secondary wastes from the above four treatment operations shall not be considered, except for in cases where their classification for recycling and composting used for data collection deviates from their definitions;
- In the cases of recycling and composting, Note 1 has to be taken into account in the manner shown in Figures 4 and 5 and the related explanation unless the residues are insignificant;

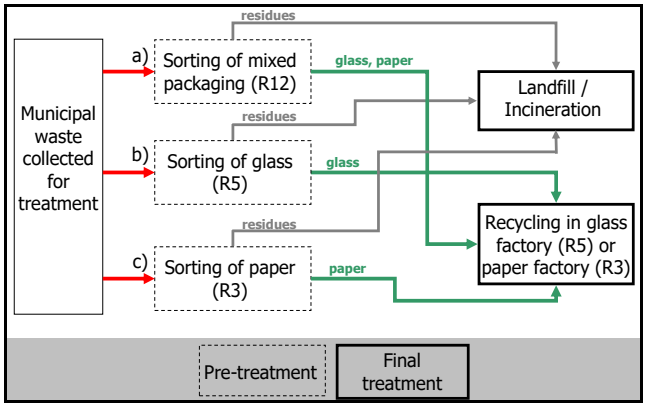

Fig. 4 The varying role of sorting in municipal waste treatment classification. Source: [8]

Figure 4 shows how sorting should be reported to Eurostat. It can be seen that case a) is an example of sorting as a specialised pre-treatment operation (R12) that shall not be reported as such but rather according to the flows of sorted materials to the recycling process and the residues to disposal or energy recovery. In cases b) and c), the reporting should be handled in a similar way to case a), even though these processes may be classified under R2 to R11.

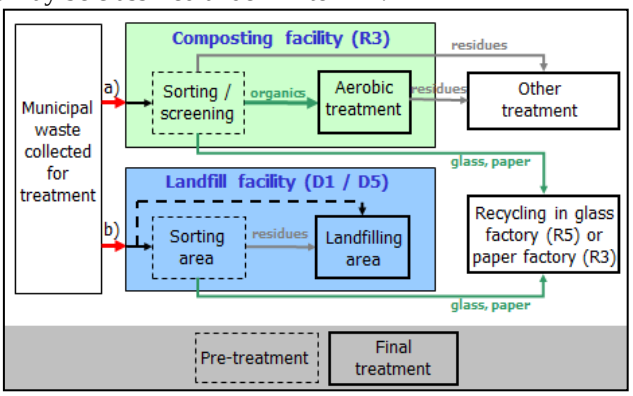

Fig. 5 The integration of pretreatment in facilities classified otherwise. Source: [8]

Figure 5 shows that sorting may also occur in facilities that are classified otherwise. In the case of composting, this means that only the part of the flow that actually ends up in biological treatment shall be reported, This is roughly the difference between the input (red arrows) and the sum of residues treated otherwise (including post-process residues, grey arrows) and materials sent to recycling (green arrows). For sorting at landfills it is similar, i.e. the sorted amounts sent to recycling can be reported under recycling while the landfilled amount is represented by the difference between the input and the materials sent for recycling. In Figure 4 and Figure 5, the flows which are reported as composting/digestion or recycling in compliance with the definitions of the WFD and the JQ are marked in green. The red flows (input except for landfill) may only be used when the residues (grey) are insignificant in the sense of the above Article 2(2) from [2].

It is important to lay down more precise rules on how MSs should report what is effectively recycled and can be counted towards the attainment of the recycling targets. The calculation of recycled MW should be based on one harmonised method which will prevent MSs from reporting discarded waste as recycled waste. To that end, the reporting on the attainment of the recycling targets must be based on the input to the final recycling process. Losses in weight of materials or substances due to physical and/or chemical transformation processes inherent to the final recycling process should not be deducted from the weight of the waste reported as recycled.
Eurostat proposed consolidated guidance on all MW treatment categories [8] for waste statistics in 2016:

- *Amount of MW recycled (excl. composting)* [8]
  Recycling means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes, see Article 3, No. 17 of the WFD [1]. Thus, the waste material is diverted from the waste stream. *Direct recycling within industrial plants at the place of generation should be excluded*. For the present reporting exercise,

recycling does not include the following operations because they are covered by other treatment categories:

- *the reprocessing of organic material by aerobic or anaerobic methods (composting/digestion);*
- *energy recovery and the reprocessing of industrial by-products into materials that are to be used as fuels.*

MW can either be recycled directly or after pretreatment operations. Residues from the other recovery/disposal operations, i.e. composting/fermentation and incineration, which go on to be recycled (e.g. metals from incineration ashes), are not reported. The calculation can be based on amounts collected for recycling purposes and adjusted according to amounts not actually recycled (e.g. sorting residues).

- *Amount of MW composted or fermented* [8]
  Composting/digestion are biological processes that submit biodegradable waste to aerobic/anaerobic decomposition. These processes produce *compost* or *digestate* which, following any further necessary reprocessing, is used as a recycled product, material or substance for land treatment resulting in benefits to agriculture or ecological improvements, see Article 2 (6) of [2].
  MW can either be composted/digested directly or after pre-treatment operations. The biological treatment of residual waste in an MBT cannot be regarded as composting when the product of that treatment is subsequently landfilled, incinerated or otherwise not used for the purpose mentioned above. The calculation can be based on amounts collected for the purpose of composting/digestion, and adjusted according to amounts not actually composted /digested (e.g. sorting residues).
- *Amount of MW landfilled* [8]
  Landfilling is defined as the deposition of waste into or onto land, including specially engineered landfill and temporary storage of over one year on permanent sites. The definition covers both landfill in internal sites (i.e. where a generator of waste is carrying out its own waste disposal at the place of generation) and in external sites. MW can either be landfilled directly or after pre-treatment operations. Residues from the other recovery/disposal operations (recycling, composting / fermentation and incineration) which go to landfills (e.g. ashes from incineration) are not reported. Only those quantities which are really landfilled have to be reported. If a sorting step takes place at the landfill site before landfilling occurs, the outputs of the sorting have to be assigned to the respective recovery/disposal operations.
- *Amount of MW incinerated / Total incineration (including energy recovery)* [8]
  Incineration means the thermal treatment of waste in an incineration plant as defined in Article 3(4) or a co-incineration plant as defined in Article 3(5) of [9]. MW can either be incinerated directly or after pre-treatment operations. The latter refers especially to secondary fuel produced from waste.
  Energy recovery is defined as incineration that fulfils the energy efficiency criteria laid down in the WFD [1], Annex II (recovery operation R1).
  Since the transposition of the WFD into national legislation, the energy efficiency criterion (according to Annex II of the WFD) allows a better distinction to be made between incineration with and without energy recovery. In this case, the treatment operation "energy recovery" covers the incineration of waste in accordance with the energy efficiency criterion mentioned as well as the co-incineration of waste in power stations or industrial facilities such as cement kilns so that the resultant energy can be used to generate heat or electricity. Depending on the available data and the feedback from countries to the suggestions above, further refinement may be necessary.

Discussion and results

Eurostat has collected and published data on MW since 1995. These data are widely used for comparing MW generation and treatment in different countries, and indicators relevant to MW are used to monitor European waste policies. The data on MW expressed in kilograms per capita are part of a set of indicators compiled annually to monitor the EU's sustainable development strategy [10].
Table 4 shows municipal waste generation by country expressed in kilograms per capita. To illustrate the trends, Table 4 shows generated waste for selected years, covering the period 1995 to 2015.

Table 4. Municipal waste generated by country in selected years (kg per capita). Source: Eurostat

	1995	*2000*	*2005*	*2010*	*2015*
EU-28	-	521	515	504	477
EU-27	473	523	517	505	477
Belgium	455	471	482	456	419
Bulgaria	694	612	588	554	419

Czech Republic	302	335	289	318	316
Denmark	521	664	736	-	789
Germany	623	642	565	602	625
Estonia	371	453	433	305	359
Ireland	512	599	731	624	-
Greece	-	412	442	532	-
Spain	505	653	588	510	434
France	475	514	530	533	502
Croatia	-	262	336	379	393
Italy	454	509	546	547	486
Cyprus	595	628	688	689	638
Latvia	264	271	320	324	433
Lithuania	426	365	387	404	448
Luxembourg	587	654	672	679	625
Hungary	460	446	461	403	377
Malta	387	533	623	601	624
Netherlands	539	598	599	571	523
Austria	437	580	575	562	560
Poland	285	320	319	316	286
Portugal	352	457	452	516	-
Romania	342	355	383	313	-
Slovenia	596	513	494	490	449
Slovakia	295	254	273	319	329
Finland	413	502	478	470	500
Sweden	386	428	477	439	447
United Kingdom	498	577	581	509	485
Iceland	426	462	516	481	:
Norway	624	613	426	469	421
Switzerland	600	656	661	708	725

We can see that for 2015, MW generation totals vary considerably, ranging from 789 kg per capita in Denmark to 286 kg per capita in Poland, and the EU-28 average was 477 kg per capita. The variations reflect differences in consumption patterns and economic wealth, but also depend on how MW is collected and managed. There are differences between EU MSs regarding the degree to which waste from commerce, trade and administration is collected and managed together with waste from households.

The period 1995-2005 shows the following trends: In 16 of the 31 countries (EU MSs and EFTA), the amount of MW generated per capita increased between 1995 and 2015. The highest average annual growth rates were recorded for Latvia based on 1995 and 2015 figures (2.5 %), Malta (2.4 %) and Denmark (2.4 %).

Using data from Eurostat we can calculate the recycling of MW by country in kilograms per capita and the MW recycling rate by country as a percentage of generated MW in the period 2010-2015.

Table 5. Recycling of MW by EFTA countries in kilograms per capita [kg/citizen] and as a percentage of total MW [%] in 2010-2015. Source: Eurostat and authors

Country	*2010*		*2011*		*2012*		*2013*		*2014*		*2015*	
	kg/ cit.	*%*	*kg/ cit.*	*%*	*kg/ cit.*	*%*	*kg/ cit.*	*%*	*kg/ cit.*	*%*	*kg/ cit.*	*%*
EU-28	124	24.6	128	25.7	130	26.8	128	26.8	134	28.1	137	28.7
EU-27	125	24.8	129	25.8	131	26.9	129	26.9	135	28.1	137	28.7
Belgium	153	33.6	155	33.9	144	32.2	138	31.6	141	33.0	143	34.3
Bulgaria	136	24.5	122	24.0	103	22.3	108	25.1	94	21.2	80	19.0
Czech Republic	43	13.6	47	14.8	63	20.6	65	21.3	70	22.6	81	25.5
Denmark	-	-	213	27.3	203	25.7	205	26.0	212	26.9	215	27.3
Germany	*275*	*45.6*	*288*	*46.1*	*293*	*47.4*	*286*	*46.6*	*300*	*47.6*	*299*	*47.8*
Estonia	31	10.1	44	14.5	40	14.0	37	12.7	95	26.6	89	24.7
Ireland	200	32.0	188	30.5	181	30.8	-	-	-	-	-	-
Greece	78	14.7	75	14.9	79	15.6	-	-	-	-	-	-#
Spain	90	17.6	81	16.7	91	19.5	70	15.5	76	16.9	73	16.8
France	95	17.8	111	20.6	110	21.1	111	21.5	112	22.1	112	22.3

Croatia	12	3.3	29	7.5	51	13.2	54	13.2	56	14.4	64	16.3
Italy	103	18.8	120	22.8	121	23.9	122	24.8	127	26.1	126	25.9
Cyprus	74	10.7	85	12.6	81	12.3	81	13.1	83	13.5	85	13.3
Latvia	28	8.8	30	8.6	41	13.7	71	20.2	85	23.4	92	21.2
Lithuania	14	3.4	81	18.2	87	19.6	88	20.4	91	21.1	103	22.9
Luxembourg	183	27.0	188	28.4	182	27.7	174	28.4	178	28.4	178	28.4
Hungary	64	15.9	66	17.2	84	20.9	81	21.4	94	24.3	98	25.9
Malta	32	5.2	46	7.8	45	7.7	48	8.1	45	7.4	42	6.7
Netherlands	142	24.8	137	24.2	131	23.9	126	23.9	125	23.7	129	24.6
Austria	152	27.1	137	23.8	139	23.9	142	24.5	144	25.5	144	25.7
Poland	47	14.8	31	9.7	33	10.3	39	13.3	57	21.1	75	26.4
Portugal	59	11.3	56	11.5	52	11.5	57	12.9	74	16.2	-	-
Romania	8	2.6	9	3.3	8	3.3	11	4.2	13	5.2	14	5.7
Slovenia	*99*	*20.2*	*126*	*30.3*	*131*	*36.3*	*116*	*28.0*	*126*	*29.0*	*208*	*46.4*
Slovakia	18	5.7	19	6.2	26	8.4	20	6.6	16	5.1	25	7.6
Finland	92	19.7	110	21.8	109	21.5	94	19.0	87	18.0	141	28.1
Sweden	*151*	*34.4*	*149*	*33.1*	*147*	*32.7*	*150*	*33.4*	*146*	*33.4*	*145*	*32.4*
United Kingdom	129	25.3	129	26.2	128	26.9	132	27.4	132	27.3	132	27.2
Iceland	75	15.7	100	20.3	122	23.8	129	25.1	114	21.1	-	-
Norway	125	26.5	121	24.9	124	25.9	116	23.4	110	26.1	110	26.2
Switzerland	*239*	*33.7*	*238*	*34.6*	*241*	*34.8*	*236*	*33.6*	*238*	*32.6*	*231*	*31.9*

We can see the best recycling rate was reached in Germany (299 kg per capita and 47.8% with method 4) in 2015, followed by Slovenia (208 kg per capita and 46.4% with method 4), Sweden (145 kg per capita and 32.4% with method 2) and Switzerland (231 kg per capita and 31.9% using none of the four methods).

It will be very difficult for most European countries to reach the 50% recycling target in 2020 if the recycling rate for the EU-28 was 28.7% in 2015: linear extrapolation suggests the rate will be 32.6% in 2020. This is especially likely to be true if Eurostat [8] does not recommend adding the amount of composted or fermented MW to the recycling rate.

The exception among European countries is Germany, with its high recycling rates that will enable it to reach a 50% recycling rate in 2020. They are driven by its waste management policy and initiatives. EU legislation under the WFD [1], for example, sets the policy framework and targets for recycling in Germany, which was one of the first European countries to limit landfilling and introduce schemes for collecting packaging waste, bio-waste and waste paper separately.

Let us have a look at the shared recycling and composting or fermentation rates for MW in European countries in the period 2010-2015.

Table 6. Shared recycling and composting of MW by EFTA countries in kilograms per capita [kg/citizen] and as a percentage of total MW [%] in 2010-2015. Source: Eurostat and authors

Country	*2010*		*2011*		*2012*		*2013*		*2014*		*2015*	
	kg/ cit.	*%*	*kg/ cit.*	*%*	*kg/ cit.*	*%*	*kg/ cit.*	*%*	*kg/ cit.*	*%*	*kg/ cit.*	*%*
EU-28	193	38.3	197	39.6	202	41.5	202	42.2	209	43.7	215	45.0
EU-27	194	38.5	198	39.8	203	41.7	203	42.4	211	43.9	216	45.2
Belgium	*250*	*54.9*	*248*	*54.3*	*237*	*53.1*	*230*	*52.7*	*228*	*53.2*	*223*	*53.4*
Bulgaria	136	24.5	133	26.2	116	25.0	123	28.5	102	23.1	123	29.4
Czech Republic	50	15.8	54	17.0	71	23.2	74	24.2	79	25.4	94	29.7
Denmark	-	-	324	41.5	333	42.1	341	43.2	356	45.1	365	46.3
Germany	*376*	*62.5*	*394*	*63.0*	*403*	*65.2*	*392*	*63.8*	*414*	*65.6*	*413*	*66.1*
Estonia	55	18.2	71	23.3	54	19.1	52	17.9	112	31.3	102	28.3
Ireland	223	35.7	222	36.1	215	36.6	-	-	-	-	-	-
Greece	91	17.1	91	18.0	98	19.3	-	-	-	-	-	-
Spain	149	29.2	130	26.7	139	29.8	147	32.5	138	30.8	144	33.3
France	186	34.9	199	36.9	197	37.8	199	38.6	199	39.2	199	39.5
Croatia	15	4.0	32	8.3	57	14.7	61	14.9	64	16.5	71	18.0
Italy	170	31.0	187	35.5	194	38.4	194	39.4	207	42.5	212	43.5
Cyprus	74	10.7	85	12.6	89	13.6	90	14.6	104	17.0	115	17.9
Latvia	30	9.4	34	9.7	47	15.8	91	25.9	98	27.0	116	26.7
Lithuania	20	4.9	89	19.9	104	23.5	120	27.8	132	30.5	149	33.1

Luxembourg	316	46.5	308	46.4	310	47.4	285	46.6	299	47.7	302	48.0
Hungary	79	19.6	84	22.0	102	25.5	100	26.4	118	30.5	121	32.2
Malta	32	5.2	53	9.0	57	9.7	48	8.1	45	7.4	42	6.7
Netherlands	*281*	*49.2*	*278*	*49.1*	*271*	*49.4*	*263*	*49.8*	*268*	*50.9*	*271*	*51.7*
Austria	*334*	*59.4*	*325*	*56.7*	*335*	*57.7*	*334*	*57.7*	*319*	*56.3*	*319*	*56.9*
Poland	68	21.4	56	17.5	63	19.6	71	24.2	87	32.3	121	42.5
Portugal	97	18.7	98	20.1	118	26.1	114	25.8	138	30.4	-	-
Romania	40	12.8	31	11.7	37	14.8	34	13.2	33	13.1	32	13.1
Slovenia	*110*	*22.4*	*148*	*35.6*	*152*	*41.9*	*144*	*34.8*	*156*	*36.0*	*242*	*54.1*
Slovakia	29	9.1	32	10.3	41	13.3	33	10.8	33	10.3	49	14.9
Finland	154	32.8	176	34.8	169	33.3	161	32.5	157	32.5	203	40.6
Sweden	211	48.1	213	47.3	212	47.2	219	48.7	218	49.9	215	48.0
United Kingdom	205	40.2	207	42.0	203	42.6	208	43.3	211	43.7	211	43.5
Iceland	100	20.9	125	25.3	144	28.0	155	29.9	160	29.7	-	-
Norway	198	42.1	194	39.9	190	39.8	194	39.2	178	42.2	180	42.8
Switzerland	*357*	*50.5*	*345*	*50.1*	*347*	*50.0*	*358*	*51.0*	*391*	*53.5*	*382*	*52.7*

We can see that for 2015 the shared recycling and composting or fermentation rates for MW vary between MSs considerably, ranging from 431 kg per capita and 66.1% in Germany to 42 kg per capita and 6.7% in Malta. The EU-28 average was 215 kg per capita and 45.0%. The variations reflect differences in applied technologies, but also depend on how MW is collected sorted and managed. Linear extrapolation suggests the average EU-28 rate will reach 51.8% in 2020.
In 2015 five EU MSs achieved the WFD's 50% EU recycling target, but they did so by including biowaste which has been composted/fermented in the calculations: Austria 56% and Sweden 50% (method 2), Germany 66%, Belgium 53% and the Netherlands 51% (method 4).

Table 7 shows waste generated by households by year in waste categories 10.1, 10.2 and 10.3 defined by EWC-Stat 4 (European Waste Classification for Statistics, version 4) [3-4, 25], and also as a percentage of total generated MW.

Table 7. Waste generated by households in EU countries by year in waste categories W101+W102+W103 [25] in kilograms per capita [kg/citizen] and as a percentage of total MW generation [%]. Source: Eurostat and authors

Country	*2010*		*2012*		*2014*	
	kg/ cit.	*% of MW*	*kg/ cit.*	*% of MW*	*kg/ cit.*	*% of MW*
EU-28	289	57.2	275	56.5	259	54.1
Belgium	186	40.6	219	49.0	182	42.4
Bulgaria	323	58.5	261	56.8	276	62.7
Czech Republic	259	81.1	241	78.3	232	74.7
Denmark	369	-	362	45.7	343	43.3
Germany	228	37.9	226	36.5	225	35.6
Estonia	134	44.0	133	47.6	170	47.5
Ireland	304	48.5	287	48.9	256	48.9
Greece	463	87.1	435	86.3	409	86.3
Spain	428	83.6	393	84.0	376	84.0
France	287	52.2	279	51.6	252	49.4
Croatia	-	-	247	63.1	238	61.7
Italy	362	66.0	311	61.5	276	56.7
Cyprus	118	16.9	121	18.4	87	14.2
Latvia	186	57.9	306	101.9	226	62.2
Lithuania	242	60.6	260	58.6	261	60.4
Luxembourg	236	34.5	228	34.5	217	34.2
Hungary	236	58.7	221	55.1	261	68.0
Malta	302	50.2	259	43.8	266	44.2
Netherlands	268	46.8	254	46.2	237	44.9
Austria	182	32.3	198	34.1	198	34.9
Poland	220	69.7	228	71.9	180	66.4
Portugal	478	92.5	419	92.7	418	92.5
Romania	220	70.5	186	74.0	176	70.9
Slovenia	252	51.4	197	54.3	165	38.2

Slovakia	270	84.8	256	83.5	259	80.8
Finland	161	34.2	178	35.1	168	34.9
Sweden	231	52.5	243	53.7	174	39.5
United Kingdom	300	58.7	282	58.8	282	58.2

Waste generated by households in Table 7 consists of mainly MMW (W101) and reflects the large potential to increase the MW recycling rate in EU MSs.

Case study of the Czech Republic

The variation in the methods used to calculate recycling rate plus the different MW definitions in MSs acted as the impetus for our research, which focuses on the Czech Republic and chosen municipalities within it in order to understand how the different calculation methods impact the recycling rate when applied to the same data sets.

The data in the above Tables 4-7 is based on data reported by the Czech Statistical Office [27] to Eurostat. The Ministry of the Environment (MoE), however, publishes a separate dataset on MW based on a different reporting methodology and the legal requirements of both the Czech Republic and the EU [28].

Waste management in the Czech Republic is a relatively new but dynamically growing sector of the national economy. The first Waste Act was adopted in the Czech Republic as recently as 1991. Prior to that, the handling of waste was not subject to any legislative control or rules in the Czech Republic, and was not governed by any sectoral rules with the exception of "*secondary raw materials*" [29]. The current Waste Act was adopted in 2001 [31]. It emphasises waste prevention, defines the hierarchy of waste management, and promotes the fundamental principles of environmental and health protection within the waste treatment sector. The main strategic document governing waste management is the *Waste Management Plan* (WMP) of the Czech Republic. The previous WMP was adopted in 2003 and covered 2003–2013, although its validity was later extended to 2014. The new WMP for 2015–2024 was adopted by the Czech government in 2014 [30].

Nearly 100 % of the population of the Czech Republic are covered by formal waste collection systems, although door-to-door collections are very limited, covering only about 1 % of the population. Bring systems mainly collect paper, plastics, glass, metals, beverage cartons, biowaste, textiles, batteries and accumulators, waste electric and electronic equipment (WEEE), tyres, hazardous waste and expired medicines, and mixed municipal (residual) waste. There is an *extended producer responsibility* (EPR) system for packaging and a deposit-refund system for some returnable packaging. In addition, EPR schemes exist for WEEE, tyres, photovoltaic solar panels, batteries and accumulators.

Individual households pay charges/fees for municipal waste collections based on *a fixed payment per person*, which changes every year according to the volume of waste generated. For about 15 % of the population the fee is based on a *pay-as-you-throw* (PAYT) system.

Generation of MW and other types of waste is reported to two autonomous systems in the Czech Republic, with the source data for both systems based on continuous record keeping by individual waste producers and processors according to the Waste Act [31]. One is operated by the MoE [29] and is based on *the collection of administrative data from waste producers and waste processors according to national waste legislation*, which is fully in line with the WFD [1] and other European waste legislation. The other system, operated by the Czech Statistical Office [27], is based on *data collected by selected reporting units*. The output data are produced using statistical imputation methods.

The main reason for the different results is the use of different methodologies. Reporting on waste management in the Czech Republic utilises not only disposal and recovery operation codes, but also special codes employed by the system [29] to specify such operations as composting, reclamation and waste collected from citizens at waste collection points. In addition, *since 2009, data from small producers under the reporting threshold and producers who do not fulfil their reporting obligations are included in the calculation*, which is based on the comparison of reported waste generation and waste treatment.

Table 8. MW, MMW generated by year in tonnes [t] and kilograms per capita [kg/citizen] and recycled MW in tonnes [t] and percentages [%] of total generated MW (method 4). Source: MoE and authors

year	*Number of inhabitants*	*Total generation of municipal waste [t]*	*Total generation of municipal waste per capita*	*Total generation of mixed municipal waste [t]*	*Total generation of mixed municipal waste per capita*	*Recycled municipal waste [t]*	*Recycling rate of municipal waste [%]*

			[kg/cit.]		*[kg/cit.]*		
2010	10 517 247	5 361 883	510	3 142 929	299	1 302 476	24.3%
2011	10 495 430	5 388 058	513	3 067 683	292	1 661 703	30.8%
2012	10 509 286	5 192 784	494	2 932 787	279	1 576 519	30.4%
2013	10 510 719	5 167 805	492	2 859 659	272	1 561 729	30.2%
2014	10 524 783	5 323 947	506	2 936 012	279	1 849 864	34,7%
2015	10 542 942	5 274 126	500	2 836 836	269	1 877 447	35.6%

Tables 4 and 8 show the generation of MW in the Czech Republic dropped from 318 kg per capita (Table 4) and 510 kg per capita according to the MoE (Table 8) in 2010 to 316 kg per capita (Table 4) and 500 kg per capita according to the MoE (Table 8) in 2015. Based on its own dataset, the MoE reported in 2015 that 35.6 % of total MW was recycled, of which 26% underwent material recycling and 9.6 % organic recycling – composting and fermentation.

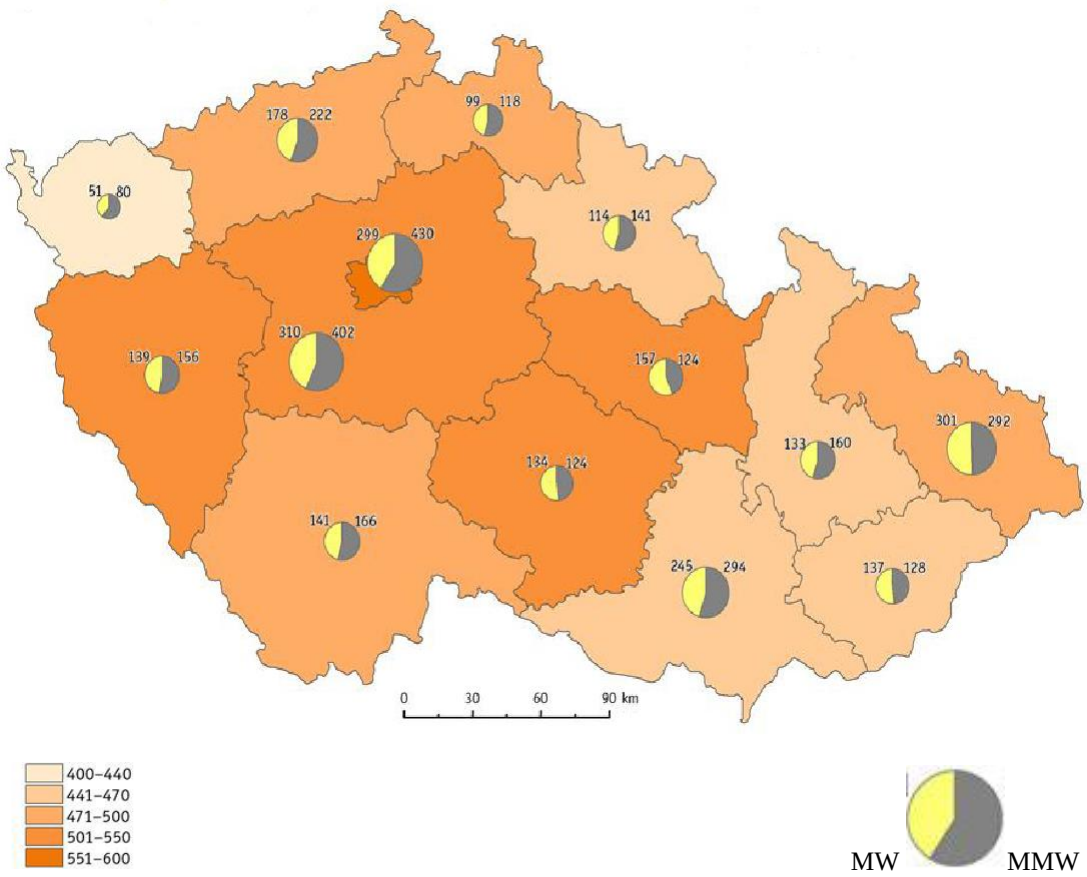

Fig. 6 Total production of municipal waste in kg per capita in regions of the Czech Republic, 2015. Source: [32]

The outlook for Czech waste management will be influenced by the new 2015–2024 WMP [30] that was adopted by the government on 22 December 2014 and came into force on 1 January 2015. Its targets are:

- to prevent and reduce specific waste generation;
- to minimise the adverse effects of waste generation and waste management on human health and the environment;
- the sustainable development of the Czech Republic and the further movement of the country towards the European concept of a recycling society;
- the maximum utilisation of waste as a substitute for primary resources, accompanied by a transition to a circular economy;
- to increase the amount of MW prepared for reuse and recycling to at least 50 % by weight of the amount generated, at least for paper, plastics, metal and glass from households, and possibly waste from other sources if such waste streams are similar to household waste;

- to use MW, after the removal of recoverable components, recyclable materials, hazardous substances and biodegradable waste, for energy recovery in facilities designed for this purpose in accordance with effective legislation;
- to reduce the quantity of biodegradable MW deposited in landfills by 2020 to a maximum of 35 % by weight of the total quantity of biodegradable municipal waste produced in 1995.

Regions and municipalities have had to draw up plans in compliance with the national WMP – there were 14 regional WMPs in place for the period 2004–2014 – and waste producers that generate more than 1,000 tonnes of non-hazardous waste or more than 10 tonnes of hazardous waste per year must also develop WMPs. Since the amendment of the Waste Act [31], from 2013 onwards these regional plans must comply with the national WMP. The national and regional WMPs include a strategy for the reduction of biodegradable waste going to landfills in line with the requirements of the national WMP and the objectives of the EU Landfill Directive, and this is gradually being implemented. All regional WMPs were adopted by July 2016. The Czech Republic reports data about compliance with the target according to Article 11 of the WFD [1] and uses method 2. According to the reported data, the MW recycling rate in 2015 was 48.3 % (MoE), and it is anticipated that the obligatory target of 50 % will be reached in 2020.

Problems will arise with the amount of recyclable MW, as its recyclable potential is decreasing because of the Waste Prevention Programme (WPP) that was approved by the government in October 2014 (Government resolution no. 869/2014) and has subsequently become part of the new WMP [30]. The main goal of the WPP is to create the conditions for the lowering of the consumption of primary resources and the gradual reduction of MW generation. The objectives and measures are part of the binding section of the 2015–2024 WMP. The WPP places particular emphasis on research, development and technological innovation that can reduce waste generation during production.

Conclusion

Large differences exist between EU MSs with respect to their waste management performance, particularly as regards the recycling of MW. The EP proposed on March 14, 2017 that in order to take account of those differences, those MSs which recycled less than 20% of their MW in 2013 (see Table 5) and which were not considered at risk of failing to achieve the target of preparing for the reuse and recycling of at least 50% of their MW by 2025, should be given additional time to comply with the preparations for the reuse and recycling targets established for 2025 [7]. Those same MSs could also be given additional time to comply with the preparations for the reuse and recycling targets established for 2030 if they are not considered at risk of failing to achieve the target of reusing and recycling at least 60 % of their MW by 2030 [7]. In the light of average annual progression rates observed in MSs over the past fifteen years, those MSs would need to increase their recycling capacity to levels that are well above past averages to meet those targets. In order to ensure that steady progress towards the targets is made and that implementation gaps are tackled in due time, MSs that are given additional time should meet interim targets and establish implementation plans, the effectiveness of which should be assessed by the EC on the basis of defined criteria.

Despite separate collection, a lot of recyclables still end up in mixed municipal waste, see Table 7. With high-quality sorting, especially optical sorting, a considerable amount of materials can be sorted from the residual waste and subsequently recycled and reprocessed into secondary raw materials. MSs should thus also take measures to ensure that waste which is not separately collected is nevertheless sorted.

In order to ensure the uniform calculation of data on preparations for meeting reuse and recycling targets, the EC should adopt detailed rules on the determination of recognised preparations for reuse operators, deposit-refund schemes and final recycling operators, including specific rules on collection, traceability, verification and the reporting of data, as well as on the quality criteria for metals that have been recycled in conjunction with incineration or co-incineration. For the purposes of calculating whether the preparations for reuse and recycling targets have been carried out, and after the adoption of the harmonised calculation method, MSs should be able to take into account ways of recycling metals that take place in conjunction with incineration or co-incineration, such as energy recovery.

Compliance with the obligation to set up separate collection systems for paper, metal, plastic, glass, textile and biowaste is essential in order to increase preparations for achieving agreed reuse and recycling rates in EU MSs. In addition, biowaste should be collected separately and recycled in order to contribute to an increase in preparations to meet target reuse and recycling rates, and to the protection of dry recyclable materials from contamination, as well as to prevent incineration and landfilling. In addition, research into possible collection and recycling systems for other waste streams and new materials should be encouraged and intensified.

Reference list

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