



Annex 2

Development of new baselines and data reconciliation and update

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Prepared by / compiled by: Malin Zu Castell-Rudenhause (VTT), Ann Van der Linden (VITO), Alessio D'Amato (SEEDS), Francesco Nicolli (IRCRES)

EEA project manager: Almut Reichel – Stefan Speck

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Data update - methodology

The European Reference Model on Municipal Waste Generation and Management aims to support the assessment of the performance of Member States' municipal solid waste management systems, and how they are likely to perform in the future. The model can serve as a tool to compare different future policy scenarios from a broad perspective, including both financial and environmental aspects. Moreover, it is intended to be used as a tool for the early warning system proposed by the European Commission within its 2015 Circular Economy Package, aimed at identifying countries that are at risk of missing the European Union targets on recycling municipal solid waste (MSW) and packaging waste, and the targets on the diversion of waste from landfill.

Key model data were last updated in 2017, a task performed by the waste management team of the European Topic Centre on Waste and Materials in a Green Economy (ETC/WMGE), commissioned by the EEA. The necessary data were collected by a consortium led by Eunomia Research & Consulting as part of a study¹ for the European Commission to identify Member States at risk of non-compliance with the 2020 recycling target of the Waste Framework Directive.

The ETC/WMGE, in cooperation with Eunomia, prepared a questionnaire requesting up-to-date statistics, as well as information on expected future developments, and strategies on the management of MSW in Member States. The questionnaire aimed to update the most relevant data in the model, and to broaden knowledge of Member States' MSW management systems. An update is a key step in the modelling process, and also provides the best possible representation of country characteristics when it comes to designing the early warning system.

The questionnaire was divided into three sections:

- the current situation, including MSW composition, generation and treatment in place, as well as existing treatment capacities;
- expectations for the future, including projections of MSW generation, details of policies under implementation that will have an impact in the near future, future treatment capacity, and planned and potential changes to the collection systems;
- recently implemented and planned measures for increasing MSW recycling rates.

Eunomia collected data through the questionnaires and meetings with Member State representatives. The updates to the model's data were mainly done through analysis of the returned questionnaires, and included MSW generation, composition and treatment data, as well as the baseline scenario for estimated future developments in MSW generation and management.

The questionnaires were analysed and requests for clarification and additional information were sent to the Member States through Eunomia. The final answers were then analysed by the ETC/WMGE waste management team. The questionnaires were analysed for inconsistencies, which were corrected based on the most reliable data, and gaps were filled based on the 2015 version of the model or other available data. For the adjustments and gap filling, an understanding of the quality and level of uncertainty in the data was important. One key element of the analysis of the questionnaires was respect for Member States' answers. Thus, whenever the country answers were not contradictory in any sense, they were used for the update of the model.

¹ Early Warning Mechanism - Study to Identify Member States at Risk of Non-compliance with the 2020 target of WFD and to Follow-up the Compliance Promotion Exercise Phase 1 and 2, under Framework Contract ENV.C.2/FRA/2013/0023).

After analysing the data, the ETC/WMGE team modelled a set of baselines. ETC/WMGE and EEA waste management experts first analysed the questionnaire answers and other available data and information, and then formed an expert opinion on the most likely scenario for the future generation and management of MSW in each Member State. This scenario presents a critical view of the effects of policy measures under implementation or firmly planned, and planned capacity. Thus, it is one of several possible futures, helping to identify the potential risk of not meeting the target for recycling and forming a basis for discussion.

Appendices 1-8 show the key updated data as fed into the model.

Austria – Baseline modelling and data updates

The Federal Ministry of Agriculture and Forestry, Environment and Water Management of Austria kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Austria reported waste composition as percentages of the total municipal solid waste (MSW) stream, based on the national waste management plan². All food and similar waste was included in the 'other biowaste' category, as food waste was not specified in the statistics. For the purpose of the modelling, it was assumed that – roughly – 50% of the biowaste is food waste and 50% is garden waste.

Municipal solid waste generation and management

Data provided by Austria on the management of MSW required no adjustment for use in the model.

Recycling tonnage

The data provided on the tonnage of materials collected for recycling required slight adjustment as they were not quite in line with the data on MSW generation.

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of these categories, the model takes account of three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

Austria records no split for food waste, thus the shares used in the 2015 version of the model were used here: 26 per cent to OAW, 26 per cent to IVC and 48 per cent to AD. For garden waste Austria reported 47 per cent to OAW, 47 per cent to IVC and 7 per cent to AD. For other biowaste Austria reported 32 per cent to OAW, 32 per cent to IVC and 36 per cent to AD.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

For biogas from AD, Austria indicated that 47.5 per cent was used for AD 1, 47.5 per cent for AD 2, 4 per cent for AD 3, and 1 per cent for AD 4.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;

² <https://www.bmlfuw.gv.at/greentec/bundes-abfallwirtschaftsplan>

- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation

Austria reported 44 per cent MBT 1, 46 per cent MBT 2, and 10 per cent MBT 5.

Austria expects the amount sent direct to MBT 1 to decrease slightly to about 40 per cent in 2025, and the amount sent to MBT 2 to increase to about 50 per cent in 2025. The treatment split for MBT is thus updated in the model as shown in Table 1.

Table 1 Estimated development of mechanical biological treatment shares in Austria, 2015–2035

	2015	2020	2025	2030	2035
MBT 1, %	44	44	40	40	40
MBT 2, %	46	46	50	50	50
MBT 3, %	0	0	0	0	0
MBT 4, %	0	0	0	0	0
MBT 5, %	10	10	10	10	10

Incineration

The model includes four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Austria reported 6 per cent Incineration 1, 65 per cent Incineration 2, and 29 per cent Incineration 3.

Waste generation projections

Austria provided its own waste projections based on the projection done for the Austrian Federal Waste Management Plan 2017 (Table 2). The projections are calculated from historical time series and foreseeable changes in waste management, and are mainly based on estimates of population development. These projections are used in the waste model.

Table 2 Municipal solid waste generation projections for Austria, 2020–2035

	2020	2025	2030	2035
Reported projections, '000 tonnes	4 988	5 106	5 189	5 269

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

As can be seen in Table 3, Eurostat time series data on MSW recycling do not show a clear trend over recent years, and recycling rates have been stagnating or even declining.

Table 3 Municipal solid waste generation and treatment, 1995–2015

Austria	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	3 476	4 110	4 241	4 240	4 496	4 646	4 634	4 914	4 932	4 687	4 732	4 933	4 951	4 997	4 921	4 701	4 807	4 883	4 905	4 833	4 836
Material recycling, '000 tonnes	820	879	941	987	1 061	1 129	1 125	1 115	1 110	1 116	1 180	1 259	1 318	1 476	1 492	1 272	1 146	1 168	1 202	1 231	1 241
Composting and digestion, '000 tonnes	936	1 674	1 752	1 744	1 792	1 818	1 855	1 955	2 055	1 572	1 577	1 661	1 661	1 683	1 553	1 520	1 578	1 650	1 627	1 492	1 511
Recycling rate, %	51	62	63	64	63	64	62	64	57	58	59	59	60	63	62	59	57	58	58	56	57
Increase in recycling rate, percentage points	0	12	1	1	-1	0	1	-2	2	-7	1	1	1	3	-1	-2	-3	1	0	-1	1

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations (08/05/2017)

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

In updating the baseline, consideration was given to Austria's waste management systems and performance in past decades, and it has been assumed that treatment shares will remain more or less stable after 2020.

Collection systems

Austria primarily has a door-to-door collection system for paper, plastics and biowaste. In some municipalities, there is also a door-to-door system for glass, and in some a co-mingled system for metal and plastic packaging. There is a bring-point system, which is the primary system for metal and glass, but also for collection of plastics and, in some municipalities, paper. Civic amenity sites collect all different fractions of MSW and in addition there is a deposit-refund system for glass and plastic beverage bottles.

Treatment capacity

Austria currently has a small overcapacity for all treatment options and has no ambition to increase them.

Measures for increasing municipal solid waste recycling

The following key measures have been introduced:

- Ordinance on Waste Electrical and Electronic Equipment (WEEE) – reuse provision for civic amenities. Increased share of preparation of reused WEEE.
- Waste prevention programme – reuse initiatives, awareness-raising campaigns, support of reuse and repair centres. Increased share of preparation for reuse, for example for furniture, toys and sports equipment.
- Waste Treatment Obligations Ordinance, 2018: improvement in recycling of specific waste streams.
- Extending the share of separately collected waste:
 - paper and plastic packaging through door-to-door systems in specific areas;
 - in specific areas plate glass, hard plastics such as garden furniture, and wax from candles.

Waste generation and treatment scenario

Based on the information above, a baseline scenario for the future generation and management of MSW has been developed. This presents a critical view of the effects of the policy measures and planned capacity. It takes into account the possibility that not all planned measures will be fully implemented. The scenario thus presents one of several possible future developments, helping to identify potential risks of not meeting the recycling target, and serving as a basis for discussion.

Austria's waste policy focuses on waste prevention, reuse, and increasing the separate collection of some specific (smaller) waste streams. The effect of waste prevention measures is assumed to be included in the waste generation projections provided. The effect of targeting separate collection of specific smaller waste streams is assumed to be small. An increase of 1 percentage point in waste collected for recycling of dry materials by 2020 is assumed in the baseline, with little or no increase thereafter. No increase in waste collected for biowaste treatment is assumed as Austria has no specific plans to increase it further. As the country is relying on its current treatment capacity, it can be assumed that it considers the current waste management system to be optimal, or at least sufficient, and has no ambition to change it.

Table 4 Baseline for the first treatment of municipal solid waste in Austria, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	4 836	4 988	5 106	5 189	5 269
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	32	33	33	33	33
Collection for biowaste treatment, %	32	32	32	32	32
Direct to MBT and mixed sorting, etc., %	10	9	9	9	9
Direct to incineration, %	26	25	25	25	25
Direct to landfill, %	1	1	1	1	1

Note: shares might not sum to 100% due to rounding.

Belgium – Baseline modelling and data updates

The Public Waste Authority of Flanders (OVAM) kindly provided data and information for the update of the waste model by answering a questionnaire, thereby collating data and information for Brussels, Flanders and Wallonia. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Belgium reported waste composition for both the composition of mixed (residual) municipal solid waste (MSW) as for total MSW. It is mainly waste from households, but for some regions includes mixed waste from small enterprises which is collected by the municipality. The composition of this waste is provided for 2015. The composition for total MSW reported by Belgium is used in the model.

Municipal solid waste generation and management

No adjustments were needed to the data Belgium provided for the model.

Recycling tonnage

The data on tonnage of materials collected for recycling was slightly adjusted from those provided. The data on MSW generation and treatment referred to MSW and was not fully consistent with the reported amounts of material collected for recycling, as the latter only refers to household waste.

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of these categories, the model takes account of three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

For food waste, Belgium reported 100 per cent to AD. For garden waste, it reported a split across the three types: 90 per cent to OAW, 9 per cent to IVC, and 1 per cent to AD. For other biowastes, Belgium reported that 70 per cent went to IVC, and 30 per cent to AD.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – Gas to flaring only.

Belgium reported 100 per cent use of AD 2 for the biogas resulting from the treatment of separately collected food waste, separately collected garden waste and other biowastes.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;

- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation

Belgium reported 63 per cent MBT 2 and 37 per cent MBT 5.

The predominance of MBT 2 as a treatment option reflects how these facilities operate in Belgium. Within the facilities, metals and inert materials are separated from the waste, which is then dried and used as solid recovered fuel (SRF) for energy production.

Incineration

The model includes four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Belgium reported 98 per cent Incineration 1, and 2 per cent Incineration 4.

A shift is expected from Incineration 1 to Incineration 2:

- starting from 2016, all the waste from the Brussels region, approximately 11 per cent of Belgium’s incinerated waste, was moved from Incineration 1 to Incineration 2;
- in 2020 the Pont-de-Loup incineration facility will be updated to use 100 per cent of the energy recovered for CHP (Incineration 2);
- construction of an urban heating network in Liège is planned for 2021.

Based on this information, the model assumes that there is a change in the incineration split by 2020, from 98 per cent electricity generation only to 78 per cent CHP by 2020.

Waste generation projections

Belgium did not provide own waste generation projections, so the model uses the updated projections produced by the ETC/WMGE for the EEA. The ETC/WMGE projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 5 Municipal solid waste generation projections for Belgium, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes	5 002	5 002	5 020	5 065

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

The recycling rate in Belgium is high. A recycling rate greater than 50 per cent has been achieved since 2008. The rate shows some fluctuations since then, but in the last 10 years has never dropped below 53 per cent.

Table 6 Municipal solid waste generation and treatment, 1995–2015

Belgium	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	4 613	4 567	4 650	4 603	4 702	4 830	4 802	4 981	4 824	5 059	5 052	5 115	5 243	5 134	5 037	4 973	5 035	4 969	4 891	4 788	4 708
Material recycling, '000 tonnes	513	647	815	1 038	1 163	1 245	1 305	1 365	1 336	1 408	1 547	1 601	1 741	1 664	1 697	1 672	1 707	1 600	1 548	1 578	1 615
Composting and digestion, '000 tonnes	363	495	759	850	951	1 091	1 030	1 098	1 123	1 208	1 173	1 190	1 236	1 047	1 025	1 057	1 028	1 038	1 031	970	901
Recycling rate, %	19	25.0	33.8	41.0	45.0	48.4	48.6	49.4	51.0	51.7	53.8	54.6	56.8	52.8	54.0	54.9	54.3	53.1	52.7	53.2	53.4
Increase in recycling rate, percentage points	0	6.0	8.8	7.2	3.9	3.4	0.3	0.8	1.5	0.7	2.1	0.7	2.2	-4.0	1.2	0.8	-0.6	-1.2	-0.4	0.5	0.2

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations (08/05/2017)

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

The share of Belgium's MSW sent direct to landfill is small, at less than 1 per cent per year since 2011.

Collection systems

In Belgium door-to-door collection is the primary system for paper and biowaste. Co-mingled plastics and metals are also collected door-to-door, but combined with composite materials. Glass is mainly collected through bring points, which are also the secondary system for paper, plastics and metals. Reusable glass beverage bottles are collected through a producer/retail take-back system. All fractions are also accepted at civic amenity sites.

Treatment capacity

Belgium has firm plans to build a further capacity of 40 000 tonnes for AD of biowaste by 2019, and additional material sorting facilities for plastics by 2018, but did not provide information on the capacity for these.

Measures for increasing municipal recycling

Belgium is planning the following measures to improve overall recycling performance:

- The separate collection of mixed plastics in Flanders and Wallonia, covering 90 per cent of Belgian inhabitants, in 2018. Based on sorting analysis, this should decrease residual mixed waste by 7–10 percentage points, the equivalent of 2–3 per cent of the total MSW generated in Flanders. This measure will increase the recycling of plastics.
- From 2015, an obligation on companies in Wallonia, 32 per cent of Belgium's population, to sort recyclable wastes. This will increase the separate collection of recyclables.
- Introduce door-to-door collection of paper and cardboard in containers (Pilot 2015–2016), with implementation in 20 Walloon municipalities in 2017. This measure should increase the quality of the waste.
- Introduce separate collection of food waste in Brussels and Wallonia, covering 42 per cent of Belgium's inhabitants, from 2016 in Wallonia and 2017 in Brussels – this is already implemented in Flanders.

Waste generation and treatment scenario

Based on the above measures, an estimate is made of future recycling rates. With the additional selective collection of plastics indicated by Belgium, it is assumed that there will be a 2 percentage point increase in collection for dry materials recycling by 2020. As far as the separate collection of biowaste is concerned, it is assumed that this will increase by 7 percentage points by 2025 based on the (planned) implementation of the separate collection of food waste in Wallonia and Brussels. This calculation is based on the relative populations of Flanders where this is common practice, and Wallonia and Brussels, where these collections were introduced in 2016 and 2017, and expert judgement.

The obligation on companies in Wallonia to sort recyclable waste has not been taken into account as this measure is likely to have hardly any effect on the amount of MSW but will mainly improve the quality of recycled materials.

Regarding the implementation of door-to-door collection of paper and cardboard in 20 municipalities in Wallonia, it is assumed that this will not have a significant effect on the overall collection of dry recyclables during the pilot phase³.

As regards final treatment, it is assumed that the selective collection of different recyclable wastes will result in a decrease in the total amount of residual waste. This is split across MBT and incineration using the same proportions as in the final treatment of residual waste. For landfill, it is assumed that the share of residual waste going directly to landfill will stay the same, at 0.3 per cent of MSW. Table 7 shows the assumed development of shares of MSW by the first treatment step, representing the best estimate based on the provided data and information, and expert judgement on the likely effects of the implementation of planned policy measures.

Table 7 Baseline for the first treatment of municipal solid waste in Belgium, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	4 889	5 002	5 002	5 020	5 065
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	39	41	41	41	41
Collection for biowaste treatment, %	20	25	27	27	27
Direct to MBT and mixed sorting, etc., %	3.6	3	2.6	2.6	2.6
Direct to incineration, %	38	31	30	30	30
Direct to landfill, %	0.3	0.3	0.3	0.3	0.3

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Belgium's share of MSW collected for dry materials recycling and biowaste treatment will reach 66 per cent by 2020, rising to 68 per cent by 2025. This is based on the planned measures to increase recycling rates.

³ Based on the assumption that there are 262 municipalities in the Walloon region, and that this measure will affect a limited number of people.

Bulgaria – Baseline modelling and data updates

The Ministry of environment and water of Bulgaria kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Bulgaria reported data on waste composition from the national waste management plan. The original data are divided by the size of the urban settlement. For the waste model, the weighted average of each group was taken, with the weight being population.

Table 8 Municipal solid waste composition, 2012

Urban settlements	Below 3 000	3 000– 25 000	25 000– 50 000	50 000– 150 000	>150 000	Weighted average
Population in each category of urban settlement	1 988 772	1 347 264	607 083	1 254 935	2 086 498	
Food, %	15.6	23.2	28.0	30.6	28.9	24
Paper, %	6.1	8.5	8.1	9.4	11.4	9
Cardboard, %	4.0	5.5	6.9	8.2	9.4	7
Plastics, %	10.3	10.1	12.8	15.4	11.3	12
Textiles, %	2.0	3.7	2.9	2.9	2.8	3
Rubber, %	1.0	0.9	1.0	1.0	0.9	1
Leather, %	1.0	0.9	1.0	1.0	0.9	1
Parks and gardens, %	30.9	21.7	13.1	11.0	11.0	18
Wood, %	2.9	2.0	2.9	2.1	2.0	2
Glass, %	2.4	6.1	7.0	7.8	9.2	6
Metals, %	1.9	2.0	2.0	2.0	1.9	2
Inert, %	21.3	14.8	13.7	8.0	9.7	14
Hazardous, %	0.6	0.6	0.6	0.6	0.6	1
Total	100.0	100.0	100.0	100.0	100.0	100

Note: shares might not sum to 100% due to rounding.

Municipal solid waste generation and management

The data provided by Bulgaria in the questionnaire were used for the update; no adjustments were needed. Data refer to total municipal solid waste (MSW).

Recycling tonnage

The data provided by Bulgaria on recycling tonnages were not consistent with the data on MSW generation and management, and were therefore adjusted for the purpose of the waste model. The amount of metals reported as recycled included metals from sources other than MSW and was therefore reduced to 50 per cent of the generated amount, calculated from the waste composition. In addition, Bulgaria did not split recycled biowaste into food and garden waste. The data on waste composition was used to calculate these.

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of these categories, the model takes account of three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and

- anaerobic digestion (AD).

Bulgaria did not provide updated information, therefore the estimates in the 2015 version of the model were retained.

Table 9 Biowaste treatment shares

	Food waste	Garden waste	Other biowaste
OAW, %	26	38	33
IVC, %	26	38	33
AD, %	48	24	34

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

Bulgaria reported 100 per cent use of AD 2.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation

Bulgaria reported a split of 70 per cent MBT 1, and 30 per cent MBT 4. Bulgaria expects a shift towards AD-based treatment in the future but the available information did not allow to make a quantified estimate, therefore the shares of MBT 1 and MBT 4 are kept constant over time in the model.

Incineration

The model includes four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Bulgaria reported 100 per cent Incineration 2. This is only a proxy as Bulgaria does not have MSW incineration plants at the moment. Some cement plants, however, are permitted to use refuse-derived fuel (RDF) from MSW as an energy source.

Waste generation projections

Bulgaria has provided waste generation projections up to 2035, summarised in Table 10. These were used to update the waste model.

Table 10 Municipal solid waste generation projections for Bulgaria, 2020–2035

	2020	2025	2030	2035
Reported projections, '000 tonnes	2 401	2 455	2 492	2 497

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

Overall, recycling volumes in Bulgaria increased between 2005 and 2015 (Table 11). However, the reporting methodology was changed in 2013 when the activities of the informal sector were included in the recycled amounts.

Table 11 Municipal solid waste generation and treatment, 1995–2015

Bulgaria	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	5 838	5 165	4 809	4 880	4 910	4 998	4 773	4 715	4 690	4 619	4 502	4 387	4 172	4 486	4 449	4 094	3 732	3 364	3 135	3 192	3 011
Material recycling, '000 tonnes	0	0	0	776	769	775	770	770	774	793	822	839	858	871	887	1 003	895	749	787	677	573
Composting and digestion, '000 tonnes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84	92	107	59	311	
Recycling rate, %	0	0	0	16	16	16	16	16	17	17	18	19	21	19	20	24	26	25	29	23	29
Increase in recycling rate, percentage points	0	0	0	16	0	0	1	0	0	1	1	-1	1	-1	1	5	2	-1	4	-5	6

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/09/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Collection systems

Bulgaria reported that the country's primary collection system is a bring system for all the main dry recyclables, using two or three containers for paper/card, glass, plastics and metals. Trials of door-to-door biowaste collection are ongoing.

The collection system is expected to change. It is planned to increase the number of bring points, to expand coverage of the separate collection system to a larger share of the population, to improve requirements for civic amenity sites, and to introduce separate collection of biowaste. In addition, according to the Municipal Taxes and Fees Act, a pay-as-you-throw system is expected to be introduced by 2018, stimulating separate collection.

Treatment capacity

With funding from the European Commission's Operational Programme Environment 2007–2013, composting facilities with a total capacity of 219 336 tonnes per year and material sorting facilities with a total capacity of 731 215 tonnes per year have been built, while 607 400 tonnes per year of RDF are permitted for co-incineration.

Additional treatment capacity is planned for 2023, with an annual capacity of 105 000 tonnes for biowaste; 45 000 tonnes for AD; 400 000 tonnes for MBT; and 180 000 tonnes for co-incineration.

Bulgaria expects all these measures to lead to an increase in recycling rates of at least 15 percentage points.

Measures for increasing municipal solid waste recycling

Bulgaria reported several initiatives.

The Waste Framework Directive (WFD) was incorporated into national law by the Waste Management Act (WMA) of 13 July 2012, which applies at the national level. Mayors of municipalities are responsible for organising household and construction waste management, including collection and pre-treatment of separated waste, within their jurisdictions. More specifically, Article 19(3) of the WMA states that a mayor is

responsible for:

- providing containers for collection of household waste – bins, buckets, etc.;
- the collection of household waste and transport to landfill sites or other facilities for recovery and/or disposal;
- the construction, operation, monitoring and closure of landfill sites, other installations or facilities for recovery and/or disposal of MSW;
- the separate collection of household waste in the municipality for at least paper and cardboard, metals, plastics and glass;
- the separate collection and storage of household biodegradable waste, including determining the location of the necessary elements for separate waste collection, and its transfer to composting or AD treatment;
- providing recycling sites for free delivery of separately collected household waste, including bulky and hazardous waste in all settlements with populations greater than 10 000 within the municipality, and, where appropriate, in other settlements;
- providing information to the population on waste management through a municipality website and other appropriate means.

Article 31 of the WMA provides that each region must establish systems for separate collection, reuse, recycling and recovery of waste, with the following targets:

- no later than 1 January 2020: preparation of at least 50 per cent by weight of waste materials for reuse and recycling, including paper and cardboard, metal, plastic and glass from households and similar waste from other sources;
- no later than 31 December 2020: limiting the amount of biodegradable MSW sent direct to landfill to 35 per cent of the total amount of biodegradable MSW generated in Bulgaria in 1995.

The WMA introduced economic instruments for covering future expenditure for the closure and post-operational activities of landfill sites, for stimulating the prevention of waste generation and for the recovery of waste prior to landfill.

Waste generation and treatment scenario

Based on the information described above, a baseline scenario for the future generation and management of MSW was developed, presenting a critical view of the effects of policy measures and planned capacities. It takes into account the possibility that not all planned measures will be fully implemented or that there will be delays in setting up new treatment capacity. The scenario thus presents one view of possible future developments, helping to identify potential risks of not meeting the recycling target, and is a basis for discussion.

The extension of separate collection for biowaste and dry recyclables, the creation of new treatment capacity for composting and AD, and the sorting of recyclables and introduction of a pay-as-you-throw system can be expected to increase collection for dry materials recycling and biowaste treatment. There is, however, a risk that all these measures will take more time to be phased in and become effective. In the baseline, it is assumed that they will gradually come into effect over the next 10 years, leading to a share of MSW collected for dry materials recycling and biowaste treatment of 42 per cent by 2025. In addition, new planned MBT capacity is expected to substantially increase waste sent direct to MBT by 2025. Thereafter it is assumed that the treatment shares will remain stable.

Table 12 Baseline for the first treatment of municipal solid waste in Bulgaria, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	3 011	2 401	2 455	2 492	2 497
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	19	23	26	26	26
Collection for biowaste treatment, %	10	12	16	16	16
Direct to MBT and mixed sorting, etc., %	25	25	33	33	33
Direct to incineration, %	3	3	3	3	3
Direct to landfill, %	43	37	22	22	22

Note: shares might not sum to 100 % due to rounding.

Croatia – Baseline modelling and data updates

The Ministry of Environment and Energy of the Republic of Croatia kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Croatia reported its municipal solid waste (MSW) composition based on the total MSW stream. The composition of this waste was provided for 2015.

Municipal solid waste generation and management

Croatia provided data on amounts of MSW generated and management. It provided information on the management of 99 per cent of the generated MSW; the remaining 1 per cent being amounts in temporary storage, waste disposed of in non-final disposal operations (D8-D11, D13, and D15), and estimated amounts from those parts of the population not covered by organised collections. As the model cannot deal with these operations, a small adjustment was made, in which this 1 per cent was distributed *pro rata* across the treatment options.

Recycling tonnage

The data provided by Croatia on tonnage of materials collected for recycling were adjusted for use in the model as the figures were not fully consistent. The reported amounts of single materials collected for recycling and biowaste treatment were adjusted so that they match with the total amount of MSW that has reported as being collected for recycling and biowaste treatment.

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of these categories, the model takes account of three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC);
- anaerobic digestion (AD).

For food waste Croatia reported 97 per cent going to OAW and 3 per cent to AD. For garden waste it reported a similar split: 98.7 per cent to OAW and 1.3 per cent to AD. No information was provided for other biowaste, but as Croatia reported the separate collection of this waste, the assumption in the model is that 98 per cent is treated in OAW and 2 per cent in AD.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – Gas to flaring only.

Croatia did not report on the type of treatment used for biogas. The same type of treatment was assumed as in the previous version of the model (100% AD 1).

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation

The type of MBT used in Croatia was not specified, but based on the description provided, MBT 2 seems to be most in line with the type used in Croatia.

Incineration

The model includes four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Croatia sends no MSW direct to incineration and does not expect this to change in the immediate future. Waste flows are likely to change significantly over the coming five years during implementation of Croatia's waste management plan (WMP). As a result, Croatia decided that the need for energy recovery should be analysed in the light of new waste data at the end of the WMP period.

Waste generation projections

Croatia provided projections up to 2030, summarised in Table 13. These were supplemented by an ETC/WMGE projection for 2035, and were used to update the waste model. The ETC/WMGE projection is based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 13 Municipal solid waste generation projections for Croatia, 2020–2035

	2020	2025	2030	2035
Reported projections, '000 tonnes	1 674	1 802	2 003	
ETC/WMGE projections, 000 tonnes				2 244

Source of reported MSW projections: <http://www.azo.hr/lgs.axd?t=16&id=5981>

Projections were calculated as one of the results of the project for the *Development of the unique methodology for analyses of the municipal waste composition and determination of the average municipal waste composition in the Republic of Croatia and of the projections of the amounts of municipal waste (cro. Izrada jedinstvene metodologije za analize sastava komunalnog otpada, određivanje prosječnog sastava komunalnog otpada u RH i projekcija količina komunalnog otpada)*, which was conducted by the Croatian

Agency for the Environment and Nature in 2015. The projections do not take into account waste prevention measures.

Baseline scenario

The recycling rate in Croatia, at 18 per cent in 2015, is rather low. Although it rose from 4 per cent to 15 per cent between 2010 and 2012, yearly increases have since been modest as data from Eurostat shows (Table 14).

Table 14 Municipal solid waste generation and treatment, 1995–2015

Croatia	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes			1 015			1 173				1 311	1 449	1 654	1 719	1 788	1 743	1 630	1 645	1 670	1 721	1 637	1 654
Material recycling, '000 tonnes			0										39	35	28	53	123	220	228	236	270
Composting and digestion, '000 tonnes			0										15	15	12	13	14	26	29	34	28
Recycling rate, %			0										3.1	2.8	2.3	4.0	8.3	14.7	14.9	16.5	18.0
Increase in recycling rate, percentage points			0										3.1	-0.3	-0.5	1.8	4.3	6.4	0.2	1.6	1.5

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

The share of Croatia's MSW going directly to landfill is high at 80 per cent.

Collection systems

In Croatia the primary collection system for paper, glass, and co-mingled plastic packaging and metal cans is through bring points, but there is also a door-to-door collection system for paper. Croatia also has producer/retail take-back systems in place for paper and cardboard packaging, glass bottles (>0.2l), polyethylene terephthalate (PET) bottles (>0.2l) and cans labelled as refundable packaging. All these are also accepted at civic amenity sites.

This is expected to change in the coming years as a result of introducing a door-to-door collection system as widely as possible.

Treatment capacity

Croatia expects to make significant changes in its biowaste treatment capacity. As separate collection of biowaste is already prescribed by the Act on Sustainable Waste Management (OG 94/13), and the new national WMP defines measures regarding separate collection and treatment, an increase in separate biowaste collection of up to 40 per cent is expected by 2022. For now, the distribution between technologies is hard to estimate because project preparation is still ongoing. Croatia expects additional biotreatment capacity of 200 000 tonnes per year by 2022. Because the installation planning is still at an initial phase there are no details about the types of facility. Therefore a similar split to that of 2015 is assumed.

Croatia also plans a significant increase in MBT capacity. MBT plants with a total capacity of 280 000 tonnes per year were available in 2017, although partly still in trial runs. According to the WMP, an additional 10 waste management centres are planned with a total treatment capacity of 740 000 tonnes per year. For these, feasibility studies are either in preparation or are yet to be undertaken, and there is no information available on technologies and exact capacities. For the model, it is therefore assumed that all new installations are of the same type as the recently installed MBT plants (MBT 2).

Measures for increasing municipal solid waste recycling rates

Croatia's 2017–2022 WMP includes recycling targets as well as basic mechanisms for municipalities, such as funding, for setting up new collection systems. The Ordinance on Municipal Waste Management will

introduce/prescribe conditions for a detailed system for the separate collection of waste. The ordinance is currently in the preparatory process for adoption by the Croatian government.

Croatia has planned/implemented the following measures to improve the overall recycling performance:

- the introduction of obligatory separate collections for each local government unit;
- the introduction of pay-as-you-throw schemes;
- the introduction of door-to-door collection systems from 2018;
- co-financing of equipment for separate collection.

According to the WMP, these measures should increase collection for recycling, so that in 2022, 60 per cent of all paper, glass, plastic, metal, biowaste and bulky waste contained in MSW would be collected separately.

For the separate collection of biowaste, Croatia has planned the co-financing of collection equipment for separate collection. According to the WMP, the amount of separately collected biowaste is expected to increase steeply, so that in 2022, 60 per cent of all biowaste in MSW will be separately collected (up from 11 per cent in 2015).

Waste generation and treatment scenario

Based on the information described above, a baseline scenario for the future generation and management of MSW was developed, presenting a critical view of the effects of policy measures and planned capacities. It takes into account the possibility that not all planned measures will be fully implemented or that there will be delays in setting up new treatment capacity. The scenario thus presents one view of possible future developments, helping to identify potential risks of not meeting the recycling target, and is a basis for discussion.

Croatia estimates that, by 2022, 60 per cent of all paper, glass, plastic, metal, biowaste and bulky waste contained in MSW will have been separated at source. Based on the waste composition data provided by Croatia, where these waste fractions (excluding bulky waste) together account for 82 per cent of total MSW, this would mean that 50 per cent of total MSW will have been separated at source. This would require an increase in separate collection of 4.6 percentage points every year between 2015 and 2022, and seems to be very high given the current situation and past development. Data across European countries shows that the greatest increase rates in total recycling were 3–4 percentage points annually over a period of five years, and just below 3 percentage points over a 10-year period⁴. In addition, the substantial planned increase in MBT capacity might hinder the expansion of separate collection.

Therefore, an annual 1 percentage point increase in the rates of waste collected for recycling for both biowaste and dry materials recycling up to 2025 is assumed in the baseline scenario, based on expert judgement and past practice.

Significant growth is expected in the amounts of waste going directly to MBT, based on the information provided by Croatia. For the baseline, it is assumed that the capacity that in 2017 was still in trial stage is fully operational and fully used in 2020. It is further assumed that the additional planned capacity of 740 000 tonnes per year will be operational by 2025 (i.e. with some delay compared to the WMP schedule). The main impact of this additional treatment is expected to be a reduction in the amounts of waste going directly to landfill.

⁴ EEA, 2013, Managing municipal solid waste – a review of achievements in 32 European countries, EEA report No 2/2013, European Environment Agency

Table 15 Baseline for the first treatment of municipal solid waste in Croatia, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	1 653	1 674	1 802	2 003	2 244
Collection coverage, % of population	99	100	100	100	100
Collection for dry materials recycling, %	16	21	26	26	26
Collection for biowaste treatment, %	2	7	12	12	12
Direct to MBT and mixed sorting, etc., %	1	17	57	57	57
Direct to incineration, %	0	0	0	0	0
Direct to landfill, %	81	55	5	5	5

Note: shares might not sum to 100% due to rounding.

As a result, the share of MSW collected for dry materials recycling and biowaste treatment will reach 28 per cent by 2020, rising to 38 per cent by 2025 in the baseline scenario.

Cyprus – Baseline modelling and data updates

The Department of Environment of Cyprus kindly provided data and information for the update of the waste model by answering a questionnaire. Most of the data had no reference year, but when indicated was mainly from 2012, 2013 and 2017. Data from unknown years was allocated a year by reference to the time-linked data. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

The data provided on waste composition are assumed to refer to total municipal solid waste (MSW) and relate to 2012. The figures provided by Cyprus were slightly adjusted for use in the model, as no breakdown of biowaste into food waste and garden waste was provided; shares from the 2015 version of the model were used. Only absolute amounts of separately collected waste electronic and electrical equipment (WEEE), batteries and accumulators were provided. As this information does not allow to calculate their share of total MSW, they are not included in the composition data used in the model.

Municipal solid waste generation and management

The data reported by Cyprus double counted waste undergoing mechanical and biological treatment (MBT) by including it in waste collected for recycling and waste sent directly to landfill. The share of waste collected for biowaste treatment was therefore estimated based on amounts of waste reported as recycled (see below), and the remaining double-counted waste was removed from the share directly sent to landfill.

Recycling tonnage

Cyprus provided data on dry materials sent to final recyclers. The model then uses reject rates to calculate the corresponding amounts of materials separately collected for recycling.

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of the biowaste categories, the model takes account of three different treatment technologies:

- open air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

For garden waste, Cyprus reported a share of 80 per cent to OAW and 20 per cent to IVC, and no information was provided on food and other biowaste because these are currently not collected separately in Cyprus. Treatment splits for food and other biowaste were therefore kept the same as in the 2015 version of the model.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

Cyprus indicated 100 percent AD 2.

Mechanical biological treatment

The model includes the following five variants of MBT:

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation

No data were reported on the types of MBT in use, thus the data from the 2015 version of the model were used (100 per cent MBT 1).

However, Cyprus reported that a second MBT facility was to begin operation in 2017, servicing the Limassol and Paphos districts with a total capacity of 140 000 tonnes (MBT 5). Estimates of future MBT treatment shares (Table 16) take into account the existing MBT 1 capacity of 160 000 tonnes.

Table 16 Mechanical biological treatment shares in Cyprus, 2015–2035

	2015	2020	2025	2030	2035
MBT 1, %	100	53	53	53	53
MBT 2, %	0	0	0	0	0
MBT 3, %	0	0	0	0	0
MBT 4, %	0	0	0	0	0
MBT 5, %	0	47	47	47	47

Incineration

The model includes four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Cyprus currently has no waste incineration plants.

Waste generation projections

Cyprus provided projections up to 2030, which are included in the model. Waste generation has been assumed (with the agreement of Cyprus) to be constant between 2030 and 2035.

Table 17 Municipal solid waste generation projections for Cyprus, 2020–2035

	2020	2025	2030	2035
Reported projections, '000 tonnes	589	634	688	688

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

As can be seen in Table 18, Cyprus has steadily increased its recycling rates over the past 10 years. However, the level of material recycling is still low, and the increase in composting and digestion results mainly from treatment of mixed MSW in MBT plants and only to a smaller extent from the separate collection of garden waste.

Table 18 Municipal solid waste generation and treatment, 1995–2015

Cyprus	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	387	400	411	418	426	436	456	465	481	498	508	521	540	573	589	571	572	568	533	524	541
Material recycling, '000 tonnes	0	11	13	12	13	13	14	15	15	16	19	22	28	42	49	61	72	70	70	71	72
Composting and digestion, '000 tonnes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	8	18	25
Recycling rate, %	0	3	3	3	3	3	3	3	3	3	4	4	5	7	8	11	13	14	15	17	18
Increase in recycling rate, percentage points		3	0	0	0	0	0	0	0	0	1	0	1	2	1	2	2	1	1	2	1

Note: material recycling = dry materials recycling.

Source: Eurostat database *Municipal waste by waste operations* [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Collection systems

Cyprus has a door-to-door collection system for paper and co-mingled packaging, and there is a bring-point system accepting paper, packaging, glass, plastics, metals and garden waste. There are plans to establish 28 civic amenity sites accepting all MSW fractions, of which four are currently in operation.

Treatment capacity

Cyprus introduced biowaste composting and digestion in 2012 and rates have been increasing annually since then. Cyprus reported having four composting plants with a total capacity of about 100 000 tonnes per year and two AD plants with a combined capacity of 80 000 tonnes per year, with a further AD facility expected to start operation in 2017. This indicates that considerable infrastructure able to treat separately collected biowaste has been built.

For material sorting, Cyprus reported having 26 sorting facilities with a total capacity of 160 000 tonnes per year. For residual MSW, Cyprus has one MBT plant with a capacity of 160 000 tonnes per year. A second MBT plant was expected to start operating in 2017 with a capacity of 140 000 tonnes per year. When the second plant is in full operation, Cyprus will have capacity to treat more than half of the generated MSW in MBT plants.

Cyprus has no waste incineration plant and reported no plans to construct a facility. The new MBT plant will produce solid recovered fuel (SRF).

Measures for increasing municipal solid waste recycling rates

Cyprus reported the following policy measures to increase recycling rates:

- legislation setting obligations on local authorities to meet recycling targets, with clear sanctions to ensure action is taken;
- co-funding programmes for separate collection of MSW;
- a co-funding programme promoting the introduction of pay-as-you-throw schemes;
- expansion of extended producer responsibility (for example, to include non-packaging paper);
- introduction of a landfill tax;
- consider mandating the separate collection of organic waste streams from waste producers;
- establishment of a data collection system;
- action to increase reuse and waste prevention activities;

- economic incentives aimed at increasing recycling.

Waste generation and treatment scenario

Based on the information above, a baseline scenario for the future generation and management of MSW has been developed. This presents a critical view of the effects of policy measures and planned capacity, and takes into account the possibility that not all planned measures will be fully implemented and that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify potential risks of not meeting the recycling target, and serves as a basis for discussion.

Regarding collection for dry materials recycling, it is assumed that there will be a 2 percentage point increase in by 2020, and a further 3 percentage point increase by 2025, as a combined result of the range of measures to increase the separate collection of dry recyclables. However, the effect of the measures is assumed to be limited in the scenario as they are partly still rather vague and their full implementation might be uncertain.

Cyprus is currently increasing its biowaste treatment infrastructure and introducing separate biowaste collection systems. While this is not very strict on door-to-door collection, it is rigorous on collection points, accounting for an increase in biowaste collection of 4 percentage points by 2020 and an additional 4 percentage points by 2025. In addition, with new MBT plants starting operation in 2017, a 40 per cent MBT and mixed sorting rate is expected by 2020. Finally, it is assumed that collection coverage will reach 100% in 2020.

Table 19 Baseline for the first treatment of municipal solid waste in Cyprus, 2013–2035

	2013	2020	2025	2030	2035
Total MSW generation, '000 tonnes	533	589	634	688	688
Collection coverage, % of population	94	100	100	100	100
Collection for dry materials recycling, %	16	18	21	21	21
Collection for biowaste treatment, %	2	6	10	10	10
Direct to MBT and mixed sorting, etc., %	21	40	40	40	40
Direct to incineration, %	0	0	0	0	0
Direct to landfill, %	61	36	29	29	29

Note: shares might not sum to 100% due to rounding.

Czech Republic – Baseline modelling and data updates

The Ministry of the Environment of the Czech Republic kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1-8.

Municipal solid waste composition

The Czech Republic's reported municipal solid waste (MSW) composition data is based on a sorting analysis of its residual MSW stream (mixed MSW only). This analysis covers only paper, metal, plastic, and glass – a total of just 29 per cent of residual MSW. The total MSW composition was therefore estimated as follows: the reported residual waste fractions were combined with the volumes reported for separately collected waste. For the other fractions, the data in the 2015 version of the model were used.

Municipal solid waste generation and management

The data provided by the Czech Republic had to be modified for input to the waste model because the treatment shares summed to only 95 per cent of the total generated amount. The fractions were adjusted to sum to 100 per cent.

Recycling tonnage

No data were provided on recycling tonnage, so for the purpose of modelling, data from the 2015 version of the model were slightly adjusted to be consistent with the provided 2015 data on MSW generation and treatment.

Biowaste treatment

In the waste model, biowaste is split into three categories: food waste, garden waste, and other biowaste. For each of the biowaste categories, the model takes account of three different treatment technologies:

- open air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

The Czech Republic did not provide updated information so the data from the 2015 version of the model were used: for food waste 25 per cent to OAW, 50 per cent to IVC, and 50 per cent to AD; for garden waste 50 per cent to OAW and 50 per cent to IVC; for other biowaste 33 per cent to OAW, 33 per cent to IVC, and 34 per cent to AD.

Anaerobic digestion

The model allows for five types of use for the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

The Czech Republic did not provide any information on the use of the biogas from AD, so the data from the 2015 version of the model were used: 100 per cent AD 1.

Mechanical biological treatment

The model includes the following five variants of MBT:

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation

The Czech Republic did not provide any information on types of MBT, so the data from the 2015 version of the model were used: 100 per cent MBT 5.

Incineration

The model includes four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

The Czech Republic reported 100 per cent Incineration 2.

Waste generation projections

The Czech Republic provided waste generation projections up to 2025. These were used in the model, supplemented by ETC/WMGE estimates up to 2035. The ETC/WMGE projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 20 Municipal solid waste generation projections for the Czech Republic, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes	5 276	5 224	5 273	5 269
Reported projections, '000 tonnes	5 340	5 300		
Data used in the model, '000 tonnes	5 340	5 300	5 273	5 269

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

Material and biowaste recycling volumes are on a generally rising trend.

Table 21 Municipal solid waste generation and treatment, 2002–2015

The Czech Republic	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000	4 615	4 603	4 652	4 439	3 979	3 846	3 812	5 324	5 362	5 388	5 193	5 168	5 324	5 274
Material recycling, '000	457	424	456	601	693	695	764	1 103	1 085	1 394	1 321	1 231	1 379	1 339
Composting and digestion, '000	92	78	93	87	103	118	158	193	217	268	256	331	471	558
Recycling rate, %	11.9	10.9	11.8	15.5	20.0	21.1	24.2	24.3	24.3	30.8	30.4	30.2	34.7	36.0
Increase in recycling rate, percentage points		-1.0	0.9	3.7	4.5	1.1	3.0	0.2	-0.1	6.6	-0.5	-0.1	4.5	1.2

Note: material recycling = dry materials recycling.

Source: Ministry of the Environment of the Czech Republic

Collection systems

In the Czech Republic biowaste is mostly collected door-to-door, while paper, glass, plastics, and some biowaste are mostly collected through bring points. Public amenity sites also collect all MSW fractions.

Treatment capacity

The Czech Republic reported a current incineration capacity of 769 000 tonnes.

There are firm plans for increasing the capacity of all waste treatment options (biowaste treatment, MBT and mixed sorting, incineration) during the years 2020–2024. Some of the facilities are already under construction.

Measures for increasing municipal recycling rates

The main priorities for waste management in the period 2015–2024 are:

- emphasis on separate collection: mandatory introduction of separate collection for at least paper, metal, plastics and biowaste; municipalities are obliged to provide locations for separated waste collection, resulting in a sufficiently numerous and accessible network of collection points;
- extended user responsibility for packaging waste;
- mixed sorting and MBT as a complement to (not replacement of) material and energy recovery;
- substantially reducing landfill including a ban on sending recyclable and recoverable waste directly to landfill from 2024; before 2024 a tax will be imposed on these materials, and will be gradually increased to encourage a reduction in the quantity of this waste deposited at landfill sites;
- energy recovery from residual MSW;
- introducing pay-as-you-throw systems; a municipality will be able to set the fee for individual taxpayers, based on their waste production and separation.

Waste generation and treatment scenario

Based on the information described above, a baseline scenario for the future generation and management of MSW was developed, presenting a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures will be fully implemented or that there may be delays in setting up new treatment capacity. The scenario thus presents one view of possible future developments, helping to identify potential risks of not meeting the recycling target and serving as a basis for discussion.

The Czech Republic reported increasing recycling rates since 2002 and is also taking further measures to increase separate collection. Further capacity is planned for all treatment options. On this basis, it is assumed that there will be a 5 percentage point increase in collection for dry recycling by 2020 and a 5 percentage point increase in separate collection of biowaste.

In the baseline scenario, the increase in separately collected waste will result in a decrease in residual waste. On the basis of action to reduce landfill by introducing a tax and banning mixed MSW and recyclable waste from landfill from 2024, the share of waste sent to landfill is assumed to diminish to 30 per cent in 2020 and 10 per cent in 2025.

The share of residual waste sent to incineration is expected to increase to meet the estimated current capacity and remain there, as no strong measures to increase incineration capacity have been reported. As far as MBT is concerned, a significant increase is expected; although there is currently no MBT capacity in the Czech Republic appropriate facilities are planned, and capacity for residual waste treatment will be needed due to the landfill ban.

Table 22 Baseline for the first treatment of municipal solid waste in the Czech Republic, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	5274	5 340	5 300	5 273	5 269
Collection coverage, % of population	99	100	100	100	100
Collection for dry materials recycling, %	27	32	32	32	32
Collection for biowaste treatment, %	11	16	16	16	16
Direct to MBT and mixed sorting, etc., %	0	8	28	28	28
Direct to incineration, %	13	14	15	15	15
Direct to landfill, %	49	30	10	10	10

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, the Czech Republic will reach a separate collection rate for dry materials recycling and biowaste treatment of 48 per cent by 2020. The majority of this increase is due to expected improvements in collection systems.

Denmark – Baseline modelling and data updates

The Danish Environmental Protection Agency kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Denmark reported residual household waste composition data based on a local study from 2012. This was used to estimate the total municipal solid waste (MSW) composition, making use of data provided by Denmark on the amounts of separately collected recyclables. For the estimation, it was assumed that household waste accounts for 80 per cent of MSW and that the composition of household waste and MSW are the same.

1. Residual MSW
 - the total volume of residual household waste was generated from reported volumes sent to residual waste treatment destinations (incineration and landfill) as reported by Denmark;
 - residual MSW was calculated on the assumption that household waste represents 80 per cent of MSW.
2. MSW separately collected for recycling
 - household waste separately collected for recycling was reported by Denmark;
 - MSW collected for recycling was calculated (see recycling tonnages).
3. Total MSW composition
 - sum of fractions in residual waste and waste collected for recycling.

Municipal solid waste generation and management

The household waste data provided by Denmark was converted to MSW generation on the assumption that household waste represents 80 per cent of MSW. The treatment destination and collection coverage data provided by Denmark needed no adjustment for use in the model.

Recycling tonnage

As the figures provided by Denmark on tonnage of waste collected for recycling was for household waste rather than MSW, they were adjusted to be in line with the MSW generation and treatment data provided by Denmark. Data on wood waste and waste electronic and electrical equipment (WEEE) remain as reported, as adjustment would have caused the volumes sent to recycling to exceed the generated amounts.

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of these categories, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

For food waste, Denmark reported 10 per cent to OAW, 66 per cent to IVC, and 24 per cent to AD. For garden waste, 90 per cent went to OAW and 10 per cent to IVC. Denmark reported no other biowaste collection and treatment.

Anaerobic digestion

- The model allows for five types of utilization of the biogas from AD: AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);

- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

For biogas from AD, Denmark indicated 60 per cent use of AD 1, 3 per cent AD 2, and 37 per cent AD 3.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting with energy generation

Denmark indicated that there is no MBT in the country.

Incineration

The model includes four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Denmark reported an 18 per cent share of Incineration 1 and an 82 per cent share of Incineration 2. It was reported that the plants which only produce electricity are expected to close in the future for economic reasons. For the model, a stepwise phase-out of Incineration 1 until 2030 is therefore assumed, as shown in Table 23.

Table 23 Estimated development of incineration shares in Denmark, 2014–2035

	2015	2020	2025	2030	2035
Incineration 1, %	18	12	6	0	0
Incineration 2, %	82	88	94	100	100
Incineration 3, %	0	0	0	0	0
Incineration 4, %	0	0	0	0	0

Waste generation projections

The Danish Environmental Protection Agency used its FRIDA model⁵ to estimate Denmark's future waste generation. The model links historical waste generation with predicted trends in economic growth and energy production to calculate future waste generation. For major waste streams, the relationship between economic development and the development of waste is determined by an econometric analysis of a specific

⁵ More information on the FRIDA model is available at <http://mst.dk/service/publikationer/publikationsarkiv/2015/mar/fremskrivning-af-generering-og-behandling-af-affald>

period. This means that the amount of waste will change if economic activity changes. The waste generation projection provided by Denmark was used for updating the model (*Table 24*).

Table 24 Municipal solid waste generation projections for Denmark, 2020–2035

	2020	2025	2030	2035
Reported projections, '000 tonnes	4 465	4 640	4 805	4 959

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

In 2010, the data collection system was revised, affecting recycling rates, and data from before 2010 are therefore not fully comparable with data from 2011 onwards. Both dry material recycling and composting/digestion have increased steadily since 2011 (Table 25).

Table 25 Municipal solid waste generation and treatment, 1995–2015

Denmark	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000	2 725	3 253	3 104	3 141	3 329	3 546	3 519	3 568	3 618	3 757	3 990	4 021	4 313	4 560	4 206		4 349	4 421	4 437	4 450	4 485
Material recycling, '000	391	800	662	710	820	755	787	796	926	934	977	977	1 149	1 559	1 310		1 187	1 135	1 152	1 198	1 223
Composting and digestion, '000	297	405	436	420	476	560	483	546	553	608	660	703	757	627	741		616	725	764	811	852
Recycling rate, %	25	37	35	36	39	37	36	38	41	41	41	42	44	48	49		41	42	43	45	46
Increase in recycling rate, percentage points		12	-2	1	3	-2	-1	2	3	0	0	1	2	4	1		0	1	1	2	1

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Treatment capacity

- Composting: there is excess capacity for composting of garden and food waste. The demand for composting of food waste has declined significantly because of the rise in AD.
- AD: there is a 130 000 tonne capacity for AD, mainly for digestion of animal slurry. 25 % of the input can be food waste.
- There is excess incineration capacity and Denmark is importing waste for incineration. Denmark has introduced a ban on building new incineration plants.

Measures for increasing municipal solid waste recycling rates

- Denmark without waste, the national strategy on waste management for 2013–2018, includes a target to increase recycling of seven specific fractions of household waste (glass, metal, plastic, paper, cardboard, wood and food waste), to reach 50 per cent in 2022.
 - Results achieved so far: recycling of these seven fractions increased from 22 per cent in 2013 to 31 per cent in 2016, and is expected to reach 49 per cent in 2022.
- Municipalities are focusing on improving the effectiveness of existing separate collection systems while also introducing new ones.
 - Extending the share of separately collected food waste through door-to-door collection: in 2016, 25 per cent of the municipalities had a collection system for food waste and many more are expecting to introduce one in the near future, so that 35 per cent will be collecting food waste by 2020.

Waste generation and treatment scenario

Based on the information above, a baseline scenario for the future generation and management of MSW has been developed. This presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures will be fully implemented and that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify potential risks of not meeting the recycling target, and serving as a basis for discussion.

Estimates of future recycling rates are based on the above measures. Regarding collection for dry materials recycling, it is assumed that there will be an increase of 5 percentage points by 2020, based on efforts to increase separate collection of dry recyclables. Separately collected biowaste is expected to increase by 4 percentage points by 2020. This is based on increasing the separate collection of food waste, which is assumed to have a capture rate of 25 per cent in 2020; the capture rate of garden waste is assumed to remain unchanged.

Regarding final treatment, it is assumed that the rise in separate waste collection will result in a decrease in residual waste. Regarding landfill, the rate is already very low, at 2 per cent, and is expected to remain at this level. There is no capacity for MBT in Denmark and no plan to build any, and it is estimated that the reduction in residual waste will lead to a reduction in incineration.

Table 26 Baseline for the first treatment of municipal solid waste in Denmark, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	4 485	4 465	4 640	4 805	4 959
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	24	29	29	29	29
Collection for biowaste treatment, %	20	24	24	24	24
Direct to MBT and mixed sorting, etc., %	0	0	0	0	0
Direct to incineration, %	54	45	45	45	45
Direct to landfill, %	2	2	2	2	2

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Denmark's share of MSW collected for dry materials recycling and biowaste treatment will reach 53 per cent by 2020. This is based on the planned measures to increase recycling rates.

Estonia – Baseline modelling and data updates

The Ministry of Environment of Estonia kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Estonia's reported municipal solid waste (MSW) composition data is based on regional and local analysis of the residual MSW stream in 2013. In order to generate the total MSW composition for the model, the reported residual MSW data was combined with data reported on MSW separately collected for recycling.

Municipal solid waste generation and management

Estonia provided data on the generated amount of MSW, and no adjustments were needed for feeding the data into the model.

Recycling tonnage

The data provided on tonnage of materials collected for recycling were slightly adjusted as the figures on MSW generation and treatment were not consistent with the amounts collected for recycling. In addition, as Estonia indicated no split between the three components of biowaste, the reported composition shares were also applied to the amounts of separately collected biowaste.

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of these categories, the model takes into account three different treatment technologies:

- open air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

Estonia does not separately record the three components of biowaste (food, garden, and other biowaste). For all biowaste combined, Estonia reported 80 per cent OAW and 20 per cent IVC. However, they state that *'there are good reasons to predict that AD treatment of the source-separated biowaste will increase and biowaste shall be delivered to the AD facilities'*. In addition, Estonia indicated that a legal issue with the status of the digestate needs to be solved. Due to these uncertainties and as there is no quantitative estimation available about the timing and extent of the change to more AD, a future switch to more AD is currently not implemented in the model.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

Estonia reports having no AD for biowaste from MSW.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation

Estonia indicated that *'descriptions of the "treatment type" are too simplified. Operational facilities mostly separate metals for recycling and high-calorific materials for energy recovery. Residues from MBT processes are treated (stabilised) and mostly used for cover layers on landfills, and are counted as 'recovery operations' not disposal'*.

Due to the energy recovery in the MBT, and the fact that the biodegradable residues from the MBT processes are not considered as recycled, Estonia’s MBT is categorised as MBT 2 for the purpose of the modelling, with no essential change expected in the foreseeable future.

Incineration

The model includes four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – combined heat and power (CHP);
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Estonia reported 100 per cent Incineration 2.

Waste generation projections

Estonia did not provide own waste generation projections, so the model uses the projections produced by the ETC/WMGE (Table 27). The projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 27 Municipal solid waste generation projections for Estonia, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes	466	480	488	472

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

Estonia’s recycling statistics have fluctuated (Table 28).

There has been a significant reduction in landfill in recent years, from 239 000 tonnes in 2011 to 35 000 tonnes in 2015, triggered by rising landfill taxes and introduction of incineration and MBT capacities.

Table 28 Municipal solid waste generation and treatment, 1995–2015

Estonia	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000	533	565	593	557	569	633	509	553	567	606	587	536	602	524	452	406	399	371	386	470	473
Material recycling, '000	0	0	0	0	0	13	15	11	77	142	121	70	122	78	52	41	58	52	49	125	117
Composting and digestion, '000	3	1	1	1	0	2	11	4	8	8	11	23	17	28	43	33	35	19	20	22	17
Recycling rate, %	1	0	0	0	0	2	5	3	15	25	22	17	23	20	21	18	23	19	18	31	28
Increase in recycling rate, percentage points	0	0	0	0	0	2	3	-2	12	10	-2	-5	6	-3	1	-3	5	-4	-1	13	-3

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Estonia states that *‘for many years, capacity and infrastructure are not the ‘bottleneck’ to developments in recycling of MSW in Estonia. The main problems are related to “organisational matters”, i.e. division of the tasks and rights between the public and private sectors, with financial issues related to the tasks of the municipalities, an economically motivating fee system, awareness raising and especially the supervision system’.*

Collection systems

In Estonia paper and cardboard are collected door-to-door in housing cooperatives with more than 10 (or, in some areas, 5) flats. In Tallinn (since 2007), Tartu (since 2016), and Pärnu and Rakvere (since 2017), these housing cooperatives must also have separate biowaste collection, other dwellings are served by a bring system. Bring systems are also the primary collection systems for packaging waste and textiles. Public amenity sites collect all recyclables. Waste types under extended producer responsibility, such as waste electrical and electronic equipment (WEEE), batteries and accumulators, are collected through retailers or collection points.

Treatment capacity

- Composting: in general, current treatment capacity is two to three times larger than Estonia's separately collected waste volumes.
- For AD, the main barriers are unsolved technical questions on pre-treatment and legal issues on end-of-waste regulations in Estonia. There are currently five bigger AD facilities mainly using animal manure, but some of these have shown an interest in receiving other treated biowaste if the barriers are removed.
- There are several facilities for the after-sorting of source-separated waste paper, cardboard and packaging.
- MBT: Estonia now has four operating MBT plants with a total theoretical annual capacity of 300 000 tonnes, of which 240 000 tonnes are unused. One MBT facility started operating in 2016 with a capacity of 25 000 tonnes per year, aiming to separate materials for recycling.
- Incineration: an incinerator with a capacity of 220 000 tonnes per year has been fully operational since 2013. The capacity limit is set by the energy produced. Due to the poor calorific value of domestic residual waste, some waste has also been imported. No new plants are planned, as in total there is technical overcapacity (Waste to Energy + MBT) for residual MSW.

Measures for increasing municipal solid waste recycling rates

- An amendment to the Ministry of Environment regulations on Requirements on Sorting Municipal Waste came into force in 2016. Progress will depend on awareness raising and control measures.
- Financial support to municipalities for MSW management: all municipalities receive €2.9 per 'living space', based on the official register of buildings.
- EU Cohesion Fund 2014–2020: €25 million is available for 'waste reduction, preparation for reuse, and recycling', not only for MSW, but for all waste types. This includes an option to support 'pre-treatment of source-separated biowaste prior to AD treatment'.
- National End-of-Waste (EoW) regulation on Compost (2013): certification systems are in place and the first facilities were certified in 2016.
- National End-of-Waste (EoW) regulation on Digestate (2016).

Waste generation and treatment scenario

Based on the information described above, a baseline scenario for the future generation and management of MSW has been developed. This presents a critical view of the effects of the policy measures and planned capacity. It takes into account the possibility that not all planned measures will be fully implemented and that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify potential risk of not meeting the recycling target, and is a basis for discussion.

Estonia has excess treatment capacity, but lacks proper separate collection systems for increasing recycling rates. Estonia is implementing some measures which aim to increase separate collection and measures for implementation.

Future recycling rates have been estimated based on the measures mentioned above. Regarding collection for dry materials recycling, it is assumed that there will be an increase of 2 percentage points by 2020, and for separately collected biowaste there will be an increase of 3 percentage points by 2020. These assumptions are based on efforts to increase separate collection, for example through stricter regulations on waste separation, and financial support to municipalities for implementation.

Regarding final treatment, it is assumed that the increase in separately collected waste will result in a decrease in residual waste. Regarding landfill, it is assumed that for the share of MSW sent directly to landfill without prior treatment will fall to 2 per cent by 2020 due to a landfill ban on organic waste. There is excess MBT treatment capacity and the incineration capacity is partly filled by imported waste. There are no reported measures or intentions to increase the waste volumes going directly to incineration or MBT, hence the figures are kept stable over the whole period.

Table 29 Baseline for the first treatment of municipal solid waste in Estonia, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	463	466	480	488	472
Collection coverage, % of population	95	100	100	100	100
Collection for dry materials recycling, %	28	30	30	30	30
Collection for biowaste treatment, %	3	6	6	6	6
Direct to MBT and mixed sorting, etc., %	11	11	11	11	11
Direct to incineration, %	51	51	51	51	51
Direct to landfill, %	7	2	2	2	2

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Estonia will reach a 36 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020. This is based on reported measures to increase recycling rates in the future. Collection coverage is assumed to reach 100 per cent of the population by 2020.

Finland – Baseline modelling and data updates

The Ministry of Environment of Finland and the Finnish Environment Institute kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Finland reported municipal waste composition data, which were based on its total MSW stream and regional or local analyses of the composition of residual waste. The data relates to the year 2015.

Municipal solid waste generation and management

As Finland provided data on the generation and management of MSW, no adjustments were needed for feeding the data into the model.

Recycling tonnage

The data on tonnage of single materials collected for recycling were slightly adjusted from those provided by Finland, as the data on MSW generation and treatment were not fully consistent with the reported amounts of material collected for recycling. In addition, as Finland gave no breakdown of biowaste into its three components, the split in its composition was applied to its collection for treatment.

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of these categories, the model takes account of three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

Finland records no split for the three components of biowaste (food, garden, and other biowaste). For all biowaste, 29 per cent went to AD and 71 per cent to composting (in-vessel and open-air windrow combined). The share of open-air windrow was estimated to have remained at 11 per cent (data used in the 2015 version of the model), leaving the share of in-vessel composting at 60 per cent.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

Finland indicated that 39 per cent of the biogas from AD was used for 'heat power', which does not fit into any of the model's five types. However, as 'heat power' used in district heating can be considered similar to CHP, it was added to the CHP share. Thus, Finland's use of AD 2 was set at 69 per cent; Finland reported 24 per cent AD 4 and 7 per cent AD 5.

Finland indicated that the recently adopted National Energy and Climate Strategy outlines a strategy for increasing production of biogas and that the use of biogas as vehicle fuel will increase. In the future, the share

of AD 2 is estimated to remain stable, while by 2025 the share of AD 4 will increase to 31 per cent as AD 5 comes to an end. The estimated evolution of technology shares used in the model is shown in Table 30.

Table 30 Estimated development of anaerobic digestion shares in Finland, 2015–2035

	2015	2020	2025	2030	2035
AD 1, %	0	0	0	0	0
AD 2, %	69	69	69	69	69
AD 3, %	0	0	0	0	0
AD 4, %	24	27	31	31	31
AD 5, %	7	4	0	0	0

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation.

Finland provided data for 2016, when two new MBT facilities began operating: MBT 4 with an annual capacity of 100 000 tonnes and MBT 5 with an annual capacity of 66 000 tonnes. In 2015 a small waste volume was reported to have been sent to MBT, when one MBT 5 facility was operational. Thus in 2015, 100 per cent of waste going to MBT was assumed to be treated with MBT 5. The number of plants is expected to increase, with one new plant currently in the planning phase (MBT 4 with a capacity of 300 000 tonnes per year, of which 66 per cent will be MSW).

Table 31 Estimated development of mechanical biological treatment shares in Finland, 2015–2035

	2015	2020	2025	2030	2035
MBT 1, %	0	0	0	0	0
MBT 2, %	0	0	0	0	0
MBT 3, %	0	0	0	0	0
MBT 4, %	0	74	85	85	85
MBT 5, %	100	26	15	15	15

Incineration

The model includes four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – combined heat and power (CHP);
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Finland reported 100 per cent Incineration 2.

Waste generation projections

Finland uses the *impact = population x affluence x technology (IPAT)* model for forecasting MSW volumes, but only to 2030. Finland agreed to use the updated ETC/WMGE projections for the model (Table 32). The projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 32 Municipal solid waste generation projections for Finland, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes	2 628	2 593	2 524	2 434
Reported projections, '000 tonnes	2 799	2 921	3 027	-

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

Finland had a recycling rate of around 33–36 per cent with no overall increase until 2015, when it rose to 41 per cent (Table 33). Finland indicated that the increase was due to the '*more sharpened and advanced data gathering method of Statistics Finland*'.

Table 33 Municipal solid waste generation and treatment, 1995–2015

Finland	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000	2 109	2 100	2 300	2 400	2 500	2 600	2 412	2 384	2 428	2 453	2 506	2 600	2 675	2 768	2 562	2 519	2 719	2 738	2 682	2 630	2 738
Material recycling, '000	549	547	599	625	651	677	628	621	632	639	652	677	695	715	615	495	592	589	510	474	770
Composting and digestion, '000	160	159	174	182	189	197	183	181	184	186	190	197	258	234	305	332	355	323	362	382	341
Recycling rate, %	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	33.6	35.6	34.3	35.9	32.8	34.8	33.3	32.5	32.5	40.6
Increase in recycling rate, percentage points		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	-1.3	1.6	-3.1	2.0	-1.5	-0.8	0.0	8.0

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Collection systems

In Finland, the number of apartments in a housing cooperative determines the requirement for separate collection services. The regulation is determined by the municipalities. Generally, in larger housing cooperatives such as apartment buildings and terraced houses, door-to-door collection is the primary system for paper, glass, metals, biowaste, and to some extent plastic packaging. For detached and semi-detached houses bring points are the primary system for recyclables. Beverage bottles (glass and plastic) are collected through a producer/retail take-back system. All fractions of MSW are also accepted at civic amenity sites.

Treatment capacity

Finland appears to be investing considerably in waste treatment capacity. There are several plans at different stages of development:

- biowaste composting: six more new composting plants are planned (capacity not specified);
- AD: 18 new (co-treatment) AD plants are planned, two of which are being finalised. These plants treat municipal biowaste together with other organic wastes including sludge and waste from industry and agriculture (capacity not specified);

- MBT: a new MBT plant of the type MBT 4 (Oulun energia Oy) is at the planning phase and will become operational in 2019 with an annual capacity of 300 000 tonnes, of which an estimated 66 per cent will be used for MSW;
- incineration: plans keep changing.

Measures for increasing municipal solid waste recycling rates

- Since 1 January 2016, Finland has prohibited most organic waste from going direct to landfill.
- According to a pilot study, a multi-locker waste collection service doubled the collection of recyclable wastes compared to the bring sites in areas of detached and semi-detached houses. The multi-locker waste collection service is available in some municipalities and is expected to expand.
- Due to reform on waste legislation, MSW management regulations have been tightened, for example for sorting and separate collection of biowaste.
- The new packaging decree (518/2014) that entered into force in 2014 sets stricter recycling obligations for packaging producers for 2016 and 2020:
 - the responsibility of packaging producers has been extended to cover the collection of consumer packaging, which previously was mainly carried out by municipalities;
 - door-to-door collection of plastic packaging waste from apartment buildings began in 2016.

Waste management plans

Finland is preparing a new national waste management plan for the period up to 2023, including targets and measures for the next six years.

The government has financed research (*Targeted methods for increasing recycling*⁶) to identify policy instruments to meet the WFD 50 per cent target for MSW recycling. Suggested policy instruments include an incineration tax; strengthened MSW management regulations; recycling advice for households; pay-as-you-throw systems; an obligation to separate the waste for non-residential properties; and establishing a national advisory network. According to the study², the following increases in recycling could be possible in Finland:

- 2.7 per cent through investment in mechanical separation plants (there are still some questions concerning the actual recycling rate of MBT plants);
- 6.2 per cent by improving the recycling rate of separately collected materials (one reason for energy recovery of separately collected materials is impurities and quality problems, so the potential for recycling is unclear);
- 2.9 per cent by expanding separate collection from households to cover all blocks of flats, terraced houses and semi-detached houses in the country;
- 1.4 per cent by increasing the sorting activity of households through pay-as-you-throw schemes and advice campaigns.
- 4.4 per cent by increasing recycling in the administrative, service and business sectors by expanding the separate collection system.

However, there is currently no information available about the uptake of these measures.

⁶ Targeted methods for increasing recycling, policy brief in English:

<http://tietokayttoon.fi/documents/1927382/2116852/Reaching+the+waste+recycling+targets+requires+significant+actions/ae3d1c99-ef85-440e-a195-8b366ced2e19?version=1.0>

Study report in Finnish:

http://tietokayttoon.fi/documents/10616/2009122/53_2016+Kohdennetut+keinot+kierr%C3%A4tyksen+kasvuun.pdf/e883402b-13dc-4d69-8126-953c80cc1b8f?version=1.0

Waste generation and treatment scenario

Based on the information above, a baseline scenario for the future generation and management of MSW has been developed. This presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures will be fully implemented and that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify potential risks of not meeting the recycling target, and is a basis for discussion.

Future recycling rates have been estimated based on the measures mentioned above. Regarding collection for recycling, it is assumed that there will be an increase of 2 percentage points by 2020 based on efforts to increase separate collection, for example through stricter recycling obligations for packaging producers. Regarding separately collected biowaste, an increase of 3 percentage points is estimated by 2020, based on strengthened legislation for sorting and separate collection.

The increase in separately collected waste will result in a decrease of residual waste. The share of MSW directly sent to landfill is expected to diminish to 2 per cent by 2020 due to the ban on organic waste going direct to landfill. The share of MBT is expected to rise to 16 per cent in 2025. The two new MBT facilities that began operations in 2016 are assumed to be fully operational by 2020, while a third, to be built in 2019, is assumed to operate at 75 per cent capacity by 2020. By 2025 all three facilities are assumed to be fully operational. It is further assumed that the remaining residual waste will be incinerated, but with a decreasing trend. On the other hand, the increase in volumes treated in MBT plants will lead to an increase in MBT outputs sent to energy recovery.

Table 34 Baseline for the first treatment of municipal solid waste in Finland, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	2 738	2 628	2 593	2 524	2 434
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	28	30	30	30	30
Collection for biowaste treatment, %	12	15	15	15	15
Direct to MBT and mixed sorting, etc., %	1	14	16	16	16
Direct to incineration, %	48	39	37	37	37
Direct to landfill, %	11	2	2	2	2

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Finland will reach a 45 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020. This is based on the indicated measures to increase recycling rates.

France – Baseline modelling and data updates

France did not provide data and information for the update of the waste model. Values for France are assumed to have remained as they currently were in the 2015 version of in the model. However, some limited update was performed: Eurostat data for 2015 waste generation and final treatment were used and the data of the 2015 version of the model were adjusted slightly accordingly.

Projections up to 2035 produced by the ETC/WMGE were used for the future waste generation in France. These projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 35 Municipal solid waste generation projections for France, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes	34 306	34 276	34 321	34 433

As France did not provide any information on future generation and management of MSW, no baseline scenario for the future can be presented. For the model, it is assumed that the MSW management of France will remain stable and France will have a 39 per cent collection rate for dry materials recycling and biowaste treatment in 2020.

Table 36 Baseline for the first treatment of municipal solid waste in France, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	33 400	34 306	34 276	34 321	34 433
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	22	22	22	22	22
Collection for biowaste treatment, %	17	17	17	17	17
Direct to MBT and mixed sorting, etc., %	4	4	4	4	4
Direct to incineration, %	33	33	33	33	33
Direct to landfill, %	24	24	24	24	24

Note: shares might not sum to 100% due to rounding.

Germany – Baseline modelling and data updates

The German Federal Environmental Agency (Umweltbundesamt) kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal waste composition

Germany provided municipal solid waste (MSW) composition data based on the total MSW stream. The composition of this waste is provided for 2015. This has been used in the model, with the fractions slightly adjusted to sum to 100 per cent.

Municipal solid waste generation and management

As Germany provided data on the amount of MSW, no adjustments were needed.

Recycling tonnage

The data on the tonnage of material collected for recycling was slightly adjusted as the data on MSW generation and treatment was not fully consistent with the amounts of material collected for recycling.

Biowaste treatment

In the waste model, biowaste is split into three categories: food waste, garden waste, and other biowaste. For each of these, the model takes account of three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

For both food and garden waste, Germany reported 45 per cent OAW, 45 per cent IVC and 10 per cent AD. For other biowastes Germany reported 33 per cent OAW, 33 per cent IVC and 34 per cent AD.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

Germany indicated 100 per cent use of AD 2.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation.

Germany reported 30 per cent MBT 1; 5 per cent MBT 3; and 65 per cent MBT 5.

Incinerator

The model includes four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Germany reported 10 per cent Incineration 1; 80 per cent Incineration 2; and 10 per cent Incineration 3.

Waste generation projections

Germany did not provide own projections, so the model will use the projections produced by the ETC/WMGE for the EEA (Table 37). The ETC/WMGE projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 37 Municipal solid waste generation projections for Germany, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes	48 517	48 336	48 385	48 492

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

Although Germany had already surpassed a 60 per cent recycling rate, it has had a slow but steady increase in biowaste and dry materials recycling over the past 10 years (Table 38).

Table 38 Municipal solid waste generation and treatment, 1995–2015

Germany	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000	50 894	52 544	53 966	53 058	52 373	52 810	52 075	52 772	49 622	48 434	46 555	46 426	47 887	48 367	48 466	49 237	50 237	49 759	49 570	51 102	51 046
Material recycling, '000	13 384	15 043	16 433	16 528	19 898	20 144	19 632	22 015	21 425	19 587	20 734	21 195	22 555	22 752	22 204	22 476	23 135	23 596	23 094	24 302	24 414
Composting and digestion, '000	6 678	7 129	7 368	7 640	6 883	7 588	7 604	7 575	7 251	7 752	7 633	7 631	7 709	8 082	8 388	8 298	8 498	8 864	8 536	9 242	9 304
Recycling rate, %	39.4	42.2	44.1	45.6	51.1	52.5	52.3	56.1	57.8	56.4	60.9	62.1	63.2	63.8	63.1	62.5	63.0	65.2	63.8	65.6	66.1
Increase in recycling rate, percentage points		2.8	1.9	1.4	5.6	1.4	-0.2	3.8	1.7	-1.3	4.5	1.2	1.1	0.6	-0.6	-0.6	0.5	2.3	-1.4	1.8	0.4

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/09/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Measures for increasing municipal solid waste recycling

- Efforts to increase recycling rates for packaging.
- Since January 2015, the separate collection of biowaste is mandatory according to § 11 CEA (Kreislaufwirtschaftsgesetz).

Waste generation and treatment scenario

Based on the information described above, a baseline scenario for future generation and management of MSW has been developed. This presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures are fully implemented or that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future

developments, helping to identify potential risks of not meeting the recycling target, and serving as a basis for discussion.

Estimates of future recycling rates are based on the measures mentioned above. Regarding collection for recycling, it is assumed that there will be an increase of 1 percentage point by 2020 based on efforts to increase the separate collection of packaging. Regarding separately collected biowaste, it is assumed that this will increase by 2 percentage points by 2020 based on tightening of the legislation for the separate collection of biowaste.

The estimated increase in separately collected waste will result in a decrease in the share of residual waste. There is currently no waste sent directly to landfill and this will continue in the future. Therefore, it is assumed that the shares of waste sent to MBT and incineration decrease slightly until 2020. No further changes in the waste management shares are anticipated for the period beyond 2020.

Table 39 Baseline for the first treatment of municipal solid waste in Germany, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	51 046	48 517	48 336	48 385	48 492
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	45	46	46	46	46
Collection for biowaste treatment, %	17	19	19	19	19
Direct to MBT and mixed sorting, etc., %	7	6	6	6	6
Direct to incineration, %	31	29	29	29	29
Direct to landfill, %	0	0	0	0	0

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Germany will achieve a 65 per cent collection rate for dry materials recycling and biowaste treatment by 2020.

Greece – Baseline modelling and data updates

The Ministry of Environment and Energy of Greece kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Greece reported waste composition as a percentage of the total municipal solid waste (MSW) stream, based on the national waste management plan⁷. Data relate to the year 2011, but differ from the data corresponding to that year that are already in the 2015 version of the model. We assume the new figures to be more correct than the old ones. Greece does not have a breakdown of the shares of food and garden waste in biowaste, but estimated that garden waste accounts for 3 per cent of biowaste, and it was thus assumed that the remaining biowaste is food waste.

Municipal solid waste generation and management

The data provided by Greece refer to total MSW, and are used in the model without adjustments.

Recycling tonnage

Greece provided data on inputs to the final recycling process. The model uses reject rates to calculate the corresponding amounts of materials separately collected for recycling. Further, it is assumed that the reported amount of recycled biowaste consists of 3 per cent garden waste and 97 per cent food waste, corresponding to the estimated biowaste composition.

Biowaste treatment

In the waste model, biowaste is split into three categories: food waste, garden waste, and other biowaste. For each of these, the model takes into account three different treatment technologies:

- open air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

Greece did not provide new data on treatment types. The shares are therefore assumed to be the same as in the 2015 version of the waste model (100 per cent IVC for food waste; 20 percent IVC and 80 per cent OAW for garden waste and 34 per cent AD, 33 per cent IVC, 33 per cent OAW for other biowaste).

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

For the biogas from AD, Greece indicated 100 per cent use of AD 2.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

⁷ <http://www.ypeka.gr/LinkClick.aspx?fileticket=8rKEKVFO8G0%3d&tabid=238&language=el-GR>

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation.

Greece reported 85 per cent MBT 1 and 15 per cent MBT 2. No information was available on the MBT category of a new facility that is currently under construction, so the shares are kept constant over time in the waste model.

Incineration

The model includes four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Greece does not operate incineration plants for MSW and has no plans to build any.

Waste generation projections

Greece provided waste generation projections up to 2020, and responded in the questionnaire that the projection made for the EEA by the ETC/WMGE seems reasonable according to their knowledge of the national waste system and their expectations of the future. The model will use Greece’s data until 2020 and ETC/WMGE projections for 2025, 2030 and 2035 (Table 40). The ETC/WMGE projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 40 Municipal solid waste generation projections for Greece, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes		5 198	5 216	5 178
Reported projections, '000 tonnes	5 400			

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

As can be seen in Table 41, Eurostat time series show a clear rising trend in the recycling rate until 2009 and a stagnation or slight decrease after 2009, coinciding with the economic crisis.

Table 41 Municipal solid waste generation and treatment, 1995–2015

Greece	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	3 200	3 600	3 900	4 082	4 264	4 447	4 559	4 640	4 710	4 782	4 853	4 927	5 002	5 077	5 154	5 917	5 586	5 463	5 284	5 315	5 249
Material recycling, '000 tonnes	195	230	328	331	346	359	370	375	382	481	543	551	905	797	936	872	832	747	647	652	670
Composting and digestion, '000 tonnes			32	32	32	32	32	32	0	2	29	81	98	100	37	142	160	180	187	168	135
Recycling rate, %	6	6	9	9	9	9	9	9	8	10	12	13	20	18	19	17	18	17	16	15	15
Increase in recycling rate, percentage points	0	0	3	0	0	0	0	0	-1	2	2	1	7	-2	1	-2	1	-1	-1	0	0

Note: material recycling = dry materials recycling

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Collection systems

The following information on collection systems was considered when updating the baseline scenario in the waste model.

The separate collection systems currently implemented in Greece are divided into two main categories: a) sorted but co-mingled dry recyclables (paper and cardboard, metal, glass, and plastic) in blue bins; and b) sorted in four separated materials (paper and cardboard, metal, glass and plastic) in 2-4 bins. There are several recent and planned changes to the collection system.

- Glass waste is increasingly collected in separate bins.
- There are plans for a network of bins for packaging waste with one bin per 75 residents.
- Legislative acts necessary for the installation and operation of 'green points' (collection areas, civic amenity sites) to separately collect waste streams have been approved by article 21 of Law 4447/2016. Therefore, at least one green point (civic amenity site) per municipality was expected to be operational in 2017. Furthermore, the development of a large network of bring points (recycling corners or vehicles) is provided in many municipalities.
- The provision of separate collections for metal, plastic, glass, and paper specified in the national and all regional waste management plans has begun in some areas such as Sparta, Kozani and Chania, with encouraging results.

Current and future treatment capacity

Biowaste

Waste treatment capacity is expected to change because of the large number of facilities to be constructed by 2020 under the regional waste management plans. Among the 116 units for residual waste and biowaste treatment (either food waste or garden waste) with a total capacity of almost 1 million tonnes per year, there are 67 small municipal plants for separately collected biowaste. In addition, the Fokida Composting Plant under construction in Central Greece, with a capacity of 6 000 tonnes per year of separately collected biowaste, was expected to become operational by the end of 2017.

According to the national waste management plan, the target of 40 per cent separate collection and treatment of biowaste is a strong reason to restructure the current system.

Mechanical and biological treatment

Greece's MBT capacity is expected to increase because of the large number of facilities to be constructed by 2020 under the regional waste management plans. Some of them have already been approved for financing by the Operational Programme on Transport, Infrastructure, Environment and Sustainable Development, for example the MBT Plant of Ipirus (105 000 tonnes per year including 8 000 tonnes per year of biowaste treatment capacity) and the 63 000 tonne per year MBT Plant of Serres, the construction of which was to begin in 2017. The MBT Plant of Thiva, with a capacity of 32 000 tonnes per year plus 7 000 tonnes per year of biowaste, was also to be under construction by the end of 2017.

Finally, the MBT Plant of Western Macedonia, with a capacity of 120 000 tonnes per year, went into full operation in June 2017.

Measures for increasing municipal solid waste recycling rates

Greece reported a comprehensive set of measures to increase MSW recycling rates.

- 1) The national and regional waste management plans foresee separate collection of paper, glass, metal and plastic. The infrastructure proposed in the regional waste management plans (for example, capacity of units and number of bins) has a separate collection target of 65 per cent.

- 2) Development of a network of green points (civic amenity sites) and centres for source separation, recycling and training of operatives.
- 3) Amendment of the legislative framework for recycling (Law 2939/01) to (i) rationalise the operation of producer responsibility organisation (PRO) schemes (extended producer responsibility); (ii) set concrete terms and conditions for the separate collection of waste streams at the municipal level; (iii) upgrade the role of the Hellenic Recycling Agency.
- 4) Increase the separate collection and recovery rates of printed paper, initially through separate collection at selected points, and across the country by 2020.
- 5) Use of economic instruments, such as pay-as-you-throw, environmental taxes and extended producer responsibility, based on the results of a national level study, in order to enhance the waste hierarchy and ensure financial resources for waste management.
- 6) Development of a guide for implementation of the pay-as-you-throw principle.
- 7) Financing of measures and projects.
- 8) Under the National Strategic Reference Framework 2014–2020, investments in the waste sector are included within two sectoral and 13 regional operational programmes, targeted to meet the requirements of the EU environmental *acquis*. The measures will be funded by the European Regional Development Fund (ERDF) and the Cohesion Fund (CF), with a total funding of € 1 billion.
- 9) Disincentives for the disposal of recyclable waste in landfill include the establishment of a special landfill tax (article 43 of Law 4042/2012). The tax will oblige municipalities to optimise and increase recycling rates within their territory.

Biowaste

- 1) The first priority under the national waste management plan is separate collection of biowaste from MSW. The following action has been taken:
 - (a) preparation and distribution to all stakeholders of the *Guide for biowaste management practices*;
 - (b) preparation and distribution of the *Technical guidelines for the design of composting plants – tender documents* – to interested parties;
 - (c) preparation and distribution of the *Guide for composting plant operation*;
 - (d) development of specifications for various types of compost to promote its use.

The regional waste management plans propose infrastructural measures for achieving a biowaste recycling rate **of 40 per cent**.

- 2) The Joint Ministerial Decision on the treatment of biowaste will specify standards for composts according to their intended use.

Waste generation and treatment scenario

Based on the information above, a baseline scenario for the future generation and management of MSW has been developed. This presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures will be fully implemented or that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify potential risks of not meeting the recycling target, and serving as a basis for discussion.

Greece has a comprehensive set of new policies and ongoing and planned investments in infrastructure for both treatment and separate collection. However, recycling rates have stagnated in the past few years, indicating that implementation of the new measures might take some time. It is therefore assumed for the baseline scenario that separate collection of dry materials for recycling and of biowaste both steadily increase

up to 2025, after which the shares remain stable up to 2035. As new MBT capacity is already under construction, it is assumed that more waste will go direct to MBT instead of direct to landfill.

Table 42 Baseline for the first treatment of municipal solid waste in Greece, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	5 249	5 400	5 198	5 216	5 178
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	16	21	26	26	26
Collection for biowaste treatment, %	2	6	10	10	10
Direct to MBT and mixed sorting, etc., %	4	22	22	22	22
Direct to incineration, %	0	0	0	0	0
Direct to landfill, %	79	51	42	42	42

Note: shares might not sum to 100% due to rounding.

Hungary – Baseline modelling and data updates

The Ministry of Agriculture of Hungary in cooperation with the Ministry of National Development and the Hungarian Central Statistical Office kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Hungary provided composition data based on residual MSW for the year 2013. It did not split biowaste into food waste, garden waste, and other biowaste. As these shares are needed by the model, the split of biowaste into these fractions from the 2015 version of the waste model have been applied to the new data.

The data are from the comprehensive impact assessment of Hungary's implementation of the proposed amendments to the EU waste directives (part of the proposed EU Circular Economy package).

The overall data has been estimated using the Hungarian composition technical standard. Hungary highlighted that the technical standard focuses on the following fractions: paper, cardboard, biodegradable, composite, plastic, metal, glass, other combustible, other non-combustible, hygienic, hazardous, and fine particles. Hungary does not analyse the share of waste electrical and electronic equipment (WEEE), batteries, soil and stones in residual MSW.

The data provided by Hungary on the residual MSW composition were combined with the data provided on waste by material separately collected for recycling in order to generate the total municipal solid waste (MSW) composition.

Municipal solid waste generation and management

The MSW generation and treatment data provided by Hungary were used in the model.

Recycling tonnage

The data provided by Hungary on tonnage of materials collected for recycling were used in the model.

Hungary reported as follows on the collection of this data:

Data reporting has to be done yearly by site and waste type, and quarterly on hazardous waste collection, commerce, collection for treatment and treatment. Different forms are submitted to the Inspectors in case of yearly reporting (HIR-ÉV) and quarterly reporting (HIR-NÉ). Both forms are submitted filled in with ÁNYK, through the secure customer site.

Biowaste treatment

In the waste model, biowaste is split into three categories: food waste, garden waste, and other bio-waste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

For food waste, Hungary reported 50 per cent treated by OAW and 50 per cent by IVC. For garden waste, it reported 75 per cent OAW and 20 per cent IVC; This was adjusted to 80 per cent OAW and 20 per cent IVC in order to sum up to 100 per cent. No information was provided for other biowastes.

Hungary is currently investigating the applicability of each technology.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – Gas to flaring only.

There is no AD capacity in Hungary.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation.

Hungary indicated a split of 28 per cent MBT 1 and 72 per cent MBT 5.

Under the development programme up to 2020, it is intended that a greater proportion of the organic content output from MBT 5 (0–80 mm waste sifted from mixed waste) undergoes biostabilisation prior to its disposal. This particularly applies to waste that is unsuitable for energy recovery. Where this is justified by the composition of the waste, the highest possible level of mixed waste sorting has to be ensured.

Incineration

The model includes the following four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Hungary reported Incineration 2 for 100 per cent of the MSW going direct to incineration.

Waste generation projections

Hungary has provided own waste generation projections for most years so the model will use these, supplemented by an estimate for 2020 provided by the ETC/WMGE. The ETC/WMGE estimate is based on linear interpolation.

Table 43 Municipal solid waste generation projections for Hungary, 2020–2035

	2020	2025	2030	2035
Reported projections, '000 tonnes		3 660	3 653	3 624
ETC/WMGE projections, 000 tonnes	3 683			

Hungary's own projection is based on the expectation that per person MSW generation will increase slightly as a result of economic growth and changing consumer habits. This will be partly offset by intensified reuse and prevention activities and the progressive reduction of packaging weight (thinner materials). In addition, the National Statistics Office expects the population of Hungary to decrease to around 9.5 million by 2035, so the total amount of MSW is projected to decrease. However, certain fractions will change: amounts of plastic and metal packaging waste will increase, while amounts of glass packaging waste and non-packaging paper waste will decrease. The shares of other waste fractions will also decrease.

However, as no quantified projections for a change in waste composition is available, the waste composition in the model is kept unchanged until 2035.

Baseline scenario

Hungary reached a dry materials and biowaste recycling rate of 32 per cent in 2015, a substantial increase over the previous 10 years. The yearly increase fluctuated between 1 and 4 percentage points (Table 44).

Table 44 Municipal solid waste generation and treatment, 1995–2015

Hungary	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	4 752	4 834	5 016	4 976	4 943	4 552	4 603	4 646	4 700	4 592	4 646	4 711	4 594	4 553	4 312	4 033	3 809	3 988	3 738	3 795	3 712
Material recycling, '000 tonnes	59	60	62	62	61	56	57	67	117	501	403	432	490	607	576	641	654	832	799	923	963
Composting and digestion, '000 tonnes	18	18	19	18	18	17	17	47	47	39	41	58	64	85	90	148	184	183	188	236	231
Recycling rate, %	1.6	1.6	1.6	1.6	1.6	1.6	1.6	2.5	3.5	11.8	9.6	10.4	12.1	15.2	15.4	19.6	22.0	25.5	26.4	30.5	32.2
Increase in recycling rate, percentage points	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.0	8.3	-2.2	0.8	1.7	3.1	0.2	4.1	2.4	3.5	1.0	4.1	1.6

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Hungary reports that none of its MSW goes directly to landfill. However, Eurostat reports that 53.6 per cent goes to landfill for final disposal. The difference indicates that significant amounts of pre-treated waste are still being sent to landfill.

Collection systems

Hungary's primary system for separate collection of paper is door-to-door, except in sparsely populated areas where bring points are used. The collection of glass is primarily done through bring points, with door-to-door collection as a secondary system. Beverage bottles are also collected through a voluntary producer/retail take-back system. Co-mingled plastics and metals are collected door-to-door, and in sparsely populated areas through bring points.

Since 1 January 2015 garden waste has to be collected under the 2012 Act CLXXXV on Waste. Garden waste can be composted by households or the residential community, or is collected by the public service provider in separate bins or bags. If the standardised bin or bag is not provided in a given public service area, garden waste has to be collected together with mixed waste. On the basis of data supplied by the public service providers, in the 2nd, 3rd and 4th quarter of 2016, an average of 25 per cent of the population was not provided with a separate collection system for green waste. Collection of bio-waste is not allowed at bring points; in some areas it is accepted at civic amenities/waste yards.

All other waste fractions are also accepted at civic amenities.

Current and future treatment capacity

The development of composting, material sorting and MBT facilities at regional level is in the planning phase, specifically for compostable MSW. The primary goal is to build treatment facilities for municipalities that do not currently have sufficient treatment capacity.

Facilities for energy recovery are currently in the planning phase. An expansion of capacity for energy recovery has been assessed, and the outcome included a number of associated requirements:

- fulfilment of obligations set out by the EU concerning MSW recycling;
- retention and improvement of separate waste collection;
- application of the most advanced technology.

Hungary believes that energy recovery from waste is very important, including energy production from biodegradable waste and the processing of waste into materials that can be used as gas or fuel.

Measures for increasing municipal solid waste recycling rates

As of the 1 January 2015, paper, glass, plastic, metal and garden waste from municipal sources must be collected separately, and a compulsory door-to-door separate collection system has to be provided by the public service provider for plastic, metal and paper waste from households. From the 1 January 2016, households can choose a smaller bin (60 or 80 litres) for the collection of residual MSW with a proportionally reduced fee. The current waste management system is not fully compliant with the above requirements, as the door-to-door system is only available for about 6 million inhabitants. A door-to-door collection system has to be ensured for all households in the coming years.

Under the new system public service providers are encouraged to improve their performance (for the fulfilment of higher recycling rates) through the service fee. Besides that, the National Waste Management Public Service Plan also specifies requirements for the recycling rates of the different waste streams.

From 1 April 2017, regional public service providers in the new integrated MSW management system must fully comply with the specifications in the National Waste Management Public Service Plan, i.e. according to the current regulations green (garden) waste collection should be ensured a minimum of four times per year for condominiums and 10 times per year for other residential properties. As a result, the collected amount of green (garden) waste is expected to increase.

Over the last few years there have been several campaigns for raising public awareness.

Waste generation and treatment scenario

Based on the information described above, a baseline scenario for the future generation and management of MSW was developed, presenting a critical view of the effects of policy measures and planned capacities. It takes into account the possibility that not all planned measures will be fully implemented or that there will be delays in setting up new treatment capacity. The scenario thus presents one view of possible future developments, helping to identify potential risks of not meeting the recycling target, and is a basis for discussion.

Hungary has shown a significant increase in its recycling rate, with an average annual increase of 1.8 percentage points over the last 10 years, and of 2.5 percentage points over the last 5 years. Based on the information provided in the questionnaire, an estimate was made of the possible increase in separate collection for dry materials recycling and biowaste treatment. For the baseline scenario, a yearly increase of 1 percentage point is used regarding collection for dry materials recycling and biowaste treatment up to 2020. As no MSW goes directly to landfill, it is assumed that the amounts of MSW separately collected for recycling will reduce the amounts going to incineration and MBT in the same proportions as they represent in treatment.

Table 45 Baseline for the first treatment of municipal solid waste in Hungary, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	3 712	3 683	3 660	3 653	3 624
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	15	20	20	20	20
Collection for biowaste treatment, %	6	11	11	11	11
Direct to MBT and mixed sorting, etc., %	69	59	57	55	55
Direct to incineration, %	10	9	8	8	8
Direct to landfill, %	0	0	0	0	0

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Hungary will reach a 31 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020. This is based on the planned and implemented measures in Hungary and the expert judgement of the ETC/WMGE.

Ireland – Baseline modelling and data updates

The government of Ireland, Department of Communication, Climate Action and Environment kindly provided data and information for the update of the waste model by answering a questionnaire. Values for Ireland are given for 2012 since no later statistics are available. Key data fed into the model are shown in appendices 1 to 8

Municipal solid waste composition

Ireland reported total household waste composition data. Data are from a slightly modified national characterisation of household and non-household municipal solid waste (MSW) carried out in 2008. The MSW composition was assumed to be the same as the household waste composition reported by Ireland, but the shares of waste electrical and electronic equipment (WEEE) and wood were adjusted (increased) to match the amounts of WEEE and wood reported as collected for recycling.

Municipal solid waste generation and management

Ireland provided data on final treatment rather than waste generated and collected. To derive an estimate for the treatment shares of the first treatment step, data from the National Waste Report for 2012⁸ were consulted. In this report, waste volumes collected for dry recycling, biowaste treatment and landfill were reported. To estimate the amount of waste sent directly to incineration (without pre-treatment), it was assumed that Ireland fully utilised its current incineration capacity and that the remaining waste reported as incinerated was actually incinerated after mechanical biological treatment (MBT). The volume collected for MBT was calculated as the remaining waste after subtracting the estimated shares collected for dry recycling, biowaste treatment, direct incineration and direct landfill.

Recycling tonnage

The data on tonnage of MSW collected for recycling had to be adjusted to match the total amounts of MSW generated, as Ireland reported collected household waste rather than MSW. Regarding biowaste, Ireland reported having collected 114 000 tonnes of brown-bin waste (food waste) and 35 000 tonnes of garden waste for treatment in 2012. In the National Waste Report, 158 000 tonnes of biowaste was reported to have been collected for treatment. It was interpreted that the additional 9 000 tonnes of biowaste collected for treatment would be categorised as ‘other biowaste’.

Data were further adjusted as the waste report indicated that the waste collected as ‘other waste’ was actually the comingled collection of dry recyclables. This amount was therefore split up and added to the categories paper and card, plastics, wood and metals. The split between fractions was based on Eurostat data on recycled packaging waste⁹ (material recycling of paper and cardboard, plastic, wooden and metallic packaging). The report also reported 828 000 tonnes of waste collected for dry recycling, which was assumed to be the total MSW separately collected for dry recycling, and which was assumed to have the same composition as the separately collected household waste reported by Ireland.

Biowaste treatment

In the waste model, biowaste is split into three categories: food waste, garden waste, and other biowaste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);

⁸ National Waste Report 2012. By the Irish Environmental Protection Agency.

http://www.epa.ie/pubs/reports/waste/stats/EPA_NWR12_Complete_to_web_5Aug14.pdf

⁹ Eurostat database Packaging waste by waste operations and waste flow, available at http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_waspac&lang=en,extracted 17/01/2001

- in-vessel composting (IVC); and
- anaerobic digestion (AD).

For food waste, Ireland reported 13 per cent to OAW, 75 per cent to IVC and 12 per cent to AD. For garden waste Ireland reported 93 per cent to OAW and 7 per cent to IVC. For other biowaste, Ireland reported 36 per cent to OAW, 27 per cent to IVC, and 37 per cent to AD.

Anaerobic digestion

The model allows for five types of output for the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

For the biogas from AD, Ireland indicated 100 per cent use of AD 2.

Mechanical biological treatment

The model includes the following five variants of MBT:

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation.

Ireland indicated that none of the MBT types included in the model describes the nature of treatment in Ireland. However, the description of the system provided by Ireland (below) was interpreted as a combination of MBT 1 and MBT 5, and the shares were assumed to be 50 per cent MBT 1 and 50 per cent MBT 5.

“Municipal waste in Ireland is either sent to bulking stations where some large items may be picked out (manual/grab) or to mechanical treatment facilities where the waste is sorted/trommelled and recyclables segregated. Refuse-derived fuel (RDF) and/or solid recovered fuel (SRF) may be produced and organic fines are sent off-site (generally to a composting facility) for biostabilisation. In 2015, five composting facilities produced biostabilised residual waste from organic fines arising from the mechanical treatment of residual waste.”

Incineration

The model includes the following four types of incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Ireland reported 100 per cent Incineration 3. A second MSW incinerator was expected to commence operations in 2017 (Dublin Waste to Energy Ltd./Poolbeg). This incinerator will supply electricity and, in time, is also intended to supply a district heating system; this infrastructure is not yet in place. However, the

available information and uncertainty about the district heating system did not allow to produce a quantified estimate about the future changes, therefore the treatment split is kept stable over time in the model.

Waste generation projections

Ireland provided own MSW generation projections up to 2025, compiled using a combination of household and commercial waste generation projections. The projections for household waste were calculated using population projections to 2021 linked to data on household waste generated per person during the period 2003–2012. Commercial waste generation projections were made by estimating gross national product (GNP) to 2021 and linking 2003–2012 national commercial waste generation to GNP.

The model will use the reported scenario up to 2025, and projections up to 2035 produced by the ETC/WMGE. These projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 46 Municipal solid waste generation projections for Ireland, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes			3 848	3 923
Reported projections, '000 tonnes	3 300	3 810		

Updating of baselines

The following information was considered when updating the baseline scenario in the waste model.

Ireland had a steady increase in composting and digestion until 2012 while the share of dry materials recycling remained stable. There is no reported data in the Eurostat database beyond 2012 (Table 47).

Table 47 Municipal solid waste generation and treatment, 1995–2012

Ireland	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Waste generation, '000 tonnes	1 848	1 898	2 000	2 057	2 168	2 279	2 704	2 720	2 918	3 001	3 041	3 385	3 398	3 224	2 953	2 846	2 823	2 693
Material recycling, '000 tonnes	124	130	150	161	205	254	284	463	650	835	898	1 064	1 081	977	902	910	861	829
Composting and digestion, '000 tonnes				6		17	22	34	40	50	48	55	79	107	88	107	157	156
Recycling rate, %	6.7	6.8	7.5	8.1	9.5	11.9	11.3	18.3	23.6	29.5	31.1	33.1	34.1	33.6	33.5	35.7	36.1	36.6
Increase in recycling rate, percentage points		0.1	0.7	0.6	1.3	2.4	-0.6	7.0	5.4	5.8	1.6	1.9	1.1	-0.5	-0.1	2.2	0.3	0.5

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Collection systems

Ireland has a three-level collection system for recycling:

- door-to-door collection, mainly biowaste;
- public bring points, mainly glass;
- public amenity sites, all types of MSW fractions.

Treatment capacity

Composting

- existing capacity: in-vessel composting of 350 000 tonnes per year, and open-air windrow facilities of 210 000 tonnes per year for garden waste.

Anaerobic digestion

- existing capacity: 30 000 tonnes per year for managing brown-bin waste (food and other biowaste).

Incineration

- existing annual capacity: waste-to-energy incineration, 825 000 tonnes (Indaver and Poolbeg); cement kilns 250 000 tonnes; additionally, 400 000–500 000 tonnes are exported annually for incineration;
- future capacity: Dublin Waste-to-Energy Plant, 600 000 tonnes per year from 2018 (approximately 370 000 tonnes in 2017);
- there is a limit of an additional 300 000 tonnes permitted thermal treatment capacity for MSW per year – 200 000 tonnes at waste-to-energy plants and 100 000 tonnes at cement kilns.

Mechanical biological treatment

- existing capacity: mixed dry recycling (MDR), 320 000 tonnes per year for sorting of co-mingled collection; preparation of RDF, 400 000–500 000 tonnes per year;
- biostabilisation is likely to diminish as more incineration facilities are built in Ireland and there will be no need to pre-treat for export for waste-to-energy incineration.

Measures for increasing municipal solid waste recycling rates

Ireland's 2015 revised waste legislation included several initiatives to increase the recycling rate and reach the 50 per cent recycling target by 2020. This is also an overarching strategic target in the Regional Waste Management Plans 2015–2021. Initiatives include:

- A brown bin awareness campaign to support the separate collection of biowaste. Recent statistics show a positive increase in the quantity of waste accepted for treatment at composting and AD plants.
- Legislation compelling collectors to provide separate collection services for biowaste.
- As of 2015, a list of recyclable materials that waste service providers are obliged to collect.
- As of 2015, regulations for decreasing landfill by gradually banning the collection of waste in bags, and through specific obligations on waste collectors such as a mandated service level as a condition for holding collection permits.

Waste generation and treatment scenarios

Based on the information described above, a baseline scenario for the future generation and management of MSW was developed. This scenario presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures will be fully implemented or that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify potential risks of not meeting the target for recycling and serving as a basis for discussion.

Estimates of future recycling rates are based on the above measures. Regarding collection for dry materials recycling, it is assumed that there will be an increase of 2 percentage points by 2020 based on planned improvements in the separate collection system. For separately collected biowaste, it is assumed that this will increase by 5 percentage points by 2020, based on actions to improve site sorting of biowaste. It is estimated that the biowaste capture rate (share of biowaste separately collected related to biowaste generated) will reach 50 per cent in 2025.

Regarding final treatment, the increase in separately collected waste will result in a decrease in the share of residual waste. It is assumed that the incineration rate will increase as the incinerator in Dublin, Poolbeg, becomes operational, and that the share of MSW directly landfilled decreases. As no specific measures to

improve MSW management after 2020 are known, the shares of waste sent directly to MBT, landfill and incineration are assumed to remain stable in the period after 2020.

Table 48 Baseline for the first treatment of municipal solid waste in Ireland, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	2 820	3 300	3 810	3 848	3 923
Collection coverage, % of population	88	97	100	100	100
Collection for dry materials recycling, %	31	33	33	33	33
Collection for biowaste treatment, %	6	11	11	11	11
Direct to MBT and mixed sorting, etc., %	9	6	6	6	6
Direct to incineration, %	8	25	25	25	25
Direct to landfill, %	46	25	25	25	25

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Ireland will achieve a 44 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020.

Italy – Baseline modelling and data updates

The Environmental Ministry of Italy kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

The reported composition of waste was calculated by the Italian Institute for the Environment (ISPRA) for all the municipal solid waste (MSW) produced, and the composition percentages are calculated as averages of the 2008–2015 figures. The waste composition is based on analyses carried out by ISPRA both on waste separately collected at source and mixed residual waste.

Municipal solid waste generation and management

Data on the generation and treatment of MSW were gathered by ISPRA¹⁰ and refer to 2015. The data provided by Italy required adjustment for use in the model as they reflected 2 per cent mass losses (humidity losses of organic waste) and did not sum to 100 per cent. The 2 per cent were added to the share of biowaste.

Recycling tonnage

Data on the generation and treatment of MSW were gathered by ISPRA² and refer to 2015.

Italy provided data on both separately collected waste by material and waste sent to final recyclers. However, as the figures for waste sent to final recyclers only cover packaging waste, the more comprehensive data provided by Italy on separately collected waste were used to update the waste model.

Biowaste treatment

In the waste model, biowaste is split into three categories: food waste, garden waste, and other biowaste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

For food waste, Italy reported 45 per cent to OAW, 45 per cent to IVC, and 10 per cent to AD. For garden waste, the shares were 43 per cent to OAW, 43 per cent to IVC, and 14 per cent to AD. Other biowaste was reported as 33 per cent to OAW, 33 per cent to IVC, and 34 per cent to AD.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

¹⁰http://www.isprambiente.gov.it/files/pubblicazioni/rapporti/RapportoRifiutiUrbani_Ed.2016_n.251_Vers.Integrale_ErrataCorrige.pdf), relevant information at pages 30, 39, 98, 110, 121

²http://www.isprambiente.gov.it/files/pubblicazioni/rapporti/RapportoRifiutiUrbani_Ed.2016_n.251_Vers.Integrale_ErrataCorrige.pdf), relevant information at pages 54, 81, 83, 91, 94, 141

Italy indicated 100 per cent AD 1. This is expected to change, with a shift from AD 1 to AD 4 and AD 3; the model therefore assumes that by 2020 the split will be 80 per cent AD 1, 5 per cent AD 3 and 15 per cent AD 4.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation.

Italy indicated 100 per cent use of MBT 1.

Incineration

The model includes the following four types of incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Italy reported 57 per cent Incineration 1 and 43 per cent Incineration 2.

Waste generation projections

Italy indicated that they wish the waste generation to be kept constant at the 2015 level (Table 49).

Table 49 Municipal solid waste generation projections for Italy, 2020–2035

	2020	2025	2030	2035
Reported projections, '000 tonnes	29 524	29 524	29 524	29 524

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

Italy's recycling volumes have increased steadily over the past 10 years at an average annual rate of about 2 percentage points.

Table 50 Municipal solid waste generation and treatment, 1995–2015

Italy	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	25 780	25 960	26 605	26 846	28 364	28 959	29 409	29 864	30 035	31 150	31 668	32 516	32 536	32 461	32 107	32 440	31 386	29 994	29 573	29 652	29 524
Material recycling, '000 tonnes	930	1 199	1 874	2 235	2 595	2 888	3 513	2 727	3 108	3 509	3 683	3 813	5 536	4 631	6 042	6 107	7 149	7 177	7 335	7 732	7 649
Composting and digestion, '000 tonnes	315	465	604	723	841	1 237	1 727	1 696	1 796	1 958	2 185	2 433	2 599	3 106	3 490	3 943	3 980	4 339	4 319	4 865	5 203
Recycling rate, %	5	6	9	11	12	14	18	15	16	18	19	19	25	24	30	31	35	38	39	42	44
Increase in recycling rate, percentage points	0	2	3	2	1	2	4	-3	2	1	1	1	6	-1	6	1	4	3	1	3	1

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Treatment capacity

Some further increase in AD is expected. In the decree (DPCM) of 10 August 2016 on treatment capacity, it is estimated that an additional incineration capacity of 1.8 million tonnes will be needed at a national level. For biowaste treatment from separate collection (DPCM of 7 March 2016), capacity requirements are given region by region. The identified combined need for new incineration and biowaste treatment capacity ranges from 2.1 to 3 million tonnes. However, the decrees are only indications to regional governments; they are not included in the regional waste management plans and cannot therefore be considered definite: the final decision is up to the regions.

Measures for increasing municipal solid waste recycling rates

Summary of new policies which may influence future recycling rates:

- 1) The national separate collection target for municipalities is set at 65 per cent of total MSW. In 2010, 11 453 tonnes of MSW were separately collected, rising to 14 021 tonnes in 2015. This positive trend is expected to continue at much the same rate.
- 2) There has been a 20 per cent increase in the landfill tax for those municipalities that do not reach the 65 per cent target on separate collection. The measure should help increase separate collection by encouraging municipalities to shift from roadside collection systems to more efficient door-to-door ones.
- 3) Municipalities that reach the separate collection target are subject to a reduced landfill tax.
- 4) The biowaste treatment decree (DPCM 7 March 2016) gives clear indications to the regions and municipalities of the requirement for separate collection of all biowaste at source. On this basis, it estimates each region's needs for the upcoming new recycling target of the EU Circular Economy package to be met.
- 5) The decree on separate collection points simplifies the municipalities' authorisation procedure for setting up new waste collection points for citizens to deposit separately collected waste, such as bulky waste and furniture. This has helped build a new waste management infrastructure and contributed to the increase in separate collection and recycling.
- 6) The Environment Ministry has proposed an increase in the landfill tax. The provision is included in the 'green act' draft regulation.

Italy plans several changes to the collection systems.

There is to be an increase in the use of door-to-door collection schemes to meet the obligatory target of 65 per cent separate collection, which has been in force since 2012. Establishing a door-to-door system for the city of Rome is expected to make the necessary difference (it currently only operates in some districts). Some large and highly populated regions, including Emilia-Romagna and Veneto, have stricter separate collection targets of 70 per cent.

Door-to-door collection of biowaste is also expected to increase. Separate collection of biowaste has been rising very rapidly in Italy – by 9.5 per cent during 2013–2014 – and is expected to continue increasing.

A new decree (Decree 266 of 29 December 2016) is expected to increase the quantity of waste recycled on site (home composting). Italian representatives believe that this will contribute to public involvement in waste management with good results in terms of responsibility, awareness and the acceptability of industrial composting and AD plants.

Waste generation and treatment scenario

Based on the information above, a baseline scenario for the future generation and management of MSW has been developed. This presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures will be fully implemented and that there may be

delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identifying potential risks of not meeting the recycling target and serving as a basis for discussion.

Given the high number of new policies in place, the past trends showing continuous improvements to recycling rates, and the considerable effort that the country is making to achieve higher recycling targets, we expect Italy to further increase collection of both dry recyclables and biowaste up to 2025. Plans to increase incineration capacity account for the reduction in waste going direct to MBT shown in the baseline.

Table 51 Baseline for the first treatment of municipal solid waste in Italy, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	29 524	29 524	29 524	29 524	29 524
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	27	30	32	32	32
Collection for biowaste treatment, %	23	27	28	28	28
Direct to MBT and mixed sorting, etc., %	36	23	20	20	20
Direct to incineration, %	10	16	16	16	16
Direct to landfill, %	4	4	4	4	4

Note: shares might not sum to 100% due to rounding.

Latvia – Baseline modelling and data updates

The Ministry of Environmental Protection and Regional Development of Latvia kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Latvia reported municipal solid waste (MSW) composition data based on the residual MSW stream. In order to generate total MSW composition as input for the model, the residual waste composition data were combined with data reported on MSW separately collected for recycling. Latvia did not provide a breakdown of biowaste into garden and food wastes, but specified that garden waste was 7 per cent of the residual waste in a specific study. As the model requires a figure for food waste, it was assumed that the remaining biowaste was food waste. Finally, the MSW composition data provided by Latvia were slightly adjusted to sum to 100 per cent.

Municipal solid waste generation and management

The data provided by Latvia on the generation and management of MSW required no adjustment for use in the model.

Recycling tonnage

The data on tonnage of materials collected for recycling provided by Latvia were slightly adjusted as food and other biowaste data were reported twice, in the section for biowaste and specified as food and other biowaste. In addition, the data had to be adjusted because the MSW generation and treatment figures were not fully consistent with the provided data on the total amounts of material collected for recycling.

Biowaste treatment

In the waste model, biowaste is split into three categories: food waste, garden waste, and other biowaste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

Latvia records no split between the three components of biowaste (food, garden, and other biowaste). For all biowaste components 100 per cent OAW was reported.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

In the questionnaire's section on biowaste Latvia reported no AD treatment of MSW. However, it has an annual 36 000 tonne AD capacity and reported 100 per cent AD 2 treatment for the biogas from AD.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation.

Latvia increased its MBT capacity in 2014 and 2015, with mechanical sorting plants treating mainly residual waste and manual sorting plants mainly sorting separately collected recyclables. Latvia reported 100 per cent MBT 5 and no indication of change in the future MBT split.

However, none of the MBT variants in the model is suitable for Latvia, where a majority of the MBT in operation in 2015 seems to be mechanical separation of recyclables and the production of a very small volume of refuse-derived fuel (RDF), with the remaining waste sent to landfill without biological treatment. In the model, the application of MBT 5 would generate a significant amount of RDF, but as Latvia does not report significant volumes of incineration of MSW to Eurostat. Therefore, it was decided to reclassify MBT treatment for Latvia as MBT 1, keeping in mind that this will underestimate greenhouse gas emissions from landfilling residual waste after the mechanical sorting. As new MBT facilities come into operation it is assumed that these correspond to MBT 5, as reported by Latvia. Thus, as of 2020, the MBT split for Latvia is assumed to be 43 per cent MBT 1 and 57 per cent MBT 5, based on the available information about existing capacity in 2015 and new capacities becoming operational after 2015.

Incineration

The model includes the following four types of incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – combined heat and power (CHP);
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

There are no waste incineration plants in Latvia. A small amount of locally produced RDF is incinerated in cement kilns. There are plans to build a small incineration facility.

Waste generation projections

Latvia provided a waste generation scenario up to 2020. The updated projections produced by the ETC/WMGE continue from the value given for the year 2020. The ETC/WMGE projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 52 Municipal solid waste projections for Latvia, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes	690	678	677	689
Reported projections, '000 tonnes	690			

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

Latvia has a trend of increasing dry material and biological recycling volumes (Table 53).

Table 53 Municipal solid waste generation and treatment, 1995–2015

Latvia	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000	657	650	621	597	613	642	713	793	695	720	716	760	861	752	753	680	721	613	704	726	857
Material recycling, '000	0	0	0	0	0	0	0	3	14	25	26	29	38	43	56	60	62	84	142	170	182
Composting and digestion, '000	0	0	0	0	0	0	3	0	2	8	1	5	5	5	2	4	8	13	40	26	47
Recycling rate, %	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	2.3	4.6	3.8	4.5	5.0	6.4	7.7	9.4	9.7	15.8	25.9	27.0	26.7
Increase in recycling rate, percentage points		0.0	0.0	0.0	0.0	0.0	0.4	0.0	1.9	2.3	-0.8	0.7	0.5	1.4	1.3	1.7	0.3	6.1	10.0	1.1	-0.3

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Collection systems

In Latvia paper, glass, and plastics are collected both door-to-door and through bring points. In sparsely populated areas, co-mingled collection of paper and plastics is in use. Public amenity sites collect all MSW fractions, as well as hazardous waste from households. There is a voluntary retail take-back system for beverage glass and polyethylene terephthalate (PET) bottles.

Treatment capacity

- Composting: currently 54 200 tonnes per year capacity.
- AD: current annual capacity of 36 000 tonnes but no reported treatment for 2015.
- MBT: in 2014 the capacity of mechanical sorting plants was 232 000 tonnes per year; such plants generally treat residual waste. New MBT facilities were built in 2015 and 2016 in the Riga and Liepāja regions with annual capacities of 300 000 tonnes and 8 000 tonnes (possibly rising to 30 000 tonnes).

The reported capacity for MBT is lower than the waste volumes reported to have been sent to MBT in 2015. However, more capacity is under construction..

- Material sorting facilities: manual sorting plant capacity of approximately 202 000 tonnes per year, mainly for separately collected recyclables.
- One municipality is exploring to build an incinerator but a decision has not been taken.

Measures for increasing municipal solid waste recycling rates

- Regulation of minimum requirements to be included in the contracts between municipalities and waste managers (including requirements for separate collection). Minimum criteria for collection points and civic amenity sites based on population densities.
- Increased recycling targets for packaging.
- Increased landfill tax 2017–2020 (Natural Resources Tax Law).
- Development of a legal basis for investment in developing collection systems and recycling facilities (2017–2022).

Waste generation and treatment scenario

Based on the information described above, a baseline scenario for the future generation and management of MSW has been developed. This presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures are fully implemented or that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify potential risk of not meeting the recycling target and serving as a basis for discussion.

Regarding collection for dry materials recycling, it is assumed that there will be a 4 percentage point increase by 2020 based on efforts to increase separate collection. For separately collected biowaste, it is assumed

that there will be no increase in separate collection as there is no indication of efforts to support this development.

All residual waste is currently being sent to MBT before final treatment and it is assumed that this will remain the case in the future. Two new MBT facilities that began operations in 2015 and 2016 are expected to be fully operational in 2020.

Table 54 Baseline for the first treatment of municipal solid waste in Latvia, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	798	690	678	677	689
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	26	30	30	30	30
Collection for biowaste treatment, %	6	6	6	6	6
Direct to MBT and mixed sorting, etc., %	68	64	64	64	64
Direct to incineration, %	0	0	0	0	0
Direct to landfill, %	0	0	0	0	0

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Latvia will reach a 36 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020.

Lithuania – Baseline modelling and data updates

The Environmental Protection Agency of Lithuania kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Lithuania reported municipal solid waste (MSW) composition data based on the total MSW, and these data are used in the model.

Municipal solid waste generation and management

The MSW generation and treatment data provided by Lithuania were slightly adjusted so that the treatment destinations sum to 100 per cent of waste generation.

Recycling tonnage

The data on tonnage of materials collected for recycling provided by Lithuania were used in the model. No adjustments were needed.

Biowaste treatment

In the waste model, biowaste is split into three categories: food waste, garden waste, and other biowaste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

For food waste, Lithuania reported 52 per cent to OAW, 32 per cent to IVC and 16 per cent to AD. For garden waste Lithuania reported 70 per cent to OAW and 30 per cent to AD. For other biowaste, Lithuania reported 34 per cent to OAW, 47 per cent to IVC, and 19 per cent to AD.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

Lithuania has no AD for treatment of separately collected biowaste, but uses AD-type MBT facilities for the treatment of residual MSW. Lithuania reported the MBT 4 treatment split for AD of separately collected biowaste, and this data is fed into the model.

Mechanical biological treatment

The model includes the following five variants of MBT:

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation

Lithuania indicated a split of 39 per cent MBT 1, 31 per cent MBT 3, 19 per cent MBT 4, and 11 per cent MBT 5.

Lithuania constructed 11 MBT facilities in 2015 and 2016, not all of which are yet in full use. There are no plans to construct further MBT facilities and it can be expected that the MBT split will move towards the theoretical treatment capacity of MBT in Lithuania (Table 55).

Table 55 Mechanical biological treatment split in Lithuania, 2016 and 2020

	2016 reported shares	2020 theoretical capacity
MBT 1, %	39	40
MBT 2, %	0	0
MBT 3, %	31	26
MBT 4, %	19	26
MBT 5, %	11	8

Incineration

The model includes the following four types of incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Lithuania reported 100 per cent Incineration 2. However, no waste is currently sent directly to incineration, instead refuse derived fuel is generated at MBT facilities that is then sent to energy recovery Lithuania indicates that ‘according to the National Waste Management Plan for 2014–2020, the design of two more incineration facilities (in Vilnius and Kaunas) is planned in the near future.’

Waste generation projections

Lithuania did not provide own projections, so the model will use the updated projections produced by the ETC/WMGE for the EEA (Table 56). The projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 56 Municipal solid waste projections for Lithuania, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes	1 321	1 317	1 308	1 271

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

Lithuania has a rising trend in material recycling and composting and digestion volumes (Table 57).

Table 57 Municipal solid waste generation and treatment, 1995–2015

Lithuania	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000	1 546	1 445	1 510	1 578	1 236	1 276	1 313	1 395	1 328	1 260	1 287	1 326	1 354	1 369	1 206	1 253	1 339	1 330	1 280	1 270	1 300
Material recycling, '000	0	0	0	0	0	0	0	0	0	14	14	14	80	101	87	43	244	261	261	268	298
Composting and digestion, '000	0	0	0	0	0	0	0	0	0	10	10	11	22	15	16	19	23	51	95	119	132
Recycling rate, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	1.9	1.9	7.5	8.5	8.5	4.9	19.9	23.5	27.8	30.5	33.1
Increase in recycling rate, percentage points		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	5.6	0.9	0.1	-3.6	15.0	3.5	4.4	2.7	2.6

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]
http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Collection systems

In Lithuania, source-separated glass and sometimes biowaste are collected door-to-door from individual households. Co-mingled plastic, metals and paper are collected door-to-door from individual households, while bring sites are used for the collection of recyclable fractions from apartment buildings. Furthermore, civic amenity sites accept all MSW fractions and hazardous waste from households. There is a take-back system for glass and polyethylene terephthalate (PET) bottles as well as for metal tins.

Treatment capacity

- Lithuania actively promotes home composting by providing households with home composting containers; more than 200 000 containers were provided in the period 2012-2017, giving room for an estimated capacity of 35 354 tonnes of individual composting of biowaste.
- Material sorting facilities: there is currently capacity of 700 000 tonnes per year for the mechanical sorting of mixed MSW without MBT (private facilities). Part of this capacity is used for sorting separately collected recyclables.
- MBT: since 2016 the following facilities are operating, with a total annual capacity of 1 002 000 tonnes:
 - Klaipėda MBT – 125 000 tonnes
 - Alytus – 65 702 tonnes
 - Panevėžys – 86 470 tonnes
 - Telšiai – 50 000 tonnes
 - Utena – 45 200 tonnes
 - Kaunas – 220 000 tonnes
 - Kėdainiai – 20 000 tonnes
 - Marijampolė – 65 000 tonnes
 - Šiauliai – 50 000 tonnes
 - Tauragė – 25 000 tonnes
 - Vilnius – 250 000 tonnes
- Incineration: the current annual capacity of 255 000 tonnes is for energy recovery of MBT outputs; 71 000 tonnes was unused in 2015. According to the national waste management plan for 2014–2020, two more incineration facilities (in Vilnius and Kaunas) are to be built in the near future.

Measures for increasing municipal solid waste recycling rates

- The landfill tax implemented in 2016 is planned to increase from EUR 3 per tonne to EUR 27.51 per tonne in 2020.
- There are plans to introduce an incineration and MBT tax (lower than the landfill tax), and use the revenue to support separate collection and alternative infrastructure.

- From 1 January 2017, a local levy or other type of payment is mandatory in all municipalities of Lithuania.
- A deposit system for single use beverage containers was implemented in February 2016 with a 55 per cent collection target for that year related to sales volumes, but 75 per cent was accomplished. The target for 2020 is 90 per cent.
- All individual households will have door-to-door collection by 2018. In addition, the bring point network is being expanded.
- It is planned that as of 2019 food waste shall be separately collected from households in cities.
- Composting containers are provided for individual households to support home composting. In cities, food waste will be collected separately from households as of 2019.

Waste generation and treatment scenario

Based on the information described above, a baseline scenario for the future generation and management of municipal waste has been developed. This presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures are fully implemented or that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify potential risk of not meeting the target for recycling and serving as a basis for discussion.

Estimates of future separate collection rates are based on the above measures. Regarding collection for dry materials recycling, it is assumed that there will be an increase of 4 percentage points by 2020 and a further 5 percentage points by 2025 based on the described efforts to increase separate collection. For separately collected biowaste, it is assumed that this will increase by 1 percentage point by 2020 and a further 5 percentage points by 2025 based on efforts to increase separate collection of food waste starting in 2019.

Regarding final treatment, the increase in separately collected waste will result in a decrease in residual waste. For landfill, the assumption is made that the waste sent directly to landfill will fall to 20 per cent by 2020 and to 5 per cent in 2025 based on the introduction and increase of the landfill tax, as well as due to the increasing MBT capacity. There are no incineration facilities for residual waste in Lithuania and no firm plans to construct any, so it is assumed that there will be no incineration of mixed residual waste in the future, however MBT outputs will be partly sent to energy recovery but this will only be reflected in the final treatment, not in the first treatment step as presented in Table 58. Regarding MBT, it is assumed that the treatment rate will increase as landfill diminishes.

Table 58 Baseline for the first treatment of municipal solid waste in Lithuania, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	1 327	1 321	1 317	1 308	1 271
Collection coverage, % of population	98	100	100	100	100
Collection for dry materials recycling, %	22	26	31	31	31
Collection for biowaste treatment, %	5	6	11	11	11
Direct to MBT and mixed sorting, etc., %	31	48	53	53	53
Direct to incineration, %	0	0	0	0	0
Direct to landfill, %	41	20	5	5	5

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Lithuania will reach a 32 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020 and a 42 per cent rate by 2035. Collection coverage is assumed to reach 100 per cent by 2020.

Luxembourg – Baseline modelling and data updates

The Environment Protection Agency of Luxembourg kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Luxembourg provided information on the composition of mixed municipal solid waste (mixed MSW). In order to estimate the composition of total MSW needed as input to the model, the reported waste composition data for residual municipal waste was combined with data reported on MSW separately collected for recycling.

Municipal solid waste generation and management

Luxembourg provided information on the generation and treatment of MSW. These data were used to update the model.

Recycling tonnage

The data provided by Luxembourg on tonnage of materials collected for recycling were slightly modified to align with the amounts of waste collected for recycling and biowaste treatment (reported total amount of separately collected MSW was slightly lower than the reported sum of separately collected materials).

Biowaste treatment

In the waste model, biowaste is split into three categories: food waste, garden waste, and other biowaste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

Luxembourg indicates a split for the treatment of food waste: 1.2 per cent OAW and 98.8 per cent AD. For garden waste the treatment split is 88.8 per cent OAW and 11.2 per cent AD. The treatment split for other biowaste reported by Luxembourg is 33 per cent OAW, 33 per cent IVC, and 34 per cent AD.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

Luxembourg indicates 66 per cent AD 2 and 34 per cent AD 3.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and

- MBT 5 – basic sorting with energy generation.

Luxembourg indicates 100 per cent MBT 1.

Incineration

The model includes the following four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Luxembourg reported 100 per cent incineration 1.

A shift from Incineration 1 to Incineration 2 is expected by the end of 2018, when the supply pipes will be installed to a district in the city of Luxembourg. The model therefore assumes a gradual switch to 100 per cent Incineration 2 by 2020.

Waste generation projections

Luxembourg did not provide own waste generation projections, so the model uses projections produced by the ETC/WMGE. The ETC/WMGE projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 59 Municipal solid waste generation projections for Luxembourg, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes	341	345	355	375

Baseline scenario

The recycling rate in Luxembourg has been quite steady over the last 10 years, with a 4.5 percentage point increase over this period, thus a yearly increase of 0.46 percentage points. The highest annual increase can be seen in the first five years of this period (2006–2011).

Table 60 Municipal solid waste generation and treatment, 1995–2015

Luxembourg	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	240	242	253	266	278	285	285	291	306	311	313	323	333	341	338	344	345	346	335	348	356
Material recycling, '000 tonnes	31	37	46	52	52	62	66	66	71	72	80	84	86	89	89	93	98	96	95	99	101
Composting and digestion, '000 tonnes	17	12	22	30	33	41	40	45	59	57	56	57	64	68	67	67	62	68	61	67	70
Recycling rate, %	20.0	20.2	26.9	30.8	30.6	36.1	37.2	38.1	42.5	41.5	43.5	43.7	45.0	46.0	46.2	46.5	46.4	47.4	46.6	47.7	48.0
Increase in recycling rate, percentage points	0.0	0.2	6.6	3.9	-0.3	5.6	1.1	1.0	4.3	-1.0	2.0	0.2	1.4	1.0	0.1	0.4	-0.1	1.0	-0.8	1.1	0.3

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Approximately 18 per cent of the MSW goes to landfill. This has been the case for more than 10 years.

Collection systems

In Luxembourg, door-to-door collection is the primary system for paper, glass and biowaste. Plastics and metals are collected co-mingled (combined with composite materials) and via a door-to-door system. Bring

points are the secondary system for paper, glass, plastics, metals and biowaste, although this type of collection is gradually disappearing. There is a producer/retail take-back system for packaging ('RE-box') and waste electrical and electronic equipment (WEEE). In RE-box collecting stations consumers can deposit, among other packaging, their yoghurt pots and plastic film. This project aims to promote the recycling of certain plastic packaging that is currently too often thrown in the grey bin (residual waste). All fractions are also accepted at civic amenity sites.

Treatment capacity

Luxembourg indicated that it has plans to install additional material sorting facilities for plastic bottles, metal waste and beverage cartons (PMC), but had no information on the planned capacity. There are also plans to upgrade a composting plant, but again there is no detailed information. Luxembourg has no plans for additional incineration or MBT capacity.

Measures for increasing municipal solid waste recycling rates

The following measures have been or are being introduced in Luxembourg to increase MSW recycling rates:

- pay-as-you-throw schemes – by 2018/2019 most municipalities will have taxes for mixed waste and bulky waste calculated on the volume and/or weight produced;
- separate collection in apartment buildings is already being implemented;
- mandatory separate collection of biowaste since 1994;
- by 2020 a recycling quota of 50 per cent has to be achieved by each municipality;
- extended PMC collection (mainly more plastic fractions) in all municipalities by 2018/2019;
- introduction of door-to-door collections for glass by 2020 in the 48 municipalities of SIDEC, the communal waste syndicate;
- introduction of a pay-as-you-throw scheme for mixed MSW by 2020 in the 48 SIDEC municipalities;
- door-to-door collections of biowaste in all municipalities by 2020.

Waste generation and treatment scenario

Based on the information described above, a baseline scenario for the future generation and management of MSW was developed, presenting a critical view of the effects of policy measures and planned capacities. It takes into account the possibility that not all planned measures will be fully implemented or that there will be delays in setting up new treatment capacity. The scenario thus presents one view of possible future developments, helping to identify potential risks of not meeting the recycling target, and is a basis for discussion.

Luxembourg has planned measures to increase the collection of glass, biowaste and plastics and to decrease residual waste through pay-as-you-throw schemes. Based on these measures, current collection rates and expert judgement, the ETC/WMGE assumes an increase in the separate collection of food, garden and plastic waste by 3 percentage points until 2020. The combined measures for improving separate collection of glass, plastics and PMC and the pay-as-you throw schemes are assumed to lead to an increase of the separate collection of dry recyclables by 3 percentage points until 2020. As no measures are indicated for the period after 2020, the treatment shares are kept stable after 2020.

Regarding final treatment, it is assumed that the increase in the share of separate collection will result in a decrease in the share of residual waste going directly to landfill.

Table 61 Baseline for the first treatment of municipal solid waste in Luxembourg, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	348	341	345	355	375
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	28	31	31	31	31
Collection for biowaste treatment, %	19	22	22	22	22
Direct to MBT and mixed sorting, etc., %	7	7	7	7	7
Direct to incineration, %	34	34	34	34	34
Direct to landfill, %	12	6	6	6	6

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Luxembourg will reach a 53 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020. This is based on the indicated measures to increase recycling rates in the future.

Malta – Baseline modelling and data updates

The Ministry for Sustainable Development, Environment and Climate Change of Malta kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Malta provided two sets of waste composition data. One refers to figures obtained from a household waste composition survey carried out by the National Statistics Office (NSO) between July 2011 and April 2012. This concluded that during this period the daily average household waste per person in Malta amounted to 0.68 kilograms. The survey covered organic and recyclable waste generated by households. This means that, according to this survey, the total household waste generated in Malta in 2012 amounted to approximately 104 000 tonnes (0.68 kg/inhabitant x 365 days x a population of 421 364).

The second set of data relates to 2015 and results from a study carried out by Wasteserv in April 2015. The composition is based on mixed municipal solid waste (mixed MSW) and the quantity of waste analysed was 15.6 tonnes.

The composition of waste was found to be quite similar in the two studies. The composition of the 2015 study was used in the model because it shows a split between food and garden waste.

In order to estimate the composition of total MSW needed as input to the model, the reported waste composition data for residual household waste was combined with data reported on MSW separately collected for recycling.

Municipal solid waste generation and management

The data provided by Malta on MSW were used in the model .

Recycling tonnage

The data on tonnage of materials collected for recycling were slightly modified from those provided as they were not fully consistent with the data on MSW generation and treatment (reported total amount of separately collected MSW was slightly lower than the reported sum of separately collected materials).

Malta indicated that the amounts of material collected for recycling were calculated from the inputs and outputs of waste in waste management facilities as declared in their annual reports. Both the inputs and the outputs are classified under a specific European Waste Catalogue (EWC) code indicating the weight and final destination for each entry. Co-mingled recyclable bags are classified under code 15 01 06. The amounts of recyclables in these bags are calculated through waste characterisation surveys. These were then included in the specific waste streams (paper and cardboard, metals and plastics).

Malta did not report biowaste collected for recycling, although they reported separate biowaste collection. For the model, it is assumed that the amount of separately collected biowaste consists of food waste. This assumption is based on the fact that Malta did not report other biowaste in their MSW composition, and did not report on biowaste treatment for garden waste.

Biowaste treatment

In the waste model, biowaste is split into three categories: food waste, garden waste, and other bio-waste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC);

- anaerobic digestion (AD).

Malta reported 100 per cent AD for food and other biowaste. However, Malta reported no actual amount of other biowaste (neither in the composition data, nor separately collected).

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

Malta reported 100 per cent AD 2.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation.

Malta reported 100 per cent MBT 4.

Incineration

The model includes the following four types of incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Malta does not have incinerator capacity installed for MSW.

Waste generation projections

The waste generation projections provided by Malta are used in the model.

Table 62 Municipal solid waste projections for Malta, 2020–2035

	2020	2025	2030	2035
Reported projections, '000 tonnes	268	278	288	299

Malta indicated that the projections were calculated using the same model as presented in the Waste Management Plan 2014–2020. Projections were then carried out using the following calculation method:

$$G_{n+m} = N \times (\% \text{ change in population})_m \times W \times (\% \text{ change in waste generated})_m$$

where:

G_n is total waste generated in year n (in tonnes)

m is the number of years to projection year from year n

N is the number of inhabitants for year n

$W (G_n/N)$ is the waste generated per inhabitant per year n (in tonnes)

Assumptions:

percentage change in population = 0.41%

percentage change in waste generated = 0.33%

Baseline scenario

The recycling rate in Malta is low and fluctuates. Over the last three years the recycling rate decreased. The total amount of waste collected for dry materials recycling was approximately the same over the last five years.

Table 63 Municipal solid waste generation and treatment, 1995–2015

Malta	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	146	156	167	177	181	208	212	214	231	250	252	253	266	276	268	249	245	247	246	256	269
Material recycling, '000 tonnes	0	0	0	0	0	1	1	1	1	3	4	6	5	8	9	13	19	19	20	19	18
Composting and digestion, '000 tonnes	20	19	18	17	13	20	18	10	14	13	18	28	6	0	0	0	3	5	0	0	0
Recycling rate, %	13.7	12.2	10.8	9.6	7.2	10.1	9.0	5.1	6.5	6.4	8.7	13.4	4.1	2.9	3.4	5.2	9.0	9.7	8.1	7.4	6.7
Increase in recycling rate, percentage points	0.0	-1.5	-1.4	-1.2	-2.4	2.9	-1.1	-3.8	1.4	-0.1	2.3	4.7	-9.3	-1.2	0.5	1.9	3.8	0.7	-1.6	-0.7	-0.7

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Malta reports treatment for 97 per cent of the generated MSW. Of the treated amount, 93 per cent is finally sent to landfill, of which 74 per cent is directly sent to landfill. This indicates that a significant fraction of waste treated in MBT is sent to landfill after treatment.

Collection systems

In Malta, there is separate door-to-door collection for glass as the primary collection system. There is co-mingled door-to-door collection for paper, plastics and metals. These fractions are also collected through bring points, which have been introduced as a secondary system. All streams are separately accepted at civic amenity sites. This is the primary collection system for garden waste, although home composting is encouraged.

A pilot exercise, the Organic Waste Pilot Project, was introduced in 2015 which targets nine localities around Malta and the whole of Gozo. This is collected through kerbside collection in a specifically colour-coded bag.

Treatment capacity

Malta reported that preparatory work is being conducted to determine the capacity needed for incineration of MSW.

Measures for increasing municipal solid waste recycling rates

- **Organic Waste Pilot Project:** kerbside collection of household organic waste was introduced in 2015. The first phase commenced in October 2015 in five localities and the project was then extended to nine localities in Malta and the whole region of Gozo, representing around 45 000 households and 85 000 inhabitants. Organic waste is collected three times per week. The objective of this separate collection is to divert organic waste from landfill and to move further up the waste hierarchy. This measure might be extended to more regions across Malta.
- **Subsidiary Legislations 504.75 – the Waste Management (Electrical and Electronic Equipment) Regulations:** these Regulations seek to govern the sustainable production, reuse, recycling and appropriate disposal of waste electrical and electronic equipment (WEEE), bringing into effect most of the provisions of Directive 2012/19/EU on WEEE.
- **National Education and Awareness Raising Campaign on Waste Management:** the overall objective of this campaign is to introduce a cultural shift in people’s behaviour towards waste prevention, minimisation, recycling and management and to accompany the implementation of Malta’s Waste Management Plan 2014–2020, by which Malta could attain its 2020 waste management targets. The campaign was launched in April 2016.
- **Littering Regulation:** this regulation is being reviewed to strengthen the enforcement capabilities, particularly against fly-tipping, litter and adherence to collection schedules. A revised regulation is currently at the consultation phase.
- **Separate glass collection:** separate kerbside collection of glass was introduced in 2013 nationwide. This is an added service to the weekly kerbside collection of co-mingled dry recyclables (paper, cardboard, plastic and metal) and to the bring sites available in various localities
- **Beverage containers refund scheme (BCRS):** work is continuing to establish the most effective and feasible way to introduce a BCRS in Malta. A first draft of legislation is being compiled.
- **Batteries compliance scheme:** the compliance scheme is run by the private sector and no longer by WasteServ Malta Ltd. It was launched in 2017 and was aiming to reach the EU’s 45 per cent collection target for Malta by the end of the year.
- **Effective regulation of commercial waste:** mechanisms are currently being evaluated to address more effective regulation of commercial waste.
- **Maintenance of bring sites and weekly kerbside collection of dry recyclables:** ongoing since 2011, this initiative is wholly driven by the private sector.

Waste generation and treatment scenario

Based on the information described above, a baseline scenario for the future generation and management of MSW was developed, presenting a critical view of the effects of policy measures and planned capacities. It takes into account the possibility that not all planned measures will be fully implemented or that there will be delays in setting up new treatment capacity. The scenario thus presents one view of possible future developments, helping to identify potential risks of not meeting the recycling target, and is a basis for discussion.

Malta indicated measures to improve separate collection of biowaste. It has also indicated measures that might lead to improved separate collection of some specific fractions such as glass, plastics, paper and metals as well as WEEE and batteries. In February 2016 a new MBT installation came into service; this installation is taken into account as of 2016. Additional amounts going to recycling and MBT are assumed to reduce the amount of waste going directly to landfill.

Malta has not indicated firm plans on new treatment capacity, although they mention research into the needed treatment capacity for incineration. Because this research is still at an early stage and the outcome is uncertain, no additional capacity is taken into account in the baseline scenario.

Based on the indicated measures and expert judgement, an annual growth of 1 percentage point in the collection rate of dry materials recycling is assumed up to 2020, and a yearly increase of 0.5 percentage points between 2020 and 2025. Regarding separately collected organic waste, an increase of 7 percentage points is assumed between 2015 and 2020. Between 2020 and 2025 an increase of 3.5 percentage points is assumed, assuming that the introduction of separate collection of biowaste is extended to further municipalities.

Table 64 Baseline for the first treatment of municipal solid waste in Malta, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	258	268	278	288	299
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	10	15	18	18	18
Collection for biowaste treatment, %	0	7	11	11	11
Direct to MBT and mixed sorting, etc., %	15	40	38	37	36
Direct to incineration, %	0	0	0	0	0
Direct to landfill, %	74	37	33	34	36

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Malta will reach a 22 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020 and a 29 per cent rate by 2025. Most of the increase is due to expected improvements in collection systems.

The Netherlands – Baseline modelling and data updates

The Rijkswaterstaat of the Netherlands kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

The Netherlands' reported waste composition data are based on mixed household waste. The data refer to 2014 and are based on the average waste composition of 2013–2015. These were combined with data provided on waste collected for recycling in order to generate total municipal solid waste (MSW) composition and using the assumption that household waste represents 80 per cent of the total MSW.

Municipal solid waste generation and management

The Netherlands usually collects only data on the final treatment of MSW, however provided an estimate for the first treatment step for the use in the model.

Recycling tonnage

The data on tonnage of materials collected for recycling were adjusted from those provided by the Netherlands. The data on MSW generation and treatment relate to total MSW, but the data on the tonnage of material collected for recycling provided by the Netherlands related to household waste only. The recycling tonnage of total MSW was therefore calculated by assuming that the separately collected non-household MSW has the same material composition as the household waste separately collected.

Biowaste treatment

In the waste model, biowaste is split into three categories: food waste, garden waste, and other biowaste. For each of these categories, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

For food waste, the Netherlands reported 43 per cent OAW, 37 per cent IV and 20 per cent AD. For garden waste it reported 100 per cent OAW. There is no split reported for other biowaste therefore an even split of all three technologies is assumed in the model. The Netherlands reports that it expects a small increase in AD in the future. We therefore assume in the model an increase from 20 per cent AD to 25 per cent by 2025 for food waste. This change is expected to reduce the amount going to OAW.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

No data was provided on the utilization of biogas from AD. We assume the use of 100 per cent AD1 in the updated model.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting with energy generation.

The Netherlands indicates the use of 100 per cent MBT 4.

Incineration

The model includes the following four types of incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

The Netherlands reported 100 per cent incineration 2.

Waste generation projections

The Netherlands provided no own waste generation projections, thus the ETC/WMGE’s waste generation projections are used in the model. The projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 65 Municipal solid waste projections for the Netherlands, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes	8 950	8 779	8 507	8 950

Baseline scenario

The recycling rate in the Netherlands is quite high, and has increased steadily since 1995 and reached a recycling rate of 50 per cent in 2013. In recent years there has still been a (small) increase in the recycling rate. The maximum yearly increase in the last 10 years was 1.5 percentage points.

Table 66 Municipal solid waste generation and treatment, 1995–2015

the Netherlands	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	8 337	8 585	8 986	9 069	9 205	9 529	9 550	9 684	9 504	9 746	9 789	9 761	9 922	9 888	9 738	9 484	9 479	9 203	8 840	8 895	8 855
Material recycling, '000 tonnes	1 295	1 437	1 604	1 710	1 822	1 899	1 917	2 022	2 039	2 183	2 142	2 247	2 388	2 450	2 384	2 354	2 291	2 196	2 112	2 112	2 179
Composting and digestion, '000 tonnes	2 013	2 121	2 313	2 269	2 209	2 303	2 261	2 366	2 293	2 387	2 424	2 317	2 401	2 330	2 393	2 310	2 360	2 353	2 294	2 417	2 400
Recycling rate, %	39.7	41.5	43.6	43.9	43.8	44.1	43.7	45.3	45.6	46.9	46.7	46.8	48.3	48.4	49.1	49.2	49.1	49.4	49.8	50.9	51.7
Increase in recycling rate, percentage points	0.0	1.9	2.0	0.3	-0.1	0.3	-0.3	1.6	0.3	1.3	-0.2	0.0	1.5	0.2	0.6	0.1	-0.1	0.4	0.4	1.1	0.8

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

The Netherlands has had low landfill rates of below 2 per cent over the last 10 years.

Collection systems

The Netherlands has introduced a separate door-to-door collection system for the fractions paper, glass, plastics, metals and biowaste as the primary collection system. For paper, glass and plastics, the country also has introduced bring points as a secondary system. All streams are also separately accepted at civic amenities. For glass beer bottles and plastic beverage bottles there is a producer/retail take-back system.

Treatment capacity

The Netherlands has currently not planned to extend its treatment capacity.

Measures for increasing municipal solid waste recycling rates

- Extending the share of separately collected waste through door-to-door or bring systems, for example, through extending to other waste streams in 2015–2016. This will be done by combining the collection of plastics with metals and drink cartons.
- Improving the effectiveness of existing separate collection systems in 2016 and beyond. Residual waste is collected less frequently (once every 4–6 weeks) and the collection of recyclables is done more frequently, and increasingly close to households (if possible door-to-door). In some municipalities, the results of such systems are better than those achieved through the introduction of a pay-as-you throw scheme.
- Improving the collection of waste in areas with a dense population and/or a lot of high buildings (flats) from 2017 onwards.

The Netherlands estimates that these measures should reduce the residual waste from households – and companies with comparable residual waste – by at least 50 per cent, down to a maximum of 100 kilograms of residual household waste per person per year by 2020. The measures should also increase the proportion of waste collected separately from 50 per cent in 2015 to more than 75 per cent in 2020. By 2025, the amount of residual waste should be reduced further to 30 kilograms per person per year. In 2015, the amount of residual household waste in the Netherlands was about 242 kilograms per person¹¹.

Waste generation and treatment scenario

Based on the information described above, a baseline scenario for the future generation and management of MSW was developed, presenting a critical view of the effects of policy measures and planned capacities. It takes into account the possibility that not all planned measures will be fully implemented or that there will be delays in setting up new treatment capacity. The scenario thus presents one view of possible future developments, helping to identify potential risks of not meeting the recycling target, and is a basis for discussion.

The Netherlands have put in place policies to increase separate collection and to reduce the amount of residual waste to below 100 kilograms per person per year by 2020 and further to 30 kilograms per person per year by 2025. These are very ambitious and would require an increase of 5 percentage points in the rate of separate collection of household waste annually between 2015 and 2020. Analysis of historic municipal waste recycling data (Eurostat, dataset was_mun) shows that no EU country managed such high increase rates, and even less so when starting at an already high recycling level.

Over the past 20 years, the Netherlands increased its recycling rate on average by 0.7 percentage points annually. Thus, for inclusion in the model, the ETC/WMGE calculated a more pessimistic baseline scenario based on the measures indicated by the Netherlands and the expert judgement of the ETC/WMGE.

¹¹ Based on ETC/WMGE calculations: 505 kg/inhabitant of household waste (dataset was_gen) generated in 2014 and assuming a share of separately collected waste of 52 %.

This ETC/WMGE baseline scenario assumes an increase in the recycling collection rate of 2 percentage points per year until 2025, split equally between collection for dry materials recycling and collection for biowaste treatment. Regarding final treatment, it is assumed that the share going to landfill will continue at current levels (1 per cent), and the shares going to MBT and incineration will decrease proportionally.

Table 67 shows the assumed development of shares of MSW in the first treatment step, representing the best estimate based on the provided data and information, and expert judgement on the likely effects of the implementation of the described policy measures.

Table 67 Baseline for the first treatment of municipal solid waste in the Netherlands, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	8 855	8 950	8 779	8 507	8 950
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	25	30	35	35	35
Collection for biowaste treatment, %	27	32	37	37	37
Direct to MBT and mixed sorting, etc., %	4	4	3	3	3
Direct to incineration, %	43	33	24	24	24
Direct to landfill, %	1	1	1	1	1

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, the Netherlands will reach a separate collection rate for dry materials recycling and biowaste treatment of 62 per cent by 2020 and 72 per cent by 2025.

Poland – Baseline modelling and data updates

The Ministry of the Environment of Poland kindly provided data and information for the update of the waste model by answering a questionnaire, but also referred to other available documents. This information was combined by the ETC/WMGE and used to update the model. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Poland referred to a document¹² in which the composition of municipal waste is reported by region. Based on this information – the population reported per region and the amount of waste produced per person (263 kilograms in 2010) – the overall composition of municipal solid waste (MSW) was determined. The information provided in the document refers to collected municipal waste. Based on the amounts collected per person per region and the composition per region, the calculated amount sums to the amount of MSW reported to Eurostat. The ETC/WMGE thus assumed that the composition relates to MSW.

Municipal solid waste generation and management

Poland provided information on the final destination of treated MSW; however, the model needs information on the first treatment step. Through the questionnaire, Poland provided data on the amounts of waste going directly to MBT, and by reference to a document¹³ provided data on amounts of waste separately collected. The amount of MSW going directly to incineration was determined on the basis of information provided in another document¹⁴ and the answers provided in the questionnaire. Based on this information, the ETC/WMGE calculated the direct (first) treatment shares. Amounts going directly to landfill are assumed to be the remainder.

Recycling tonnage

The ETC/WMGE used information reported in one of the documents referenced by Poland² to determine the amounts of MSW separately collected for recycling.

Biowaste treatment

In the waste model, biowaste is split into three categories: food waste, garden waste, and other biowaste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC);
- anaerobic digestion (AD).

Poland did not report on treatment destinations for separately collected food, garden and other biowaste. The shares in the 2015 version of the model have been retained in the updated version.

Anaerobic digestion

- The model allows for five types of utilization of the biogas from AD: AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

¹² https://bip.mos.gov.pl/fileadmin/user_upload/bip/strategie_plany_programy/DGO/Kpgo_2022_EN.doc

¹³ <http://stat.gov.pl/en/topics/environment-energy/environment/environment-2016,1,8.html>

¹⁴ http://www.vivis.de/phocadownload/Download/2016_wm/2016_WM_189-200_Pajak.pdf

Poland did not report on which type of AD is in use; the type indicated in the 2015 version of the model has been assumed for the update.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation.

Poland did not report which type of MBT is in use. A 20% share per type of MBT is therefore assumed in the model.

Incineration

The model includes the following four types of incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Poland reported 100 per cent Incineration 2.

Waste generation projections

As Poland provided its own MSW projections, these are used in the model. Projections were based on the National Waste Management Plan 2022¹⁵. The Polish Ministry of the Environment explained the methodology as follows:

‘In forecasting trends in the amount of MSW generated in Poland to 2030, account has been taken of the population according to the Central Statistical Office, and the amount of waste collected per person in 2014, as reported by each administrative subdivision. Due to the interaction of these two factors in calculating MSW generation over time, it was decided to draw up a forecast for two hypotheses: high and low. Therefore, as part of the National Waste Management Plan 2022, in addition to the demographic changes, two waste generation indices have been adopted for forecasting purposes: ‘low’ amounting to 0.6 per cent, and ‘high’ amounting to 1 per cent. The lower index assumes a significant reduction in the amount of generated waste, while the higher assumes a smaller reduction. The adoption of the two indices will prevent an overestimation of the amount of waste generated in the future, and potential overcapacity of planned installations. The lower forecast assumes a negative rate of natural increase amounting to -0.15 per cent a year. Forecasts of the amount of waste collected in subsequent years have been made for 2025 and 2030.

For the above assumptions and according to the higher forecast, it is assumed that in 2030 the amount of waste will be about 13.7 per cent higher than in 2014, the base year. More optimistic results are shown in the lower forecast, according to which the level of generated MSW will increase by 8.1 per cent compared to the base year. Therefore, the average amount of MSW generated in the forecast period and calculated on

¹⁵ <https://bip.mos.gov.pl/strategie-plany-programy/krajowy-plan-gospodarki-odpadami/krajowy-plan-gospodarki-odpadami-2022/krajowy-plan-gospodarki-odpadami-2022-przyjety-przez-rade-ministrow-uchwala-nr-88-z-dnia-1-lipca-2016-r/>

the basis of the average from the high and low forecasts will increase by 10.9 per cent in 2030 relative to 2014. ‘

Table 68 Table Municipal solid waste generation projections for Poland, 2020–2035

	2020	2025	2030	2035
Reported projections, '000 tonnes (high/low projection)		11 797 / 11 339	12 280 / 11 682	
Projections used in the model, '000 tonnes	11 330	11 797	12 280	12 210

Waste Projection	2015	2020	2025	2030	2035
Projection Currently in the Waste Model	12 417	12 790	13 022	13 215	13 587
Updated EEA / ETC/WMGE Projection	10 687	10 284	10 271	10 267	10 209

For the model, the ETC/WMGE decided to use the higher forecast. For 2020, the amount of waste is calculated by linear interpolation of the amounts produced in 2015 and 2025. For 2035 the ETC/WMGE made a projection using an econometric forecasting model.

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

Poland's rate of dry materials recycling and composting and digestion increased significantly over the last 10 years, from 6 per cent in 2005 to 43 per cent in 2015; the amounts collected also show a substantial rise during this period.

Table 69 Municipal solid waste generation and treatment, 1995–2015

Poland	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	10 985	11 621	12 183	11 827	12 317	12 226	11 109	10 509	9 925	9 759	12 169	12 235	12 264	12 194	12 053	12 032	12 129	12 084	11 295	10 330	10 863
Material recycling, '000 tonnes	0	0	0	13	18	13	147	116	145	243	367	487	580	895	1 421	1 783	1 173	1 244	1 499	2 180	2 867
Composting and digestion, '000 tonnes	201	219	369	222	225	248	309	215	129	234	318	358	363	386	672	790	951	1 128	1 231	1 154	1 750
Recycling rate, %	1.8	1.9	3.0	2.0	2.0	2.1	4.1	3.1	2.8	4.9	5.6	6.9	7.7	10.5	17.4	21.4	17.5	19.6	24.2	32.3	42.5
Increase in recycling rate, percentage points	0.0	0.1	1.1	-1.0	0.0	0.2	2.0	-1.0	-0.4	2.1	0.7	1.3	0.8	2.8	6.9	4.0	-3.9	2.1	4.5	8.1	10.2

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

More than 40 per cent of MSW still goes to landfill, although amounts disposed of in this way have decreased considerably.

Collection systems

In densely populated areas, the primary collection system for separate collection of paper, glass, plastics and metals is through bring points. Paper and metals are collected co-mingled. In sparsely populated areas, door-to-door collection is more popular. Furthermore, there are civic amenity sites collecting all MSW fractions and hazardous waste from households. Poland's waste management plans foresee significant investment, with EU co-financing, in civic amenity sites that would accept all fractions of MSW with the exception of mixed waste – regional waste management plans foresee the modernisation of the 446 existing sites and construction of 1 008 new ones across the country. Biowaste is rarely collected in Poland. However, this is

changing, with mandatory separate collection introduced as of 1 July 2017. Municipalities have until 2021 to introduce this type of separate collection.

Treatment capacity

Poland indicated no firm plans regarding building new capacity, but there has been a significant increase in treatment capacity over the last few years, especially for incineration. According to the national waste management plan, a maximum of 30 per cent of MSW can be incinerated. Some increase in waste-to-energy capacity is expected, although there are currently no firm plans.

Measures for increasing municipal solid waste recycling rates

- The amendment to the Act on Maintaining Cleanliness and Order in Municipalities entered into force on 1 July 2013. This requires the selective collection of municipal waste at source (from property owners), by establishing separate collections covering at least the following waste fractions: paper, metal, plastic, glass and multiple packaging material as well as biodegradable MSW, including biodegradable packaging waste. This is expected to lead to a reduction in the amount of MSW being sent to landfill and increase the amount of waste transferred for recycling. To meet the obligations arising from the EU directives, the amendment also sets waste collection requirements to achieve appropriate levels in the indicated time:
 - by 16 July 2020, reduce the weight of biodegradable MSW landfilled to not more than 35 per cent of the total weight of MSW, based on the weight of the waste produced in 1995;
 - by the 31 December 2020, ensure a level of recycling and preparation for reuse of paper, metals, plastics and glass of at least 50 per cent by weight;
 - The Ordinance of the Minister of the Environment on the detailed method for the separate collection of selected waste fractions (i.e. biowaste) came into force on 1 July 2017. This Ordinance unifies the principles for separate collection of MSW and should ensure the recycling levels required by targets set out in EU legislation. This will also provide the approach for MSW collection across the whole country.
 - Poland is planning significant landfill tax increases from 2018 to 2020 and beyond (a legal measure that was adopted in March 2017); MBT residues are currently accepted in landfill at a price of PLN 74.26 per tonne (under EUR 20) but this will increase to PLN 140 in 2018, PLN 170 in 2019 and PLN 270 (almost EUR 80) in 2020.
 - According to the Act on Maintaining Cleanliness and Order in Municipalities, municipalities have an obligation to meet a number of targets, otherwise fines apply. The targets are as follows: 18 per cent in 2016, 20 per cent in 2017, 30 per cent in 2018, 40 per cent in 2019 and 50 per cent in 2020.

Waste generation and treatment scenario

Based on the information described above, a baseline scenario for the future generation and management of MSW was developed, presenting a critical view of the effects of policy measures and planned capacities. It takes into account the possibility that not all planned measures will be fully implemented or that there will be delays in setting up new treatment capacity. The scenario thus presents one view of possible future developments, helping to identify potential risks of not meeting the recycling target, and is a basis for discussion.

Poland expects separate collection of certain dry materials and biowaste for recycling to increase steeply by 2020, corresponding to an increase of 30 per cent over a five-year period. Based on past performances in the EU, such an increase is very ambitious¹⁶. For the baseline scenario, it is assumed that the collection for dry

¹⁶ Only one Member State has achieved a comparable increase in the past.

materials recycling can be increased by 2 percentage points annually until 2020, and that the mandatory introduction of separate collection of biowaste will increase biowaste collection by 1 percentage point annually until 2020. As no additional measures are known for the period after 2020, the treatment shares are kept stable after 2020.

In the calculation of MSW going directly to incineration, it is assumed that all built capacity will be in use after 2015. For 2015 it is assumed that the capacity of facilities in Warsaw, Konin and Bialystok was in use. For 2016 it is assumed that the reported capacity of facilities in Bydgoszcz, Cracow, Poznan was in use. The seventh incineration plant in Szczecin is assumed to have come into use in 2017.

The amounts going directly to landfill are assumed to decrease – by 1 percentage point annually up to 2020. The remaining MSW is assumed to be treated in the available incineration and MBT installations using the planned treatment split (as there seems to be overcapacity planned based on the available information). This means that 10 per cent of the residual waste is assumed to go directly to incineration, and 90 per cent to MBT.

Table 70 shows the assumed development of shares of MSW receiving first treatment – representing the best estimate based on the provided data and information, and expert judgement on the likely effects of the implementation of the described policy measures.

Table 70 Baseline for the first treatment of municipal solid waste in Poland, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	10 863	11 330	11 797	12 280	12 210
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	14	24	24	24	24
Collection for biowaste treatment, %	6	11	11	11	11
Direct to MBT and mixed sorting, etc., %	69	55	55	55	55
Direct to incineration, %	3	6	6	6	6
Direct to landfill, %	9	4	4	4	4

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Poland will reach a 35 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020, staying constant afterward.

Portugal – Baseline modelling and data updates

The Agência Portuguesa do Ambiente kindly provided data and information for the update of the waste model by answering a questionnaire. Updated data refer to 2015. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Data on waste composition reported in the questionnaire refer to total municipal waste, but exclude waste from larger commercial producers, which are included in the technical definition of MSW. However, we assume that the composition refers to total MSW. The reported waste composition was therefore assumed to hold for total MSW.

Municipal solid waste generation and management

The municipal waste generation and treatment data provided by Portugal were used in the model. Due to double counting of the collection for biowaste treatment in the data provided, the data on waste collected for recycling were slightly adjusted: 2 percentage points were subtracted from this share (reducing it from 13 to 11 per cent), as the total of all shares added up to 102 per cent. This was approved by Portugal.

Recycling tonnage

Some inconsistencies concerning the reported recycling tonnages were corrected. These inconsistencies have been justified on the basis of materials storage from one year to the next. Data have been adjusted so that specific recycling tonnages match the generation and management information provided.

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); anaerobic digestion (AD).

No updated figures were provided by Portugal, so the treatment shares in the 2015 version of the model were retained: food waste was 26 per cent OAW, 26 per cent IVC and 48 per cent AD; garden waste was 38 per cent OAW, 38 per cent IVC and 24 per cent AD; other biowaste was 33 per cent OAW, 33 per cent IVC and 34 per cent AD. These figures relate to 2011.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

No updated data was available to the 2011 data in the 2015 version of the model, so the earlier shares for the utilization of the biogas from AD were retained (100 % AD 1).

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting with energy generation

Portugal indicated that existing infrastructure capacity could be considered a proxy for treatment. For this reason, after responses from Portugal, the following updated shares were used in the model: 80 per cent MBT 3 and 20 per cent MBT 4 for the reference year 2015 and beyond.

Incineration

The model includes the following four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Portugal did not provide updated data, so the information reported in the 2015 version of the waste model was retained, namely 100 per cent Incineration 2.

Waste generation projections

Portugal provided a projection for 2020, and this was complemented with projections for 2025-2035 calculated by the ETC/WMGE. The ETC/WMGE projections are based on an econometric forecasting model, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 71 Municipal solid waste generation projections for Portugal, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes	4 762	4 928	4 966	4 980
Reported projections, '000 tonnes	4 762			

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model. Portugal increased its recycling of dry recyclables in the past few years, as well as the amounts composted and digested.

Table 72 Municipal solid waste generation and treatment, 1995–2014

Portugal	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Waste generation, '000 tonnes	3 529	3 740	4 013	4 198	4 427	4 705	4 709	4 585	4 693	4 665	4 745	4 898	4 967	5 472	5 496	5 457	5 178	4 766	4 598	4 710
Material recycling, '000 tonnes	40	54	67	82	109	157	190	213	227	320	406	475	528	567	648	619	595	549	594	765
Composting and digestion, '000 tonnes	302	311	332	351	364	339	370	135	286	308	313	302	321	382	424	399	447	694	593	665
Recycling rate, %	10	10	10	10	11	11	12	8	11	13	15	16	17	17	20	19	20	26	26	30
Increase in recycling rate, percentage points	0	0	0	0	0	0	1	-4	3	3	2	1	1	0	2	-1	1	6	0	5

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Collection systems

The overview description of collection systems in the questionnaire was confirmed by Portugal.

Treatment capacity

Existing treatment capacity is as reported in Table 73. The existing capacity is sufficient for the total amount of incineration in the base year (2015), but would have to increase in the future if the share of incineration is to be kept stable, due to the projected increase in waste generation. It is assumed that the corresponding capacity will be made available. However, no information on future planned capacity is available.

Table 73 Reported treatment capacity in Portugal, 2015

Treatment/disposal infrastructure	Existing capacity (tonnes per year)	Unused existing capacity (tonnes per year)
Biowaste composting (OAW, IVC)	80 000	19 200
AD	40 000	2 900
Material sorting facilities	30 660	
MBT	400 000	
Incineration	970 000	0

Measures for increasing municipal solid waste recycling rates

Portugal reported a broad range of existing policies for improving recycling performance. The most important suggested interventions include:

- setting up new collection systems and reinforcing selective collection (supported by EU funds);
- targets for MSW management systems (reuse and recycling, biodegradable urban waste deposited in landfill and separate collection returns) and sanctions on municipalities for non-compliance;
- increases in landfill and incineration taxes;
- changes in waste-related charges;
- improvements in the data system.

Other policies, linked to pay-as-you-throw schemes and improvements in door-to-door collection, are under discussion and therefore not accounted for here. No estimate was provided by Portugal of the quantitative impacts that are expected from these policies.

Waste generation and treatment scenario

Based on the information above, a baseline scenario for the future generation and management of MSW has been developed. This presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures are fully implemented or that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify potential risks of not meeting the recycling target and serving as a basis for discussion.

Sanctions and landfill/incineration taxation are currently relatively insignificant so provide little incentive, at least until 2020 when they reach their maximum levels. Existing policies are assumed to have an impact, however, due in part to the low starting point for recycling, and mainly to improvements in the data system. In the baseline scenario, the share of waste collected for dry materials recycling is assumed to increase by 5

percentage points over the periods 2015-2020 and 2020–2025. This is assumed to be diverted from the share of waste sent directly to landfill, while the share of waste sent to MBT and incineration is assumed to remain constant.

Table 74 Baseline for the first treatment of municipal solid waste in Portugal, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	4 764	4 762	4 928	4 966	4 980
Collection coverage, % of the population	100	100	100	100	100
Collection for dry materials recycling, %	11	16	21	21	21
Collection for biowaste treatment, %	2	2	2	2	2
Direct to MBT and mixed sorting, etc., %	33	33	33	33	33
Direct to incineration, %	20	20	20	20	20
Direct to landfill, %	34	29	24	24	24

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Portugal will reach a 18 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020 and a 23 per cent rate by 2025.

Romania – Baseline modelling and data updates

The Ministry of Environment of Romania and the National Environmental Protection Agency of Romania kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Romania reported municipal solid waste (MSW) composition data from the 2017 Draft National Waste Management Plan (composition of residual domestic and similar waste). The composition data were slightly adjusted as biowaste was not separated into categories and waste collected for recycling was not included in the data. The biowaste shares in the 2015 version of the model were retained: 75 per cent food waste and 25 per cent garden waste.

Municipal solid waste generation and management

Romania provided updated MSW generation and management data, the data on waste management was not fully consistent with the data on recycling. The data on waste collected for dry recycling and biowaste treatment was adjusted for consistency¹⁷.

Recycling tonnage

The data on tonnage of materials collected for recycling were adjusted from those provided by Romania, as biowaste was not separated into categories. The split in the 2015 version of the model (75 per cent food waste and 25 per cent garden waste) was retained. In addition, the data on amounts of material collected for dry recycling and biowaste treatment were adjusted as Romania reported both on waste collected for recycling and outputs from first stages of sorting. These were combined to generate the total volume of waste separately collected for treatment.

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

Romania reported no AD, and 12–13 per cent IVC (12.5 per cent used in the model) and no split between the three components of biowaste (food, garden, and other biowaste). Romania also reported firm plans to construct both IVC and AD facilities, resulting in a switch from OAW (Table 75) to IVC and AD. The information about the additional planned capacity is used to assume a future development as shown in Table 75.

Table 75 Future estimates of biowaste treatment shares in Romania, 2015–2035

	2015	2020	2025	2030	2035
OAW, %	87.5	87.5	40.8	40.8	40.8
IVC, %	12.5	12.5	7.5	7.5	7.5

¹⁷ This interpretation reflects Romania's report on waste treatment to Eurostat. The provided data could also have been interpreted as double reporting of material collected for recycling, which would, in turn, reduce the material collected for recycling and consequently the recycling rate,

AD, %	0	0	51.7	51.7	51.7
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Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

There is no AD treatment of MSW in Romania. For future AD capacity, 100 % AD 1 is assumed.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation.

Romania developed some MBT capacity in 2015, but there is no information on the type of MBT facilities. There is manual and mechanical sorting capacity in Romania (MBT 5), so it can be assumed that the majority of MBT will fall into this category in the future. There is also significant co-incineration of MSW in cement kilns in Romania, supporting the assumption that MBT 5 is the dominant variant. As a result, all MBT capacity was assumed to be MBT 5.

Incineration

The model includes the following four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

There are no waste incineration plants in Romania.

Waste generation projections

Romania did not provide own projections, so the model will use the updated projections produced by the ETC/WMGE (Table 76). These projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 76 Municipal solid waste generation projections for Romania, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes	4 629	4 546	4 473	4 465

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

Romania's dry materials recycling volumes are rising; composting and digestion increased strongly in 2010 but declined thereafter.

Table 77 Municipal solid waste generation and treatment, 1995–2015

Romania	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000	7 758	7 375	7 347	6 246	7 066	7 961	7 539	8 365	7 611	7 483	8 173	8 392	8 161	8 439	7 768	6 343	5 216	5 044	5 071	4 956	4 895
Material recycling, '000	0	0	0	0	0	0	123	170	17	83	145	41	34	72	78	162	173	165	215	256	277
Composting and digestion, '000	0	0	0	0	0	0	0	0	0	0	0	0	2	3	4	650	436	580	455	391	365
Recycling rate, %	0.0	0.0	0.0	0.0	0.0	0.0	1.6	2.0	0.2	1.1	1.8	0.5	0.4	0.9	1.1	12.8	11.7	14.8	13.2	13.1	13.1
Increase in recycling rate, percentage points		0.0	0.0	0.0	0.0	0.0	1.6	0.4	-1.8	0.9	0.7	-1.3	0.0	0.4	0.2	11.7	-1.1	3.1	-1.6	-0.2	0.1

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Collection systems

Romania currently has public bring points for some recyclables, and public amenity sites are to be established for the collection of recyclables. Romania is putting effort into recycling food and garden waste through home composting.

Treatment capacity

- Composting: the total annual capacity of waste composting facilities is 215 435 tonnes.
 - There is a programme aiming for 30 per cent of households to have individual composting units.
 - There are plans to build composting facilities for garden waste in 17 counties by 2021, with an estimated total annual capacity of 26 800 tonnes.
- No facilities exist for AD of biowaste, but there are plans for the construction of 31 AD plants serving 31 counties and the Bucharest Municipality with an estimated total annual capacity of 811 000 tonnes. No information was available on timing.
- There are 154 sorting facilities in Romania, mostly relying on manual processing with very limited use of more advanced mechanical sorting. The sorting facilities have an estimated annual capacity of approximately 2.335 million tonnes (mainly for separately collected recyclable waste).
- MBT: There are two MBT facilities in Romania (Timișoara and Chiajna) with a total annual capacity of around 117 000 tonnes. There are plans for the construction of six MBT facilities with a total estimated annual capacity of 404 000 tonnes. No information was available on timing.
- There are no waste incineration plants. There are plans for the construction of three plants serving Bucharest and six counties, with a total estimated annual capacity of 404 000 tonnes, to be operational by 2024.

Measures for increasing municipal solid waste recycling rates

- Increasing landfill tax from RON 80 (c. EUR 17) per tonne in 2017 to RON 120 (c. EUR 26) per tonne in 2018.
- Introduction of pay-as-you-throw schemes. There are at least two systems, one in which the fee is based on the collected waste volumes, and one in which the collection of recyclables is free of charge.
- Ministry of Environment support mechanisms for municipalities to set up new separate collection systems for dry recyclables and biowaste.

- A target capture rate for separate collection of biowaste of 35 per cent in most municipalities and of 45 per cent in the Bucharest Municipality.

Waste generation and treatment scenario

Based on the above information, a baseline scenario has been developed for the future generation and management of MSW in Romania. This presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures are fully implemented or that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify potential risks of not meeting the recycling target and serving as a basis for discussion.

Estimates of future recycling rates are based on the above measures. Regarding collection for recycling, it is assumed that there will be a 5 percentage point increase by 2020 and an additional 5 percentage point increase by 2025. Likewise, for separately collected biowaste it is assumed that there will be a 5 percentage point increase by 2020 and an additional 5 percentage point increase by 2025. Both these expectations are based on Romania's efforts to increase separate collection.

As far as final treatment is concerned, the rise in separately collected waste will result in a decrease in the share of residual waste. Regarding MBT, it is assumed that the capacity built in 2015 is fully operational by 2020, and that a third of the planned capacity is operational in 2025 and all planned capacity by 2030. For incineration, it is assumed that a third of the planned capacity will be operational in 2025 and all planned capacity by 2030. The reduction in residual waste generation, as well as the increasing MBT and incineration rates, will lead to a reduction in waste sent directly for landfill.

Table 78 Baseline for the first treatment of municipal solid waste in Romania, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	4 895	4 629	4 546	4 473	4 465
Collection coverage, % of population	84	100	100	100	100
Collection for dry materials recycling, %	6	11	16	16	16
Collection for biowaste treatment, %	8	13	18	18	18
Direct to MBT and mixed sorting, etc., %	0	3	6	15	15
Direct to incineration, %	0	0	3	9	9
Direct to landfill, %	87	74	58	43	43

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Romania will reach a 24 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020 and a 34 per cent rate by 2025. Collection coverage is assumed to reach 100 per cent by 2020.

Slovakia – Baseline modelling and data updates

The Ministry of the Environment of the Slovak Republic provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Slovakia provided composition data on mixed (residual) waste, with reference to 2011. Together with data on separately collected waste for recycling and biowaste treatment, these were used to calculate the composition of total municipal solid waste (MSW). A figure under the heading composite packaging and reported by Slovakia as ‘predominantly made up of paper’ was added to the paper share (1.4 per cent).

Municipal solid waste generation and management

Data on waste generation and treatment are assumed to refer to total MSW, consistent with the additional information provided by Slovakia for the period 2005–2015. Data were only provided on the last treatment step, not the first, but indicated an estimated 50 000 tonnes of MSW sent to mechanical biological treatment (MBT). The MSW generation and treatment data provided were adjusted as they did not account for the waste sent to MBT; this was added to the data, and the shares sent to incineration and landfill were reduced accordingly.

Recycling tonnage

The data on tonnage of materials collected for recycling were slightly adjusted, as they were not fully consistent with the data on MSW generation and treatment (reported amount of separately collected MSW was lower than the reported sum of separately collected materials).

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

For food waste, Slovakia reported 80 per cent OAW and 20 per cent AD; for garden waste, 100 per cent OAW; and for other biowaste, 50 per cent OAW and 50 per cent AD.

Slovakia expects biowaste treatment to evolve towards a larger share of AD in the future, particularly for food waste. However, the available information did not allow to produce a quantitative estimate of the future changes, therefore the shares are kept stable over time.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

Slovakia indicated 100 per cent AD 2 in 2015.

Mechanical biological treatment

The model includes the following five variants of MBT:

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation.

Slovakia reported 100 per cent MBT 5. No change is expected in the future.

Incineration

The model includes the following four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Slovakia reported 100 per cent Incineration 1. No change is expected.

Waste generation projections

Slovakia provided a waste generation scenario until 2020. The model will use this scenario until 2020, with later projections produced by the ETC/WMGE. The ETC/WMGE projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 79 Municipal solid waste generation projections for Slovakia, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes		2 118	2 244	2 377
Reported projections, '000 tonnes	2 000			

Baseline scenario

Eurostat data for Slovakia shows a relatively low recycling rate, but a steadily rising trend in recent years.

Table 80 Municipal solid waste generation and treatment, 1995–2015

Slovakia	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	1 580	1 479	1 477	1 396	1 408	1 369	1 286	1 449	1 511	1 400	1 468	1 524	1 579	1 686	1 654	1 719	1 679	1 657	1 645	1 733	1 784
Material recycling, '000 tonnes	24	22	35	28	28	34	36	34	47	46	14	14	39	60	72	98	104	140	108	88	136
Composting and digestion, '000 tonnes	20	19	39	38	39	36	34	35	37	41	16	48	65	64	64	59	69	81	69	91	130
Recycling rate, %	3	3	5	5	5	5	5	5	6	6	2	4	7	7	8	9	10	13	11	10	15
Increase in recycling rate, percentage points	0	0	2	0	0	0	0	-1	1	1	-4	2	3	1	1	1	1	3	-3	0	5

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Collection systems

Slovakia confirmed that in cities and larger villages, the primary collection system is a bring system for paper, glass and plastics, while door-to-door collection of these fractions is widely practised in small municipalities,

mainly through bags and increasingly through containers. Door-to-door collection of biowaste is increasingly applied but still rare, while the main collection system for metals and biowaste is civic amenity sites which also accept paper, glass and plastics.

Treatment capacity

Slovakia reports to have no information on prepared or planned treatment capacity, which is in the hands of private investors. However, the Ministry of Environment does have policy instruments that are key to the future strategies of the waste management sector.

Slovakia reports a current annual composting capacity of approximately 500 000 tonnes and an annual AD capacity of approximately 270 000 tonnes. A large share of this treatment capacity is used for non-municipal waste, but Slovakia does indicate that larger shares could be freed for municipal biowaste. Thus, the capacity for biowaste treatment is considered to be sufficient for increasing the separate collection of biowastes.

In Slovakia, separately collected dry recyclables are first sorted mechanically; Slovakia reports that the capacity is sufficient and could even handle increased rates of separate collection. For MBT, Slovakia reports insufficient knowledge of currently used capacity or whether there is available capacity within the existing facilities.

In Slovakia, 13 waste incinerators are in operation, of which two are intended for MSW with a total annual capacity of 203 000 tonnes. In addition, there is a 300 000 tonne annual capacity for co-incineration, which may partly use waste from municipal sources. According to this, there is approximately 50 000 tonnes of unused annual capacity available for incineration of MSW.

Measures for increasing municipal solid waste recycling rates

The main policies reported, partially overlapping with the suggested changes in the collection systems, are as follows:

- introduction of an extended producer responsibility (EPR) scheme;
- implementation of standards for separate collection of paper, glass, plastics, metals and biowaste by 2017; this measure is connected with the EPR principle and defines minimum capacities for separate collection of each dry waste stream for citizens with the aim of achieving a target of 50 per cent separate collection of recyclables by 2020;
- increased landfill fees.

Waste generation and treatment scenario

A baseline scenario for the future generation and management of MSW has been developed based on the above information. This presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures are fully implemented or that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify potential risks of not meeting the recycling target and serving as a basis for discussion.

Taking into account the upcoming changes in policies, it is assumed that the separate collection of paper, glass, plastics, metals and biowaste will increase. A 7 percentage point rise in collection for dry materials recycling is assumed to be realised by 2020, and a 4 percentage point rise in biowaste collection.

As no strong policies or other changes are described for the period after 2020, the shares are assumed to stay constant. Although the landfill fee is rather low to act as an incentive, it is assumed that the increase in separate collection will divert waste from direct landfill.

Table 81 Baseline for the first treatment of municipal solid waste in Slovakia, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	1 888	2 000	2 118	2 244	2 377
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	13	20	20	20	20
Collection for biowaste treatment, %	8	12	12	12	12
Direct to MBT and mixed sorting, etc., %	3	3	3	3	3
Direct to incineration, %	8	8	8	8	8
Direct to landfill, %	68	57	57	57	57

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Slovakia will reach a 32 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020. This is based on reported measures to increase recycling rates in the future.

Slovenia – Baseline modelling and data updates

The Ministry of the Environment and Spatial Planning (MOP) of Slovenia kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Slovenia reported that its municipal waste composition data are based on total municipal solid waste (MSW). Data were provided for the year 2014.

Municipal solid waste generation and management

No adjustment was needed to the data on MSW generation and management provided by Slovenia.

Recycling tonnage

The data provided by Slovenia on tonnage of materials collected for biowaste treatment were adjusted because sum of food waste, garden waste and other biowaste reported as separately collected was higher than the reported amount of total biowaste separately collected.

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

For both separately collected food waste and garden waste Slovenia reported 38 per cent OAW, 33 per cent IVC and 30 per cent AD. For other biowaste, Slovenia reported 3 per cent OAW, 5 per cent IVC and 92 per cent AD.

Slovenia indicated that the AD treatment shares will rise because a new biogas facility in the municipality of Ljubljana has come into service. This installation will treat separately collected food waste, separately collected garden waste and other biowaste. It is therefore assumed in the model that the treatment shares of AD will increase with 30 percentage points by 2020, at the expense of OAW for both food and garden waste treatment while no change is assumed for other biowaste.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

Slovenia indicated 100 per cent AD 2 for the biogas resulting from the treatment of separately collected food waste, separately collected garden waste and other biowaste.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation.

Slovenia reported 55 per cent MBT 1 and 45 per cent MBT 4.

Slovenia provided some additional information on the types of MBT in use and how they differ from the modelled variants. There are nine MBT plants operating in Slovenia (eight with aerobic and one with anaerobic technology).

Slovenia indicated that the eight aerobic facilities were classified under MBT 1 because they work as follows: a mechanical treatment step removes as much non-compostable material as possible but also recyclable fractions and fractions with high calorific value as refuse-derived fuel (RDF). Biological treatment breaks down biodegradable material sufficiently to ensure against significant amounts of methane if sent to landfill – this process produces low-grade composted material that is then used for land treatment or landfill. The main difference from the model installation is that RDF is generated by this process. One installation was classified as MBT 4 as it has an AD element. The model assumes that no RDF is generated by this process, but the installation in Slovenia does generate RDF that is thermally treated.

Incineration

The model includes the following four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Slovenia did not provide information on treatment shares according to type of incineration facility. The information in the 2015 version of the model assumes 96 per cent Incineration 2 and 4 per cent Incineration 4, and this is kept unchanged in the model. However, Slovenia operates only a very small incineration plant and has no intention to build new incineration capacity.

Waste generation projections

The waste generation projections provided by Slovenia are being used in the model.

Table 82 Municipal solid waste generation projections for Slovenia, 2020–2035

	2020	2025	2030	2035
Reported projections, '000 tonnes	936	953	968	982

Baseline scenario

The recycling rate in Slovenia has increased significantly over the past 10 years, from 20 per cent in 2004 to 54 per cent in 2015. Between 2014 and 2015 the recycling rate rose by 18 percentage points; however, even though there was a substantial rise overall, the recycling rate has been fluctuating considerably.

Table 83 Municipal solid waste generation and treatment, 1995–2015

Slovenia	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	1 186	1 175	1 170	1 159	1 090	1 020	953	812	834	969	989	1 036	1 060	1 095	1 069	1 004	852	744	853	892	926
Material recycling, '000 tonnes	21	54	54	90	50	47	14	62	92	183	169	145	217	190	189	203	258	270	239	259	430
Composting and digestion, '000 tonnes	3	8	16	21	19	14	12	11	13	15	15	15	15	17	20	22	45	42	58	62	71
Recycling rate, %	2.0	5.3	6.0	9.6	6.3	6.0	2.7	9.0	12.6	20.4	18.6	15.4	21.9	18.9	19.6	22.4	35.6	41.9	34.8	36.0	54.1
Increase in recycling rate, percentage points	0.0	3.3	0.7	3.6	-3.2	-0.3	-3.3	6.3	3.6	7.8	-1.8	-3.2	6.4	-3.0	0.6	2.9	13.2	6.4	-7.1	1.2	18.1

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

The share of MSW going to landfill has decreased significantly over the last five years, from just below 50 per cent in 2011 to 23 per cent in 2015.

Collection systems

The collection system in Slovenia is quite diverse. The primary system in use for paper, glass and biowaste is door-to-door collection. For paper and glass this is supplemented with bring points. For reusable glass, there is a voluntary system in place offered by retailers. For plastics and metals, the primary system is co-mingled door-to-door collection. In sparsely populated areas this fraction is mainly collected through bring points. All fractions are also accepted at civic amenity sites.

Treatment capacity

Slovenia expects to build additional MBT, AD and material sorting facilities, but gives no indication of the planned capacity or timing of these installations.

Measures for increasing municipal solid waste recycling rates

Slovenia indicates no firmly planned measures to increase MSW recycling rates in the coming years.

Waste generation and treatment scenario

Based on the above information, a baseline scenario for the future generation and management of municipal waste has been developed. This presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures are fully implemented or that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify the potential risk of not meeting the recycling target and serving as a basis for discussion.

Slovenia has firm plans for additional MBT capacity; this is taken into account from 2017 onwards in the calculation of treatment capacity and it is assumed that it will reduce the amount of MSW going directly to landfill. As there are no firm plans for other treatment capacity or measures to increase separate collection or to reduce the production of MSW, it is assumed that the shares of waste separately collected for dry materials recycling and biowaste treatment will remain stable.

Table 84 Baseline for the first treatment of municipal solid waste in Slovenia, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	926	936	953	968	982
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	45	45	45	45	45
Collection for biowaste treatment, %	11	11	11	11	11
Direct to MBT and mixed sorting, etc., %	38	42	41	41	40
Direct to incineration, %	0	0	0	0	0
Direct to landfill, %	6	2	3	3	4

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, and on the fact that Slovenia has indicated no extra measures to achieve higher recycling rates, no increase is foreseen in Slovenia's 56 per cent collection rate for dry materials recycling and biowaste treatment.

Spain – Baseline modelling and data updates

The Ministerio de Agricultura y Pesca, Alimentación y Medio Ambiente of Spain kindly provided data and information for the update of the waste model by answering a questionnaire. Spain mostly reported data for 2014, but in some cases also from 2010–2011. It was assumed that data referring to one year (2014) can be used with reference to data from another time (2010–2011). Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Spain reported municipal waste composition data based on total municipal solid waste (MSW) for the years 2010–2011. The MSW composition data provided required slight adjustment because biowaste was not separated into categories. The split in the 2015 version of the model was used (82 per cent food waste and 18 per cent garden waste). In addition to the waste fractions, Spain reported a ‘moisture’ fraction, which was added to the total biowaste fraction. Furthermore, a minor adjustment was made to the reported waste composition in order for the total to sum to 100 per cent.

Municipal solid waste generation and management

The municipal waste generation and treatment data provided by Spain was used in the model.

Recycling tonnage

The data provided by Spain on tonnage of materials collected for recycling refer to the input to the final recycling process. The model then uses standard reject rates to calculate the corresponding amounts of materials separately collected for recycling. The reported total amount of materials separately collected for recycling and biowaste treatment was higher than the amounts calculated by the model using the standard reject rates, therefore the amount of separately collected waste was adjusted in order to take into account that Spain seems to experience higher reject rates than the ones used in the model.

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

Spain reported the following shares: for food waste, 50 per cent OAW and 50 per cent AD; for garden waste, 55 per cent OAW, 40 per cent IVC and 5 per cent AD. Spain provided no information on other biowaste, so the shares in the 2015 version of the model were used: 33 per cent OAW, 33 per cent IVC and 34 per cent AD.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

Spain indicated that no new information was available, but suggested using the data in the 2015 version of the model, namely 100 per cent AD 2. Spain also indicated a shift towards a combination of AD 2, AD 3 and AD 4 in the future. For the purpose of the model, the future shares were therefore assumed to develop as shown in Table 85.

Table 85 Estimates of future biogas output shares from anaerobic digestion in Spain, 2014–2035

	2014	2020	2025	2030	2035
AD 1, %	0	0	0	0	0
AD 2, %	100	100	80	60	60
AD 3, %	0	0	10	20	20
AD 4, %	0	0	10	20	20
AD 5, %	0	0	0	0	0

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation

Spain reported 71 per cent MBT 1 and 29 per cent MBT 4. Spain reports the biodegradable fraction of MBT inputs as composted (it is calculated as total input - recovered materials - rejects = composted).

Incineration

The model includes the following four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Spain reported 100 per cent use of Incineration 1.

Waste generation projections

Spain did not provide own projections, so the model uses the projections produced by the ETC/WMGE for the EEA (Table 86). The projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 86 Municipal solid waste generation projections for Spain, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes	19 293	18 749	18 533	18 567

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

Eurostat time series data on MSW recycling show no clear trend over recent years, and recycling rates seem to have been stagnating (Table 87).

Table 87 Municipal solid waste generation and treatment, 1995–2015

Spain	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	20 076	21 125	22 174	22 423	24 470	26 505	26 616	26 404	27 270	25 746	25 683	26 209	26 154	25 317	25 108	23 774	22 672	21 896	21 184	20 836	20 151
Material recycling, '000 tonnes	1 415	1 640	1 860	2 067	1 920	1 778	2 956	3 811	3 770	3 730	3 685	3 646	3 496	3 898	3 811	4 175	3 782	4 277	3 284	3 526	3 393
Composting and digestion, '000 tonnes	0	0	0	0	1 555	3 106	2 746	3 914	4 065	4 220	4 370	4 523	4 498	6 158	4 516	2 767	2 272	2 245	3 607	2 894	3 316
Recycling rate, %	7	8	8	9	14	18	21	29	29	31	31	31	31	40	33	29	27	30	33	31	33
Increase in recycling rate, percentage points	0	1	1	1	5	4	3	8	-1	2	0	0	-1	9	-7	-4	-2	3	3	-2	-2

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Collection systems

In Spain, there is a bring point system in use for the collection of recyclable waste; in addition, all waste fractions are accepted at civic amenity sites. Door-to-door collection systems are very rare. There are no deposit-refund systems in Spain.

Measures for increasing municipal solid waste recycling rates

The PEMAR (the Spanish national waste management plan) sets out objectives to be met for recyclable materials in 2020, combined with guidelines to achieve this, but it does not establish a timetable for the process. Each objective includes a series of measures to be developed within the framework of the objective. The objectives are:

- separate collection and treatment of separately collected waste;
- the correct treatment of mixed waste;
- information, training and awareness raising;
- investment in waste management, development and implementation of economic instruments.

The plan transfers the responsibility of waste management to municipalities, which are responsible for ensuring compliance with national waste management objectives but are free to choose how to apportion waste management responsibilities.

In accordance with national policy guidelines, existing separate collection systems are expected to improve, and some municipalities may introduce door-to-door collection for this purpose.

Policies entering into force or firmly planned include extended producer responsibility (EPR) schemes for waste electrical and electronic equipment (WEEE), support to separate collection of biowaste and the introduction of a landfill tax.

The PEMAR establishes the following objectives with respect to treatment infrastructures:

- investment in new treatment infrastructures, mainly intended for the preparation for reuse and recycling, located in places close to those of generation and adapted to the quantities generated in those environments;
- investments for the adaptation, modernisation and improvement of existing treatment infrastructures;
- complete and adapt the network of existing bring points to ensure the separate collection of different fractions so that collected waste can be prepared for reuse or recycled.

Waste generation and treatment scenario

Based on the above information, a baseline scenario for the future generation and management of municipal waste has been developed. This presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures are fully implemented or that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify the potential risk of not meeting the recycling target and serving as a basis for discussion.

Spain's waste management plan sets out targets for improved waste management but fails to communicate clearly on more specific targets on separate collection. Spain reports a high degree of uncertainty surrounding the introduction of separate collection systems. This, in combination with strong reliance on MBT facilities, reduces the probability of separate collection systems being rolled out broadly in Spain.

Estimates of future recycling rates are based on the above measures. Regarding collection for dry materials recycling, it is assumed that there will be an increase of 1 percentage point by 2020; for separately collected biowaste it is assumed that there will be an increase of 2 percentage points by 2020 and another 2 percentage points by 2025.

Regarding final treatment, the increase in separately collected waste will result in a decrease in residual waste. The share of MSW directly sent to landfill without pre-treatment is assumed to reduce accordingly due to the landfill tax. No measures to increase the waste volumes sent to incineration or MBT have been indicated, nor any interest in doing so, and the corresponding shares are therefore assumed to remain constant.

Table 88 Baseline for the first treatment of municipal solid waste in Spain, 2014–2035

	2014	2020	2025	2030	2035
Total MSW generation, '000 tonnes	20 836	19 293	18 749	18 533	18 567
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	15	16	16	16	16
Collection for biowaste treatment, %	4	6	8	8	8
Direct to MBT and mixed sorting, etc., %	56	56	56	56	56
Direct to incineration, %	4	4	4	4	4
Direct to landfill, %	21	18	16	16	16

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Spain will reach a 22 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020. This is based on reported measures to increase recycling rates in the future.

Sweden – Baseline modelling and data updates

The Swedish Environmental Protection Agency kindly provided data and information for the update of the waste model by answering a questionnaire. Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

Sweden's reported municipal solid waste (MSW) composition combined total municipal waste stream data with composition based on regional or local waste statistics. No adjustments were needed for feeding the data into the model.

Municipal solid waste generation and management

As Sweden provided data on both generation and treatment of MSW, no adjustments were needed for use in the model.

Recycling tonnage

The data provided by Sweden on tonnage of materials collected for recycling required adjustment because the data on MSW generation and treatment were not fully consistent with the amounts of material collected for recycling. In the waste generation section of the questionnaire, Sweden reported more waste collected for recycling than was reported in the section on waste collection. Sweden reported *'the data are taken from different tables which are not compatible with each other. The difference depends on recycled packaging from businesses'*. Sweden then provided the data on packaging from businesses, which were included in the figures for MSW collected for recycling in the model.

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

For food waste, Sweden reported 9 per cent OAW, 10 per cent IVC and 81 per cent AD; for garden waste it reported 50 per cent OAW and 50 per cent IVC; for other biowaste it reported 100 per cent IVC.

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

For biogas from AD treatment of MSW, Sweden reported having a 4 per cent share of AD 2, which is actually only heat production. This was considered correct, as heat power used in district heating can be considered as efficient as CHP (from the environmental perspective). Sweden also reported 9 per cent AD 1, 20 per cent AD 3, 81 per cent AD 4, and 4 per cent AD 5. As the sum of reported gas output came to 118 per cent, the excess 18 per cent was removed equally from all AD types in order to get 100 per cent.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation.

Sweden reported one small MBT 5 facility in the country, which is several years old and may be closed down in 5–10 years. There are no plans to build new MBT plants. Sweden considers the 2 300 tonnes per year of biologically treated biodegradable material coming out of MBT facilities to be recycled waste.

Incineration

The model includes the following four types of waste incineration:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

Sweden reported 97 per cent Incineration 2 and 3 per cent Incineration 3. Sweden indicated that the share of Incineration 3 may decrease in the future. This is probably due to the old facilities (Incineration 3) being replaced by new ones (Incineration 2). This is recognised in the model (Table 89).

Table 89 Estimates of future incineration shares in Sweden, 2015–2025

	2015	2020	2025
Incineration 1, %	0	0	0
Incineration 2, %	97	97	100
Incineration 3, %	3	3	0
Incineration 4, %	0	0	0

Waste generation projections

Sweden provided a national waste generation projection. This projection is based on an economic model called EMEC, a computable general equilibrium (CGE) model of the Swedish economy developed and maintained by the National Institute of Economic Research for analysis of the interaction between the economy and the environment. The projections are made by the National Institute of Economic Research in cooperation with IVL Swedish Environmental Research Institute. The waste projections are based on a study made in 2010 and updated in 2016. The study concerned the generation of all waste in Sweden, not only MSW. Sweden reported having used factors for translating waste into MSW.

Table 90 Municipal solid waste generation projections for Sweden, 2020–2035

	2020	2025	2030	2035
Reported projections, '000 tonnes	5 107	5 670	6 295	6 983

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

Sweden's recycling rate has increased steadily, approaching 50 per cent in the mid 2000s and then remaining at around 48–50 per cent. There is no rising trend in (dry) material recycling, but composting and digestion is on an increasing trend.

Table 91 Municipal solid waste generation and treatment, 1995–2015

Sweden	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000	3 405	3 458	3 678	3 869	3 794	3 793	3 907	4 149	4 156	4 134	4 306	4 447	4 442	4 455	4 366	4 115	4 246	4 285	4 326	4 246	4 377
Material recycling, '000	685	810	923	1 046	1 094	1 091	1 135	1 295	1 314	1 385	1 474	1 658	1 591	1 520	1 604	1 414	1 406	1 403	1 443	1 418	1 417
Composting and digestion, '000	210	240	275	309	320	360	388	354	403	434	454	470	491	522	555	564	602	621	663	699	684
Recycling rate, %	26.3	30.4	32.6	35.0	37.3	38.3	39.0	39.7	41.3	44.0	44.8	47.9	46.9	45.8	49.5	48.1	47.3	47.2	48.7	49.9	48.0
Increase in recycling rate, percentage points		4.1	2.2	2.4	2.2	1.0	0.7	0.8	1.6	2.7	0.8	3.1	-1.0	-1.0	3.6	-1.4	-0.8	-0.1	1.4	1.2	-1.9

Note: material recycling = dry materials recycling.

Source: Eurostat database Municipal waste by waste operations [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Collection systems

In Sweden, larger housing cooperatives (apartment buildings and terraced houses) have door-to-door collection as the primary system for paper, glass, metals, biowaste, and plastic packaging. For detached and semidetached houses, co-mingled collection and bring points are the primary systems for recyclables. Beverage bottles (glass and plastic) are collected through a producer/retail take-back system. All fractions are also accepted at civic amenity sites.

There has been an ongoing process to develop door-to-door collection and this will continue.

- There is a target to recycle at least 50 per cent of food waste from households and services by 2018, an important driver for separate collection of food waste in municipalities. Today about two thirds of municipalities have separate collection of food waste (increased during the past years).
 - Recycling of food waste increased from 1.245 million tonnes in 2011 to 2.034 million tonnes in 2015. The recycling rate is expected to increase.
 - The collection of food waste is increasing as more municipalities introduce separate collection and home composting is reduced.
 - Composting is decreasing as anaerobic digestion increases.
- There is an increasing interest in co-mingled collection and optical sorting, currently covering about 5 per cent of households. The system is based on separating different fractions into different coloured bags. Up to six different fractions apply: food waste, paper packaging, newspaper, metal packaging, plastic packaging, and residual waste.
- Pay-as-you-throw schemes were used in about 30 municipalities in 2015.
 - There has been a slight increase in the collection of packaging waste from households, from 682 000 tonnes in 2011 to 712 000 tonnes in 2015.

Treatment capacity

- Biowaste composting facilities had an excess capacity of 1 million tonnes in 2014. It is estimated that some facilities will close down, leaving the excess capacity at approximately 300 000 tonnes per year.
- Digestion facilities had an excess capacity of 1.1 million tonnes in 2014. There are plans for new facilities but no detailed information has been provided.
- Sweden reported plans for increasing mechanical sorting capacity but gave no information on how definite these are.
- Facilities for MSW incineration had an excess capacity of 0.2 million tonnes in 2014. An additional excess capacity of 40 000–160 000 tonnes per year is expected to be built by 2020. Sweden imports waste of high calorific value for incineration.

Waste generation and treatment scenario

Based on the above information, a baseline scenario for the future generation and management of MSW has been developed. This scenario presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures are fully implemented or that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify the potential risk of not meeting the recycling target and serving as a basis for discussion.

Estimates of future recycling rates are based on the measures mentioned above. Regarding collection for dry materials recycling, it is assumed that there will be an increase of 3 percentage points by 2020 based on efforts to increase separate collection, for example through expanding co-mingled collection. For separately collected biowaste, it is assumed that this will increase by 2 percentage points by 2020 based on the target for capturing 50 per cent of food waste; the capture rate is currently 45 per cent.

Regarding final treatment, the increase in separately collected waste will result in a decrease in residual waste. Regarding landfill, the rate is already very low, at 1 per cent, and it is assumed that it will remain at this level. There is negligible capacity for MBT in Sweden, and no intention of increasing it, so it is estimated that the reduction in residual waste will lead to a reduction in the share of MSW incinerated. However, due to increasing projected generation of MSW, the absolute amount of MSW incinerated would still increase after 2015.

Table 92 Baseline for the first treatment of municipal solid waste in Sweden, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	4 377	5 107	5 670	6 295	6 983
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	35	38	38	38	38
Collection for biowaste treatment, %	16	18	18	18	18
Direct to MBT and mixed sorting, etc., %	0	0	0	0	0
Direct to incineration, %	49	44	44	44	44
Direct to landfill, %	1	1	1	1	1

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, Sweden will reach a 56 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020. This is based on reported measures to increase recycling rates in the future.

United Kingdom – Baseline modelling and updates

The Department for Environment, Food and Rural Affairs of the United Kingdom (UK), the Welsh Government and the Government of Northern Ireland kindly provided data and information for the update of the waste model by answering a questionnaire. Answers were partly provided for the UK as a whole and partly separately for England, Northern Ireland, Scotland and Wales, and some information was missing. Data refer to different years (mostly 2015, but reference years differ between the different data sets). Key data fed into the model are shown in appendices 1 to 8.

Municipal solid waste composition

The UK provided waste composition data for England, Scotland and Wales separately, and no data for Northern Ireland. In order to derive municipal solid waste (MSW) composition data for the UK as a whole, the average waste composition was calculated according to the population shares¹⁸ of England, Scotland and Wales. This waste composition is then assumed to apply to the UK as a whole.

The data provided for Wales refer to the composition of residual waste, while data for England and Scotland refer to total MSW. For calculating average UK waste composition, it is assumed that all composition data refer to total MSW.

Municipal solid waste generation and management

The MSW generation and treatment data provided by the UK were slightly adjusted for use in the model (see next paragraph).

Recycling tonnage

The data on tonnage of materials collected for recycling provided by the UK were related to the input to the final recycling process. The model then uses standard reject rates to calculate the corresponding amounts of materials separately collected for recycling. The reported total amount of materials separately collected for recycling and biowaste treatment was lower than the amounts calculated by the model using the standard reject rates, therefore the amount of separately collected waste was adjusted in order to take into account that the UK seems to experience lower reject rates than the ones used in the model.

Biowaste treatment

In the waste model, biowaste is split into three components: food waste, garden waste, and other biowaste. For each of these, the model takes into account three different treatment technologies:

- open-air windrow (OAW);
- in-vessel composting (IVC); and
- anaerobic digestion (AD).

For food waste, the UK reported 2 per cent OAW, 17 per cent IVC, and 81 per cent AD; for garden waste, 86.8 per cent OAW, 11.6 per cent IVC and 1.6 per cent AD; for other biowaste, 15.6 per cent OAW, 77.4 per cent IVC and 7.0 per cent AD. All these figures are totals for England, Scotland and Wales and are assumed to apply to the UK as a whole.

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<https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/lates>

Anaerobic digestion

The model allows for five types of utilization of the biogas from AD:

- AD 1 – electricity only;
- AD 2 – combined heat and power (CHP);
- AD 3 – gas cleaned and injected to the gas distribution network;
- AD 4 – gas cleaned and compressed for use as vehicle fuel; and
- AD 5 – flaring only.

Scotland reported 100 per cent AD 2, while no data is available for England, Northern Ireland and Wales; the Scottish data was used for updating the model.

Mechanical biological treatment

The model includes the following five variants of mechanical biological treatment (MBT):

- MBT 1 – biostabilisation;
- MBT 2 – biodrying with no plastics recycling;
- MBT 3 – biodrying with plastics recycling;
- MBT 4 – AD-based treatment; and
- MBT 5 – basic sorting and energy generation.

The UK reported 11 per cent MBT 1, 37 per cent MBT 2, 23 per cent MBT 4, and 29 per cent MBT 5. The UK reported having no breakdown between MBT 2 and MBT 3, but suspected that most facilities do not recycle plastic, and if they do, it would be a very small recovery rate. No adjustments were made to the data provided.

Incineration

The model includes the following four types of use of the energy from the waste:

- Incineration 1 – electricity generation only;
- Incineration 2 – CHP;
- Incineration 3 – heat generation only; and
- Incineration 4 – without energy generation.

The UK estimated 75 per cent Incineration 1 and 25 per cent Incineration 2.

Waste generation projections

The UK did not provide own projections, so the model will use the updated projections produced by the ETC/WMGE (Table 93). These projections are based on an econometric forecasting model developed by the ETC/WMGE, using historic trends and forecasts of population and gross domestic product (GDP) as driving forces.

Table 93 Municipal solid waste projections for the United Kingdom, 2020–2035

	2020	2025	2030	2035
ETC/WMGE projections, '000 tonnes	31 763	32 643	33 990	35 508

Baseline scenario

The following information was considered when updating the baseline scenario in the waste model.

The UK managed to increase its MSW recycling rate steadily until 2010, after which it stagnated.

Table 94 Municipal solid waste generation and treatment 1995–2015

United Kingdom	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste generation, '000 tonnes	28 900	29 750	31 042	31 697	33 392	33 954	34 945	35 532	35 279	36 121	35 121	35 479	34 780	33 424	32 507	31 955	31 066	30 413	30 890	31 131	31 567
Material recycling, '000 tonnes	2 020	1 922	2 265	2 763	3 421	2 836	3 181	3 733	4 698	5 657	6 362	7 107	7 680	7 775	7 890	8 069	8 134	8 173	8 468	8 503	8 602
Composting and digestion, '000 tonnes						937	1 137	1 423	1 687	2 499	3 007	3 626	4 016	4 402	4 566	4 786	4 922	4 788	4 904	5 091	5 124
Recycling rate, %						11	12	15	18	23	27	30	34	36	38	40	42	43	43	44	43
Increase in recycling rate, percentage points						0	1	2	4	4	4	4	3	3	2	2	2	1	1	0	0

Note: material recycling = dry materials recycling.

Source: Eurostat database *Municipal waste by waste operations* [08/05/2017]

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_wasmun&lang=en

Collection systems

In the UK, door-to-door collection is the primary system for biowaste and co-mingled paper and cardboard, glass, plastics and metals. In addition, there are bring points collecting the same fractions as the co-mingled system. Furthermore, all MSW fractions are accepted at civic amenity sites.

Treatment capacity

Information about current and future capacity in the UK as a whole is not available. Data for England¹⁹ show that a considerable number of new waste-to-energy plants became operational in 2016 and 2017 and several others are under construction, with an overall new annual capacity of about 5.5 million tonnes coming gradually online up to 2020. Further, about 1.5 million tonnes of new annual MBT capacity is becoming operational in 2016–2017, and an additional annual incineration capacity of 210 000 tonnes is planned for Northern Ireland.

Measures for increasing municipal solid waste recycling rates

England

- Increase in landfill tax: marginal expected impacts on the recycling rate as the waste is expected to shift to energy recovery.
- Technical support and guidance for local authorities.
- Increased requirements for separate collection:
 - transition to two-stream recycling away from a multi-stream and co-mingled system; the results are expected to be marginal and mainly in terms of quality, not quantity of materials;
 - increases in weekly collection aim to increase waste separation.
- Transition to separate food waste collection and a reduction in mixed garden and food waste collections. Separate food waste collection has increased since 2010, so far with a low impact on recycling rates overall, but with significant local impacts.
- There are also plans to increase the charge for garden waste collections. The Environment Protection Agency has allowed local authorities to charge for the collection of garden waste since 1990 and there has been a small increase in the number of authorities charging in recent years. If all local authorities introduced charging this could be expected to reduce recycling rates by up to 3 per cent.

Northern Ireland

- The Food Waste Regulations aim to push the management of food waste up the waste hierarchy, encourage the prevention of such waste in the first place, improve the quality of its recycling and prohibit the landfill of separately collected food waste.

¹⁹ https://s3-eu-west-1.amazonaws.com/data.defra.gov.uk/Waste/residual_waste_dec2016_05.xls

- The Rethink Waste Fund – financial assistance to improve resource efficiency through waste prevention, reuse and recycling, especially collection systems and recycling centres – has contributed to an increase in recycling rates of 6.6 percentage points between 2009/10 and 2015/16.

Wales

- Towards Zero Waste (TZW) is the overarching waste strategy document for Wales. This sets out a high-level strategy for how to manage waste in Wales to the benefit not only of the environment, but also for the economy and social well-being. The Waste Infrastructure Procurement Programme (2008) helps develop waste treatment facilities for MSW, including for food waste. The Welsh government has offered all local authorities the opportunity to participate in a Collaborative Change Programme (2011) (CCP) to help ensure that Wales meets the recycling targets set out in Towards Zero Waste and also included in the Municipal Sector Plan. These measures seem to have been effective: Wales achieved an MSW recycling rate of 54.3 per cent in 2013/14.

Waste generation and treatment scenario

Based on the above information, a baseline scenario for the future generation and management of MSW has been developed. This presents a critical view of the effects of policy measures and planned capacity. It takes into account the possibility that not all planned measures are fully implemented or that there may be delays in setting up new treatment capacity. The scenario thus presents one of several possible future developments, helping to identify the potential risk of not meeting the recycling target and serving as a basis for discussion.

Due to the different policies, ambitions and past performance of England, Northern Ireland, Scotland and Wales, the modelling of future MSW management scenarios results in many uncertainties. Since the questionnaire was partly answered independently for England, Northern Ireland, Scotland and Wales, and in some cases data and information was only available for a part of the UK, these uncertainties in the data may affect the results of the baseline modelling. As no information on plans for constructing new facilities for biowaste treatment was provided in the questionnaires, the future development of biological treatment remains uncertain. It was assumed that dry recyclables and refuse-derived fuel for energy recovery can be exported and thus do not need domestic facilities to treat the full amount of generated RDF and dry recyclables.

Based on the measures mentioned above, estimates have been made of future waste management paths. Regarding collection for dry materials recycling, it is assumed that there will be an increase of 3 percentage points by 2020 and another 1 percentage point by 2025. While there are planned measures to increase separate collection of food waste, especially in Northern Ireland and Wales, it is assumed that, on a UK level, this is countered by an expected decrease in garden waste collection in England through increased charging for garden waste. No change in the collection rate of biowaste is therefore assumed in the baseline.

Regarding landfill, it is assumed that direct landfill will decrease by 5 percentage points up to 2020 and by an additional 5 percentage points by 2025, mainly due to the increase in the landfill tax. Given the new capacity for waste-to-energy in England and Northern Ireland, and for MBT in England, it is assumed in the baseline scenario that the waste diverted from landfill will mainly be sent to incineration and to a smaller extent to MBT.

Table 95 Baseline for the first treatment of municipal solid waste in the United Kingdom, 2015–2035

	2015	2020	2025	2030	2035
Total MSW generation, '000 tonnes	31 567	31 763	32 643	33 990	35 508
Collection coverage, % of population	100	100	100	100	100
Collection for dry materials recycling, %	28	31	32	32	32
Collection for biowaste treatment, %	17	17	17	17	17
Direct to MBT and mixed sorting, etc., %	18	19	19	19	19
Direct to incineration, %	21	22	26	26	26
Direct to landfill, %	17	12	7	7	7

Note: shares might not sum to 100% due to rounding.

Based on these assumptions, the UK will reach a 48 per cent separate collection rate for dry materials recycling and biowaste treatment by 2020. This is based on reported measures to increase recycling rates in the future.

Appendix 1 Municipal solid waste composition as fed into the model for 2015

	Food, %	Garden, %	Other biowaste, %	Wood, %	Paper/ cardboard, %	Textiles, %	Glass, %	Metals, %	Plastics, %	WEEE, %	Rubble, soil, %	Batteries and accumulators, %	Hazardous waste (excluding WEEE), %	Fines, %	Inerts, %	Other, %
Austria	18.2	18.6	0.0	5.1	17.3	3.2	5.9	3.8	9.6	1.6	0.0	0.1	0.6	2.7	1.8	11.5
Belgium	9.3	15.6	5.4	6.4	18.1	3.4	8.0	2.9	7.4	2.0	0.0	0.2	0.7	0.4	2.8	17.6
Bulgaria	23.0	17.5	0.0	2.2	18.6	2.0	6.0	2.8	10.7	3.1	0.1	0.0	0.8	0.0	9.8	3.3
Croatia	20.9	7.0	0.5	1.1	28.0	2.5	5.9	2.3	17.5	1.4	2.4	0.0	0.1	0.0	0.0	10.5
Cyprus	29.6	11.8	0.0	2.1	24.2	6.0	3.9	3.2	14.6	0.5	0.0	0.0	0.0	0.0	1.3	2.7
Czech Republic	23.9	13.0	0.0	5.0	18.4	4.0	7.8	3.6	14.8	0.5	0.0	0.0	0.0	0.0	3.0	6.0
Denmark	24.6	22.4	0.0	3.5	20.0	0.0	5.7	4.9	7.3	1.7	0.0	0.3	0.0	0.0	1.1	8.4
Estonia	21.0	3.0	0.9	1.7	22.8	3.7	9.5	5.6	15.4	2.2	0.0	0.0	1.2	0.0	2.5	10.5
Finland	27.1	3.3	2.1	2.2	29.6	2.4	4.3	5.6	11.9	2.8	1.3	0.1	0.2	0.0	1.2	5.8
France	19.9	16.6	0.0	2.7	19.9	2.1	12.6	5.5	10.7	3.9	0.0	0.0	0.5	1.9	2.3	1.1
Germany	19.4	12.4	0.0	3.3	20.9	2.7	6.7	2.2	16.6	1.5	0.0	0.0	0.2	4.7	1.7	7.7
Greece	41.3	3.0	0.0	0.0	22.2	0.0	4.3	3.9	13.9	0.0	0.0	0.0	0.0	0.0	0.0	11.4
Hungary	20.9	5.7	0.0	0.6	18.6	2.9	3.3	5.7	15.5	0.7	0.0	0.0	0.6	11.9	4.4	9.2
Ireland	16.2	5.9	0.0	3.4	24.3	5.5	8.3	3.6	12.1	2.8	0.0	0.0	0.9	7.7	0.0	9.4
Italy	21.0	11.4	2.5	3.0	22.9	3.8	7.5	2.7	12.9	0.8	0.0	0.0	0.0	0.0	0.8	10.7
Latvia	15.1	4.3	7.1	2.8	28.7	2.4	9.2	1.9	8.4	0.4	1.7	0.0	0.0	12.4	2.6	3.3
Lithuania	9.8	9.4	8.0	1.2	13.1	5.1	7.4	6.8	10.7	1.6	0.0	0.0	0.2	0.0	9.7	16.8
Luxembourg	22.1	12.7	0.0	3.6	18.9	2.6	7.0	2.1	10.0	1.8	0.3	0.5	0.7	3.7	2.6	11.5
Malta	39.9	1.8	0.0	0.6	20.3	3.2	5.4	4.2	12.0	1.0	0.0	0.0	0.1	1.6	0.0	9.9
Netherlands	12.8	19.4	11.4	5.0	19.1	2.9	6.1	2.7	7.8	0.8	0.9	0.0	0.2	0.0	0.0	10.7
Poland	20.7	11.7	0.0	0.4	11.4	2.6	10.0	2.3	12.3	0.0	0.0	0.0	0.8	9.8	4.2	13.8
Portugal	28.5	6.5	4.9	0.9	13.6	3.5	6.7	1.9	10.8	0.2	0.0	0.0	0.3	11.1	0.0	11.1
Romania	44.8	14.9	0.0	2.0	12.5	0.8	5.0	3.2	13.1	1.0	0.0	0.0	0.0	0.0	0.0	2.8
Slovakia	23.6	21.0	0.1	2.7	12.8	2.9	8.1	3.8	10.3	0.5	3.1	0.0	0.8	0.0	1.1	9.2
Slovenia	12.9	7.8	1.2	7.1	26.0	1.1	7.8	4.7	7.9	1.3	0.0	0.0	0.7	0.0	0.0	21.6
Spain	40.1	8.7	0.0	1.8	15.5	4.7	7.7	3.4	9.1	0.0	0.0	0.0	0.0	0.0	0.0	9.0
Sweden	23.7	8.5	0.0	5.0	25.2	1.7	5.3	5.4	9.5	3.6	0.0	0.2	0.1	0.0	0.0	11.8
United Kingdom	16.8	16.2	2.2	3.6	19.3	3.0	6.9	3.7	10.4	2.4	2.1	0.1	0.6	1.3	0.0	11.5

WEEE: Waste electrical and electronic equipment

Appendix 2 Municipal solid waste generation and management as fed into the model for 2015 (first treatment step)

	Total MSW generation, '000 tonnes	Collection coverage, % of population	Collection for dry recycling, %	Collection for biowaste treatment, %	Direct to MBT & mixed sorting etc, %	Direct to incineration, %	Direct to landfill, %
Austria	4 836	100	32	32	10	26	1
Belgium	4 766	100	39	20	4	38	-
Bulgaria	3 011	100	19	10	25	3	43
Croatia	1 654	99	16	2	1	-	81
Cyprus	533	94	16	2	21	-	61
Czech Republic	5 274	99	27	11	-	13	49
Denmark	4 485	100	24	20	-	54	2
Estonia	463	95	28	3	11	51	7
Finland	2 738	100	28	12	1	48	11
France	33 400	100	22	17	4	33	24
Germany	51 046	100	45	17	7	31	-
Greece	5 249	100	16	2	4	-	79
Hungary	3 712	100	16	5	69	10	-
Ireland	2 820	88	31	6	9	8	46
Italy	29 524	100	27	23	36	10	4
Latvia	798	100	26	6	68	-	-
Lithuania	1 327	98	22	5	31	-	41
Luxembourg	348	100	28	19	7	34	12
Malta	269	100	10	-	15	-	74
Netherlands	8 855	100	25	27	4	43	1
Poland	10 863	100	14	6	69	3	9
Portugal	4 764	100	11	2	33	20	34
Romania	4 895	84	6	8	-	-	87
Slovakia	1 888	100	13	8	3	8	68
Slovenia	926	100	45	11	38	-	6
Spain	20 836	100	15	4	56	4	21
Sweden	4 377	100	35	16	-	49	1
United Kingdom	31 567	100	28	17	18	21	17

Appendix 3 Split of biowaste treatment technologies for different components of biowaste as fed into the model for 2015

	Food waste			Garden waste			Other biowaste		
	Anaerobic digestion, %	In-vessel composting, %	Open air windrow, %	Anaerobic digestion, %	In-vessel composting, %	Open air windrow, %	Anaerobic digestion, %	In-vessel composting, %	Open air windrow, %
Austria	48	26	26	7	47	47	36	32	32
Belgium	100	-	-	1	9	90	30	-	70
Bulgaria	48	26	26	24	38	38	34	33	33
Croatia	3	-	97	1	-	99	2	-	98
Cyprus	-	100	-	-	20	80	34	33	33
Czech Republic	25	50	25	-	50	50	34	33	33
Denmark	24	66	10	-	10	90	34	33	33
Estonia	-	80	20	-	80	20	-	80	20
Finland	29	60	11	29	60	11	29	60	11
France	2	98	-	2	98	-	2	98	-
Germany	10	45	45	10	45	45	34	33	33
Greece	-	100	-	-	20	80	34	33	33
Hungary	-	50	50	-	20	80	34	33	33
Ireland	12	75	13	-	7	93	37	27	36
Italy	40	60	-	-	60	40	40	55	5
Latvia	-	-	100	-	-	100	-	-	100
Lithuania	16	32	52	30	-	70	19	47	34
Luxembourg	99	-	1	11	-	89	34	33	33
Malta	100	-	-	24	38	38	100	-	-
Netherlands	20	37	43	-	-	100	34	33	33
Poland	-	-	100	-	20	80	34	33	33
Portugal	48	26	26	24	38	38	34	33	33
Romania	-	13	88	-	13	88	-	13	88
Slovakia	20	-	80	-	-	100	50	-	50
Slovenia	30	32	38	29	33	38	92	5	3
Spain	50	-	50	5	40	55	34	33	33
Sweden	81	10	9	-	50	50	-	100	-
United Kingdom	81	17	2	2	12	87	7	77	16

Appendix 4 Split of the use of the biogas from anaerobic digestion plants as fed into the model for 2015

	Combined heat and power, %	Electricity only, %	Gas flaring only, %	Gas to grid, %	Gas to vehicle fuel, %
Austria	48	48	4	1	-
Belgium	100	-	-	-	-
Bulgaria	100	-	-	-	-
Croatia	-	100	-	-	-
Cyprus	100	-	-	-	-
Czech Republic	-	100	-	-	-
Denmark	3	60	-	37	-
Finland	69	-	7	-	24
France	-	100	-	-	-
Germany	100	-	-	-	-
Greece	100	-	-	-	-
Ireland	100	-	-	-	-
Italy	-	100	-	-	-
Latvia	100	-	-	-	-
Lithuania	100	-	-	-	-
Luxembourg	34	-	-	66	-
Malta	100	-	-	-	-
Netherlands	-	100	-	-	-
Poland	-	100	-	-	-
Portugal	-	100	-	-	-
Slovakia	100	-	-	-	-
Slovenia	100	-	-	-	-
Spain	100	-	-	-	-
Sweden	3	8	3	17	69
United Kingdom	100	-	-	-	-

Appendix 5 Split of the types of mechanical biological treatment variants as fed into the model for 2015

	Biostabilisation, %	Biodrying with no plastics recycling, %	Biodrying with plastics recycling, %	Anaerobic digestion-based treatment, %	Basic sorting and energy generation, %
Austria	44	46	-	-	10
Belgium	-	63	-	-	37
Bulgaria	70	-	-	30	-
Croatia	-	100	-	-	-
Cyprus	100	-	-	-	-
Czech Republic	-	-	-	-	100
Estonia	-	100	-	-	-
Finland	-	-	-	-	100
France	-	-	-	100	-
Germany	30	-	5	-	65
Greece	85	15	-	-	-
Hungary	28	-	-	-	72
Ireland	50	-	-	-	50
Italy	100	-	-	-	-
Latvia	100	-	-	-	-
Lithuania	39	-	31	19	11
Luxembourg	100	-	-	-	-
Malta	-	-	-	100	-
Netherlands	-	-	-	100	-
Poland	-	-	-	-	100
Portugal	-	-	80	20	-
Romania	-	-	-	-	100
Slovakia	-	-	-	-	100
Slovenia	55	-	-	45	-
Spain	71	-	-	29	-
Sweden	-	-	-	-	100
United Kingdom	11	37	-	23	29

Appendix 6 Split of the types of waste incineration as fed into the model for 2015

	Electricity generation only, %	Combined heat and power, %	Heat generation only, %	Incineration without energy generation, %
Austria	6	65	29	-
Belgium	98	-	-	2
Bulgaria	-	100	-	-
Czech Republic	-	100	-	-
Denmark	18	82	-	-
Estonia	-	100	-	-
Finland	-	100	-	-
France	100	-	-	-
Germany	10	80	10	-
Hungary	-	100	-	-
Ireland	100	-	-	-
Italy	57	43	-	-
Luxembourg	100	-	-	-
Netherlands	-	100	-	-
Poland	-	100	-	-
Portugal	100	-	-	-
Slovakia	100	-	-	-
Spain	100	-	-	-
Sweden	-	97	3	-
United Kingdom	75	25	-	-

Appendix 7 Municipal solid waste generation projections for Member States, 2020–2035, '000 tonnes

	2020	2025	2030	2035
Austria	4 988	5 106	5 189	5 269
Belgium	5 002	5 002	5 020	5 065
Bulgaria	2 401	2 455	2 492	2 497
Croatia	1 675	1 803	2 003	2 155
Cyprus	589	634	688	688
Czech Republic	5 340	5 300	5 273	5 269
Denmark	4 465	4 640	4 805	4 959
Estonia	466	480	488	472
Finland	2 628	2 593	2 524	2 434
France	34 306	34 276	34 321	34 433
Germany	48 517	48 336	48 385	48 492
Greece	5 400	5 198	5 216	5 178
Hungary	3 683	3 660	3 653	3 624
Ireland	3 300	3 810	3 848	3 923
Italy	29 524	29 524	29 524	29 524
Latvia	690	678	677	689
Lithuania	1 321	1 317	1 308	1 271
Luxembourg	341	345	355	375
Malta	268	278	288	299
Netherlands	8 950	8 779	8 507	8 383
Poland	11 330	11 797	12 280	12 210
Portugal	4 762	4 928	4 966	4 980
Romania	4 629	4 546	4 473	4 465
Slovakia	2 000	2 118	2 244	2 377
Slovenia	936	953	968	982
Spain	19 293	18 749	18 533	18 567
Sweden	5 107	5 670	6 295	6 983
United Kingdom	31 763	32 643	33 990	35 508

Appendix 8 Baseline scenarios for the future management of municipal solid waste

All management is related to the first treatment step and does not include the calculated recycling rates

	Collection for dry recycling, %				Collection for biowaste treatment, %				Direct to MBT & mixed sorting etc, %				Direct to incineration, %				Direct to landfill, %			
	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
Austria	33	33	33	33	32	32	32	32	9	9	9	9	25	25	25	25	1	1	1	1
Belgium	41	41	41	41	25	27	27	27	3	3	3	3	31	30	30	30	0	0	0	0
Bulgaria	23	26	26	26	12	16	16	16	25	33	33	33	3	3	3	3	37	22	22	22
Croatia	21	26	26	26	7	12	12	12	17	57	57	57	0	0	0	0	55	5	5	5
Cyprus	18	21	21	21	6	10	10	10	40	40	40	40	0	0	0	0	36	29	29	29
Czech Republic	32	32	32	32	16	16	16	16	8	28	28	28	14	15	15	15	30	10	10	10
Denmark	29	29	29	29	24	24	24	24	0	0	0	0	45	45	45	45	2	2	2	2
Estonia	30	30	30	30	6	6	6	6	11	11	11	11	51	51	51	51	2	2	2	2
Finland	30	30	30	30	15	15	15	15	14	16	16	16	39	37	37	37	2	2	2	2
France	22	22	22	22	17	17	17	17	4	4	4	4	33	33	33	33	24	24	24	24
Germany	46	46	46	46	19	19	19	19	6	6	6	6	29	29	29	29	0	0	0	0
Greece	21	26	26	26	6	10	10	10	22	22	22	22	0	0	0	0	51	42	42	42
Hungary	20	20	20	20	11	11	11	11	60	60	60	60	9	9	9	9	0	0	0	0
Ireland	33	33	33	33	11	11	11	11	6	6	6	6	25	25	25	25	25	24	24	24
Italy	30	32	32	32	27	28	28	28	23	20	20	20	16	16	16	16	4	4	4	4
Latvia	30	30	30	30	6	6	6	6	64	64	64	64	0	0	0	0	0	0	0	0
Lithuania	26	31	31	31	6	11	11	11	48	53	53	53	0	0	0	0	20	5	5	5
Luxembourg	31	31	31	31	22	22	22	22	7	7	7	7	34	34	34	34	6	6	6	6
Malta	15	18	18	18	7	11	11	11	40	38	37	36	0	0	0	0	37	33	34	36
Netherlands	30	35	35	35	32	37	37	37	4	3	3	3	33	24	24	24	1	1	1	1
Poland	24	34	34	34	11	16	16	16	55	44	44	44	6	5	5	5	4	2	2	2
Portugal	16	21	21	21	2	2	2	2	33	33	33	33	20	20	20	20	29	24	24	24
Romania	11	16	16	16	13	18	18	18	3	6	15	15	0	3	9	9	74	58	43	43
Slovakia	20	20	20	20	12	12	12	12	3	3	3	3	8	8	8	8	57	57	57	57
Slovenia	45	45	45	45	11	11	11	11	42	41	41	41	0	0	0	0	2	3	3	3
Spain	16	16	16	16	6	8	8	8	56	56	56	56	4	4	4	4	18	16	16	16
Sweden	38	38	38	38	18	18	18	18	0	0	0	0	44	44	44	44	1	1	1	1
United Kingdom	31	32	32	32	17	17	17	17	19	19	19	19	22	26	26	26	12	7	7	7

